US Army Corps of Engineers
Louisville District

Design-Build Request For Proposal

PHYSICAL FITNESS FACILITY
PN 65147, P2 146364, FY12

CLARKSVILLE BASE
FORT CAMPBELL, KENTUCKY

W912QR-12568463
NOVEMBER 2011

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SECTION 01 10 00.TBD
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1.0 PROJECT OBJECTIVES

1.0.1 The project objective is to design and construct facilities for the military that are consistent with the design and construction practices used for civilian sector projects that perform similar functions to the military projects. For example, a Company Operations Facility has the similar function as an office/warehouse in the civilian sector; therefore the design and construction practices for a company operations facility should be consistent with the design and construction of an office/warehouse building.

Comparison of Military Facilities to Civilian Facilities

Military Facility	Civilian Facility
Physical Fitness Facility (PFF)	Fitness Center, Gym or Health Club

1.0.2 It is the Army's objective that these buildings will have a 50 year useful life. The design and construction should provide an appropriate level of quality to ensure the continued use of the facility over that time period with the application of reasonable preventive maintenance and repairs that would be industry-acceptable to a major civilian sector project OWNER. The facility design should consider that the Army may repurpose the use of the facility over the 50 year life. The Army's intent is to install products and materials of good quality that meet industry standard average life that corresponds with the period of performance expected before a major renovation or repurpose. The design should be flexible and adaptable to possible future uses different than the current to the extent practical while still meeting the operational and functional requirements defined within. Flexibility is achieved through design of more flexible structural load-bearing wall and column system arrangements. The site infrastructure will have at least a 50-year life expectancy with industry-accepted maintenance and repair cycles. Develop the project site for efficiency and to convey a sense of unity or connectivity with the adjacent buildings and with the Installation as a whole.

1.0.3 Requirements stated in this contract are minimums. Innovative, creative, and life cycle cost effective solutions, which meet or exceed these requirements are encouraged. Further, the OFFEROR is encouraged to seek solutions that will expedite construction (panelization, pre-engineered, etc.) and shorten the schedule. **The intent of the Government is to emphasize the placement of funds into functional/operational requirements. Materials and methods should reflect this by choosing the most economical Type of Construction allowed by code for this occupancy/project allowing the funding to be reflected in the quality of interior/exterior finishes and systems selected.**

1.1. SECTION ORGANIZATION

This Section is organized under 6 major “paragraphs”.

(1) Paragraph 1 is intended to define the project objectives and to provide a comparison between the military facility(ies) and comparable “civilian” type buildings.

(2) Paragraph 2 describes the scope of the project.

(3) Paragraph 3 provides the functional, operational and facility specific design criteria for the specific facility type(s) included in this contract or task order.

(4) Paragraph 4 lists applicable industry and government design criteria, generally applicable to all facility types, unless otherwise indicated in the Section. It is not intended to be all-inclusive. Other industry and government standards may also be used, where necessary to produce professional designs, unless they conflict with those listed.

(5) Paragraph 5 contains Army Standard Design Criteria, generally applicable to all facility types, unless otherwise indicated in the Section.

(6) Paragraph 6 contains installation and project specific criteria supplementing the other 5 paragraphs.

2.0 SCOPE

2.1. PHYSICAL FITNESS FACILITY

Provide a(n) Medium (64,799 SF) Physical Fitness Facility. The overall goal is to provide a functional, secure, visually appealing facility that is a source of pride for the installation. The desire is to provide "State-of-the-Art" facilities that rival similar use facilities found in local communities and on college campuses.

Refer to the PHYSICAL FITNESS FACILITY PROGRAM AREAS table below for the configuration of the facility.

Physical Fitness Facility Size (Small, Medium, etc.)**:** Medium (64,799 SF)
Total Gross Building Area:
Subtotal, Physical Fitness Facility: 64,799 **SF**
Subtotal, Indoor Jogging Track: 5,946 **SF**

Modules:

Fitness Module

Exercise Module

Gymnasium Module

(Indicate required elements by "X")	
	1 Court w/ Track
X	1 Court no Track
X	2 Courts w/ Track and Tournament Court
	2 Courts w/ Track
	2 Courts w/ Tournament Court
	2 Courts no Track, no Tournament Court
	3 Courts w/ Track and Tournament Court
	3 Courts w/ Track
	3 Courts w/ Tournament Court
	3 Courts no Track, no Tournament Court
	4 Courts w/ Track and Tournament Court-Option A
	4 Courts w/ Track-Option A
	4 Courts w/ Tournament Court-Option A
	4 Courts w/ Track and Tournament Court-Option B

	4 Courts w/ Track-Option B
	4 Courts w/ Tournament Court-Option B
	4 Courts no Track, no Tournament Court-Option A
	4 Courts no Track, no Tournament Court-Option B

Structured Activity Module

(Indicate required elements by “X” and by providing information requested)		
	Racquetball Courts	0
	Small Group Fitness (Area desired)	0
	Climbing Wall	
	1 Mat Combatives	
	2 Mat Combatives	
	Spinning Room (Area desired)	0
	Concessions (Area desired)	0
	Small Child Care	
	Large Child Care	
X	Other #1	Increased Fitness Module Area: Minimum Dimensions for first floor: 110' x 105' (11,550 SF) Second floor "Fitness Balcony": 2517 SF. Balcony overlooking first floor fitness module. Fitness Module and Fitness Balcony to be connected with an interior stair. Must have clearance for individuals with disabilities around all equipment.
X	Other #2	Exercie Module: Provide a 2,800 SF Exercise Module on the second floor as shown in the conceptual level presentation drawings. Exercise module to have maple wood flooring.
	Other #3	

	Other #4	
	Storage	

Additional Module Details:

(1) 2 Court Gymnasium (with Tournament Court and Retractable Bleachers) to have maple wood flooring. 1 Court Gymnasium (Multipurpose Court) to have synthetic athletic flooring.

OPTION ITEMS
Item No. 0005: DESIGN OF ALL OPTIONS
Complete design services required to produce complete plans and specifications for all of the options.

Item No. 0006: MULTIPURPOSE ATHLETIC FIELD
Provide a multipurpose athletic field (360 feet x 200 feet), including all necessary earthwork, grading, seeding, lighting, lightning protection, and associated goal post installation.

Item No. 0007: TWO SOFTBALL FIELDS
Provide two softball fields. At least one of the fields shall be a minimum of 300 feet in depth and accomodate regulation intramural slow pitch mens' softball play (NSA rules). Both softball fields shall be lighted. The option includes all necessary earthwork, grading, seeding, fencing, lighting, lightning protection, and associated water line and hydrants for field maintenance.

Item No. 0008: INDOOR CLIMBING WALL
Provide an indoor climbing per requirements of this contract, including visual access from Control Desk, depressed slab, and appropriate flooring and safety zone.

Item No. 0009: ADDITIONAL PARKING
Provide an additional 140 parking spaces within the project limits. Additional parking may be located adjacent to the main parking lot (Base Bid) and/or an additional parking lot may be constructed near the ball fields. The option includes all necessary earthwork, paving, associated storm water management, pavement markings, signage, lighting, and lightning protection.

2.2. SITE:

Provide all site improvements necessary to support the new building facilities. Refer to Paragraph 6.

Approximate area available 26.00 acres

2.3. GOVERNMENT-FURNISHED GOVERNMENT-INSTALLED EQUIPMENT (GFGI)

Coordinate with Government on GFGI item requirements and provide suitable structural support, brackets for projectors/VCRs/TVs, all utility connections and space with required clearances for all GFGI items. Fire extinguishers are GF/GI personal property, while fire extinguisher brackets and cabinets are Contractor furnished and installed CF/CI. Local Area Network and personal Computers along with related hardware, copiers, faxes, printers, video projectors, VCRs and TVs are GFGI.

The following are also GFGI items: Fire Extinguishers shall be Government Furnished, Government Installed. FF&E package shall include specifications for fire extinguishers.

2.4. FURNITURE REQUIREMENTS

Provide furniture design for all administrative and lobby spaces listed in Chapter 3 and including any existing furniture and equipment to be re-used. Coordinate with the user to define requirements for furniture systems, movable furniture, storage systems, equipment, any existing items to be reused, etc. Early coordination of furniture design is required for a complete and usable facility.

The procurement and installation of furniture is NOT included in this contract. Furniture will be provided and installed under a separate furniture vendor/installer contract. The general contractor shall accommodate that effort with allowance for entry of the furniture vendor/installer onto this project site at the appropriate time to permit completion of the furniture installation for a complete and usable facility to coincide with the Beneficial Occupancy Date (BOD) of this project. The furniture vendor/installer contract will include all electrical pre-wiring and the whips for final connection to the building electrical systems however; the general contractor shall make the final connections to the building electrical systems under this contract. Furthermore, the general contractor shall provide all Information/Technology (IT) wiring (i.e. LAN, phone, etc.) up to and including the face plate of all freestanding and/or systems furniture desk tops as applicable, the services to install the cable and face plates in the furniture, the coordination with the furniture vendor/installer to accomplish the installation at the appropriate time, and all the final IT connections to the building systems under this contract.

The Government reserves the right to change the method for procurement of and installation of furniture to Contractor Furnished/Contractor Installed (CF/CI). CF/CI furniture will require competitive open market procurement by the Contractor using the Furniture, Fixtures and Equipment (FF&E) package. Reference applicable appendix for Preliminary FF&E Information including furniture dimensions sizes as shown in the Standard Design.

2.5. NOT USED

3.0 PHYSICAL FITNESS FACILTIY (PFF)

3.1. FUNCTIONAL/OPERATIONAL REQUIREMENTS

Comply with the American College of Sports Medicine (ACSM) Health/Fitness Facility Standards and Guidelines and the Technical Criteria – U.S. Army Physical Fitness Facilities (no older than the October 2003 edition), except where modified by this document..

(a) Additional reference material for comparable private sector facilities is accessible from the American College of Sports Medicine website: http://www.acsm.org/AM/Template.cfm?Section=Home_Page

(b) Examples of private sector State-of-the-Art athletic facilities may be found at the Athletic Business websites: http://www.architecturalshowcase.com/galleries/ArchitecturalShowcase.aspx

3.1.1. ACCESSIBILITY REQUIREMENTS

All aquatic facility functional areas shall be barrier-free and accessible to people with disabilities as required by the Architectural Barriers Act (ABA). Site, sidewalks, building, and pool designs shall enable people with disabilities to act independently and enjoy the full range of programs provided. Level changes may be included, but must be accommodated by ramps suitable for wheelchair access, both indoors and outdoors. Accessible entry to pools may be accomplished by utilizing zero entry depth ramps with ABA compliant handrails or by lift and assistance equipment designed specifically for people with disabilities. Utilize lifts that do not require assistance by another person, and that are operated by rechargeable batteries. The need for special equipment, such as transfer benches, crane lifts, or ramps into the pool shall be considered during the design process.

3.1.2. FUNCTIONAL SPACE REQUIREMENTS

The functional space and design must comply with the Army Standards for the facility type, along with the PFF functional criteria. The Technical Criteria for U.S. Army Physical Fitness Facilities is provided in Attachment B. The Army Standard for Physical Fitness Facilities is provided in Attachment A.

3.1.3. Facility Betterments: DELETED

3.1.4. Pool and Spa Safety

In accordance with VIRGINIA GRAEME BAKER POOL AND SPA SAFETY ACT, PUBLIC LAW 110-140, each public pool and spa in the United States shall be equipped with anti-entrapment devices or systems that comply with the ASME/ANSI A112.19.8 performance standard, or any successor standard; and each public pool and spa in the United States with a single main drain other than an unblockable drain shall be equipped, at a minimum, with one or more of the following devices or systems designed to prevent entrapment by pool or spa drains:

(a) Safety vacuum release system.--A safety vacuum release system which ceases operation of the pump, reverses the circulation flow, or otherwise provides a vacuum release at a suction outlet when a blockage is detected, that has been tested by an independent third party and found to conform to ASME/ANSI standard A112.19.17 or ASTM standard F2387.

(b) Suction-limiting vent system.--A suction-limiting vent system with a tamper-resistant atmospheric opening.

(c) Gravity drainage system.--A gravity drainage system that utilizes a collector tank.

(d) Automatic pump shut-off system.--An automatic pump shut-off system.

(e) Drain disablement.--A device or system that disables the drain.

(f) Other systems.--Any other system determined by the Commission to be equally effective as, or better than, the systems described in (I) through (V) of this paragraph at preventing or eliminating the risk of injury or death associated with pool drainage systems.

(g) Outlet covers located in less than 6 feet of water shall be unblockable covers, flush with the floor rather than domed, to avoid trip hazards.

3.2. SITE PLANNING AND DESIGN

Organize the site to be compatible with the site planning and style of adjacent existing structures. Locate the building to reflect local climatic conditions. For example, provide protection from prevailing winds and glare . Locate the building to take advantage of passive solar heating and day lighting.

3.2.1. Landscaping

Choose a plant selection that is easy to maintain and enhances the visual quality of the facility in all seasons. Indigenous species are preferred. Assess the growth characteristics of selected plant material when considering line of sight requirements to either flight pavements or facilities. Comply with the local Installation landscape standards.

Take into consideration sustainable design issues when designing the landscape. Select plants that require little to no additional water beyond normal rainfall. Avoid plants that require an irrigation system or, if irrigation is required, consider a gray water or storm water irrigation system.

3.3. ARCHITECTURAL REQUIREMENTS

3.3.1. Building Exterior

Design the facility to enhance or compliment the visual environment of the Installation. The building entrance shall be architecturally defined and easily seen. When practical, exterior materials, roof forms, and detailing shall be compatible with the surrounding development and adjacent buildings on the Installation and follow locally established architectural themes. Use durable materials that are easy to maintain. Provide large glass areas where fitness equipment is located to provide visual interest from the outside, and views from the inside. Use glass in other areas as appropriate, taking into consideration glare, direct solar heat gain, and other functional requirements. Design the building exterior using energy efficient strategies and technologies to meet overall energy performance requirements. Exterior colors shall conform to the Area Design Guide.

3.3.1.1. Trim and Flashing: All exterior metals including gutters, downspouts, and fascias shall be factory pre-finished metal, aluminum, or galvanized steel base metal with baked-on or bonded high-performance fluoropolymer coating, fabricated and installed in compliance with SMACNA Architectural Sheet Metal Manual.

3.3.1.2. Bird Habitat Mitigation: Provide details necessary to eliminate the congregating and/or nesting of birds at, on, or in the facility.

3.3.1.3. Exterior Doors and Frames

(a) Main Entrance Doors: Provide aluminum storefront doors and frames with Architectural Class 1 anodized finish (color selected by the Contracting Officer from the manufacturer’s full line of standard colors), fully glazed, and with medium or wide stile are preferred for entry lobbies or corridors. Storefront systems shall comply with wind load requirements of applicable codes and UFC 4-010-01 requirements. Framing systems shall have thermal-break design.

(b) Side Entrance/Exit Doors: Exterior doors and frames opening to spaces other than corridors or lobbies shall be insulated hollow metal and comply with SDI/DOOR A250.8 Recommended Specification for Standard Steel Doors and Frames. Fire-rated openings shall comply with NFPA 80 Standard for Fire

Doors and Other Opening Protectives, and the requirements of the labeling authority. Door and frame installation shall comply with applicable codes and UFC 4-010-01 requirements. Provide a local alarm as part of the hardware on all doors other than the main entrance door. This alarm shall sound at the door and shall notify the control desk if the door is opened. This alarm requirement is separate from the security forces requirements in paragraph 6.

(c) Exterior Door Finish Hardware: All hardware and accessories in the facility shall be consistent and shall conform to BMHA A156 Series Standards, Grade 1. Coordinate door hardware and security requirements with the functional requirements, the Technical Criteria for U.S. Army Physical Fitness Facilities, and the electrical security/fire alarm system requirements of this document. Provide bored Locks in accordance with BHMA A156.2 Bored and Preassembled Locks and Latches. Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for all exit doors and BHMA A156.3 Exit Devices. Provide closers on all exterior doors, fire-rated doors, and restroom doors. The Main Entrance door is considered a high traffic door that requires a high quality door closing mechanism complying with BHMA A156.4 Door Controls - Closers with adequate strength to ensure safe and easy operation in a high wind environment. Hardware finish shall be US 26D/652 Satin Chrome over Nickel, steel base metal. Doors leading directly outside from functional areas (such as gymnasium, locker rooms, etc.) do not require any hardware on the exterior side of the door.

3.3.1.4. Exterior Windows: Provide non-operable windows.

3.3.1.5. Exterior Glass and Glazing: Provide the thickness required to provide necessary sound deadening properties for the exterior walls. The rating of the exterior glass shall be within 5 decibels of the wall to which it is installed. In addition, glazing must comply with ATFP and Energy requirements.

3.3.1.6. Thermal Insulation: Provide exterior wall, floor, and roof/ceiling assemblies with thermal transmittance (U-values) required to comply with the proposed energy calculations for the facility. Do no install insulation directly on top of suspended acoustical panel ceilings.

3.3.1.7. Exterior Louvers: Design exterior louvers to exclude wind-driven rain, with bird screens and made to withstand a wind loads in accordance with the applicable codes. Wall louvers shall bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-D Laboratory Methods of Testing Dampers for Rating and AMCA 511 Certified Ratings Program for Air Control Devices.

3.3.1.8. Exterior Paint Systems: Exterior Paint Systems shall be based on and comply with the recommendations of the Master Painters Institute (MPI) for the substrate to be painted and the environmental conditions existing at the project site. Exterior surfaces, except those from factory pre-finished material, shall be painted with a minimum one prime coat and two finish coats. No lead paints are acceptable. For exterior applications provide an MPI gloss Level 5 finish (semi-gloss), unless otherwise specified. Apply all paints in accordance with the manufacturer’s specifications.

3.3.2. Building Interior

3.3.2.1. Space Configuration: Arrange spaces in an efficient and functional manner. Structure interior spaces to allow maximum flexibility for future modifications. Provide glass panels between functions when appropriate to enhance the open concept of the PFF. Maximize use of natural lighting and daylighting within the constraints of the applicable codes and UFC 4-010-01. Arrange active spaces visible from the lobby to provide a high energy feel when entering the facility. Per the requirements of the Technical Criteria, locate the Control Counter with direct visual and physical access to the Lobby and the Free Weight Area.

3.3.2.2. Locate electrical distribution equipment installed within the facility, including dry-type transformers and electrical panels, within dedicated electrical rooms/closets.

3.3.2.3. Concepts such as exposed structure in lieu of acoustical tile ceilings may be utilized in many different areas. Spaces shall be as open as possible to provide flexibility to accommodate shifts in trends in fitness and recreation.

3.3.2.4. Circulation schemes must support easy way-finding within the building. Consider locating the control desk on the right side as you enter the facility to avoid cross traffic conflicts when entering the facility. Ensure wet circulation is kept separate from dry circulation.

3.3.2.5. Appearance retention is the top priority for building related finishes. Provide low maintenance, easily cleaned room finishes that are commercially standard for the facility occupancy specified, unless noted otherwise.

3.3.2.6. In general, use neutral tones with contrasts. Bright color accents or schemes may be considered for areas where appropriate. Facility should have a bright and energetic feel.

3.3.2.7. Interior Doors and Frames

(a) Wood Doors: Provide flush wood solid core doors complying with National Wood Window and Door Association (NWWDA) I.S.-1A. Stile edges shall be non-finger jointed hardwood compatible with face veneer. Provide Architectural Woodwork Institute (AWI) Grade-A hardwood face veneer for transparent finished doors; provide AWI Sound Grade hardwood face veneer for painted doors. Transparent finished doors are preferred.

(b) Hollow Metal Doors: Comply with SDI/DOOR A250.8. Doors shall be minimum Level 2, physical performance Level B, Model 2; factory primed. Hollow metal doors shall be mounted in hollow metal frames.

(c) Hollow Metal Frames: Comply with SDI/DOOR A250.8. Frames shall be minimum Level 2, 16 gauge, with continuously welded corners and seamless face joints; factory primed.

(d) Side Lites: Provide ¼” clear tempered glass at all door lites.

(e) Interior Door Finish Hardware: Door hardware and security requirements must be coordinated with the functional requirements, the room-by-room criteria, and the electrical security/fire alarm requirements. Hardware finish shall be US 26D/652 Satin Chrome over Nickel, steel base metal.

(f) Programmable Electronic Key Card Access Systems: Provide Key Card System on all doors to rooms from corridors other than service doors such as: Janitor’s closets, communication rooms, electrical rooms, mechanical rooms.

3.3.2.8. Interior Doors and Frames, Natatorium

(a) Hollow Metal Doors: Comply with SDI/DOOR A250.8. Doors shall be minimum Level 2, physical performance Level B, Model 2; factory primed. Hollow metal doors shall be mounted in hollow metal frames. Doors shall be 316L stainless steel, painted with high performance coating (to avoid corrosion).

(b) Hollow Metal Frames: Comply with SDI/DOOR A250.8. Frames shall be minimum Level 2, 16 gauge, with continuously welded corners and seamless face joints; factory primed. Frames shall be 316L stainless steel, painted with high performance coating (to avoid corrosion).

(c) Side Lites: Provide ¼ inch clear tempered glass at all door lites.

(d) Interior Door Hardware: Door hardware and security requirements must be coordinated with the functional requirements, the room-by-room criteria, and the electrical security/fire alarm requirements. At a minimum, provide closers on all fire-rated doors, locker room doors, and restroom doors. If possible, utilize “airport” entrances to locker rooms and other applicable areas to minimize wear on finishes and hardware. Hardware finish shall be type 316L stainless steel.

(e) NOTE: As an alternative to stainless steel door and frames, FIB-R-DORS could be utilized. These would be the best doors and frames for doors leading directly to the pools.

(f) Interior doors shall be rated the same as the wall in which they are installed.

3.3.2.9. Casework: Provide casework complying with AWI Section 400, Custom Grade flush overlay cabinets with stained wood. Work surfaces and counters shall be solid surfacing material or a material with at least the same durability qualities. Laminate countertops are not allowed. Install casework complying with AWI Section 1700.

3.3.2.10. Comply with the recommendations of the Master Painters Institute (MPI) on interior paint systems for the substrate to be painted and the interior environmental conditions existing at the project site. Apply a minimum of one prime coat and two finish coats on iInterior surfaces, except factory pre-finished material or interior surfaces receiving other finishes. Lead paints are acceptable. In wet areas, provide an MPI Gloss Level 5 (semi-gloss) finish. Apply all paints in accordance with manufacturer's instructions.

3.3.2.11. Gypsum Board: Comply with ASTM C 36 Gypsum Wallboard. Minimum panel thickness shall be 5/8 inch. Provide moisture resistant panels (glass–mat panels are preferred) at locations subject to moisture. Consider use of impact resistant gypsum board.

3.3.2.12. Interior Windows: Provide minimum ¼" clear tempered glass. Provide STC rated windows that meet required STC rating of the wall it is located.

3.3.2.13. Signage: Provide interior signage for overall way finding and life safety requirements. The comprehensive interior plan shall be from one manufacturer and shall include the following sign types: (1) Lobby Directory; (2) Directional Signs; (3) Room Identifications signs; (4) Building Service signs; (5) Regulatory signs; (6) Official and Unofficial Signs; (7) Visual Communication Boards.

3.3.2.14. Window Treatments: Provide window blinds or an appropriate type of window treatment on all exterior windows in administrative spaces. Provide permanent shading devices and other measures to reduce glare in activity spaces while still allowing for natural daylighting and views into and out of the facility.

3.3.2.15. Provide bulletin boards in the lobby and main corridors. Bulletin boards shall fit into an overall architectural theme. The intent is to avoid randomly placed bulletin boards that are not coordinated with the interior finishes, colors, and/or theme. Coordinate placement of bulletin boards with the user.

3.3.2.16. Corner Guards: On gypsum board walls, provide surface-mounted, high impact integral color rigid vinyl corner guards where necessary to reduce the potential for damage (i.e. in areas subject to high traffic and where carts or other mobile pieces may be used.). Provide stainless steel corner guards at all outside corners of ceramic tile walls where necessary to reduce the potential for damage (i.e. in areas subject to high traffic and where carts or other mobile pieces may be used.).

3.3.2.17. Mold Prevention: Design and construct buildings to maintain space humidity at reasonable levels. Building construction shall be relatively air tight. Locate vapor barriers, if used, where temperature is above dewpoint in both heating and cooling seasons, and not under insulation installed on top of a ceiling at a ventilated attic. Do not ventilate crawl spaces. Install a vapor barrier on ground surfaces of crawl spaces. Acoustical ceiling tiles shall have factory applied mold preventive and sag resistant physical properties.

3.3.3. Special Acoustical Requirements

Design and construct exterior walls and roof/ceiling assemblies, doors, windows and interior partitions to provide for attenuation of external noise sources such as airfields in accordance with applicable criteria. Provide additional acoustical control for reverberation in gymnasiums and natatoriums.

3.4. STRUCTURAL REQUIREMENTS

3.4.1. General

Design and construct as a complete system in accordance with APPLICABLE CRITERIA.

3.4.2. Running Track

Structural design shall account for a suspended running track. Attach the track to the roof system structural framing. Design suspended running track to dampen all vibrations from users.

3.5. MECHANICAL REQUIREMENTS

3.5.1. Fire Protection

Provide facilities with automatic sprinklers that provide 100 percent coverage of the facility. in accordance with UFC 3-600-01

3.5.1.1. Racquetball Courts - Any fire suppression or detection equipment must be protected and flush with the wall or ceiling surface.

3.5.1.2. Gymnasium/Basketball/Volleyball Courts - Provide protection for sprinkler heads, exit signs, manual pull stations, and other exposed components. Minimize equipment that protrudes into activity space or raise it above 6 feet for safety considerations.

3.5.2. Plumbing

Provide facilities with a fully functional plumbing system that complies with the International Plumbing Code (IPC).

3.5.3. Heating, Ventilating and Air-Conditioning (HVAC)

3.5.3.1. Provide facilities with a fully functional HVAC system that is automatically controlled by a Building Automation System (BAS). Do not locate HVAC equipment above the gymnasium or inside the gymnasium due to any possible risk of a leak causing water damage. Provide for air flow from the dry side of the Men’s And Women’s Locker/Dressing/Shower/Toilet space to the exhaust intakes in the wet area.

3.5.3.2. Provide for connection to energy monitoring and control system (EMCS) for monitoring purposes.

3.5.3.3. Steam Room – Maintain space temperature at 100 F minimum, 110 F maximum. Humidity 100% relative.

3.5.3.4. Sauna - Provide a separate dry heat system with individual temperature controls and a timer . Provide secure controls. Provide passive ventilation.

3.5.3.5. Gymnasium/Basketball/Volleyball Courts - Provide durable air grill covers and do not place air grills in line with basketball nets.

3.5.3.6. Racquetball Courts - Ventilating ducts must be installed flush with the ceiling or wall surfaces. Locate supply and return vents in the rear one-third of the ceiling and/or the upper one-third of the back wall.

3.6. ELECTRICAL REQUIREMENTS

Electrical power, lighting and telecommunications shall be provided to the facility as specified below, in accordance with APPLICABLE CRITERIA, GENERAL TECHNICAL REQUIREMENTS, all IEEE Standards (including Recommended Practice) where the scope is applicable to this design effort, all UL Standards where the UL scope is applicable to this design effort, and where itemized in the combined interdisciplinary areas cited.

Perform a short circuit study as an integral part of selecting and sizing electrical distribution components (all equipment shall be fully rated; that is, do not use series-combination rated equipment). Perform a coordination study to ensure that protective device settings are appropriate for the expected range of conditions (depending on the design and construction schedule, it is acceptable to design adequate protective devices with adjustable features, followed by a coordination study required during construction to specify the correct settings.) Circuit breakers, disconnect switches, and other devices that meet the OSHA definition of energy-isolating device must be lockable. Do not exceed 5 percent combined voltage drop on feeders and branch circuits if the transformer providing service is located within the facility. If the transformer is located exterior to the facility, limit the combined voltage drop for service conductors, feeders, and branch circuits to 5 percent. Individual voltage drop on branch circuits should not exceed 3 percent. Branch circuits supplying sensitive circuits shall be limited to 1 percent voltage drop.

3.6.1. Interior Power

Provide interior power per the general electrical requirements and per the Technical Criteria – U.S. Army Physical Fitness Facilities unless revised by the requirements of this RFP. When facility electrical design includes a 480/277V power distribution system, mechanical systems and lighting systems shall generally be fed from the available 480/277V power distribution system.

3.6.1.1. Lobby. Power to circuits as needed to Control Desk, for computer terminals (2 minimum in the X-small and Small, 3 minimum in the medium, 4 minimum in the large and X-large), counter mounted video monitors, multiplex video receiver, tape backup, sound processor for multiple paging sources, music source (such as a CD player) and sound amplifier.

3.6.1.2. Gymnasium/Suspended Running Track. Scorer's table is generally located for one designated court, at mid court, and requires one (1) 4-outlet, 20 amp power outlet and two (2) Cat5 or better data connections, both in recessed floor boxes, centered under the anticipated table location, but outside the court boundaries. Solid brass cover plates shall be provided for these outlets for when scoreboard equipment is not in use to provide good ball return value and skid resistance.-

3.6.1.3. Fitness Module (Cardio, Circuit, Free Weight). 20A dedicated circuits (one outlet per piece of equipment is acceptable) unless equipment manufacturer’s data indicates a larger circuit is required for the equipment.

3.6.1.4. Miscellaneous Areas – Offices. In copy/file/work/break room, provide outlets at built-in counter area for microwave, coffee pot, refrigerator, and other cooking devices. Provide ground fault protection of outlets within 6 feet of any water source.

3.6.2. Interior Lighting

Provide interior lighting and control per the Technical Criteria – U.S. Army Physical Fitness Facilities unless revised by the requirements of this RFP. When “PL Lamp” is indicated by Technical Criteria – U.S. Army Physical Fitness Facilities, provide multi-tube, 4-pin, compact fluorescent lamp. When building

electrical design includes 480/277V power distribution system, interior lighting will generally be fed from the 480/277V power distribution system. Pay particular attention to issues such as glare, heat generation, and impact protection for the fixtures in Fitness Facility activity spaces. Provide fluorescent luminaires with electronic programmed start fluorescent ballasts. Provide daylighting dimming systems where dimming is controlled by a photosensor to save energy in interior spaces where on a clear summer day a minimum interior illumination of 50% is expected in the majority of the space and where there is a life cycle cost benefit.

3.6.2.1. Lobby. Low profile LED lighting is acceptable under cabinet lighting.

3.6.2.2. Gymnasium/Suspended Running Track. High Intensity Discharge (HID) fixtures are not required. Lighting selected shall be identified as suitable for the intended use and lighting design shall meet IESNA recommendations for Basketball Sports-Lighting, Class III (Class of Play). Fixtures shall be mounted not less than 25' above the finished floor. Fixtures with 80% direct and 20% indirect lighting are preferred. For overhead locations, protect luminaires with wire cages and/or provide appropriate shatterproof enclosed luminaires. Switching for lighting control shall provide different lighting options to take into account natural lighting and different activities (such as boxing matches, etc.). Lighting control shall be located in a controlled area to avoid accidental and unauthorized switching.

3.6.2.3. Fitness Module (Cardio, Circuit, Free Weight). When ceilings heights do not allow pendant mounted or suspended lighting, 2 x 2 or 2 x 4 lay-in indirect fluorescent fixtures may be used. Independent slide or toggle controls may be used to control fixtures by groups. Grouping needs and/or preferences will be determined by circuit capacity and by location and amount of natural daylighting. If fixtures requiring remote ballasts are used, where possible install the remote ballasts above ceiling and provide with above ceiling access adequate to service the remote ballasts . It is recommended that ballast be located above accessible ceilings. Plan to provide ceiling access to service ballasts. Additional contribution of natural light via windows and/or skylighting is highly recommended.

3.6.2.4. Exercise Module. When ceilings heights do not allow pendant mounted or suspended lighting, direct 2 x 2 or 2 x 4 lay-in fluorescent fixtures may be used but are not recommended due to lower light quality (excessive glare and static light distribution; e.g. causes greater eye fatigue over long periods of time). Natural light via windows may be provided, but direct sun-light and glare must be avoided. Windows providing internal views to other spaces is desirable.

3.6.2.5. Miscellaneous Areas – Offices. Flush edge lens frames are minimum; chamfered lens frames preferred. Indirect lighting, to reduce computer glare, would be preferred. Provide recessed wall wash downlight accent lighting to improve wall surface brightness and illuminate architectural features to assist visitor wayfinding in the main lobby, to functional areas, and in the waiting spaces for office suites. Lay-in lighting fixtures with integral HVAC diffusers in a slot arrangement on the fixture frame do not provide a good distribution of air and tend to increase air noise; therefore, these are not recommended.

3.6.3. General Site Lighting

Ensure that parking areas and the facility have adequate lighting for safety, evacuation, and security measures. Lighting for all exterior applications shall be controlled by a photosensor and astronomical time switch that is capable of automatically turning off the exterior lighting when sufficient daylight is available or the lighting is not required.

3.6.4. Cathodic Protection System

Corrosion protection for the facility shall be provided by coordinated material specification and/or provision of a cathodic protection system to assure corrosion will not compromise system operation for the 50 year infrastructure design lifetime of the facility. Provide an appropriate Cathodic Protection System when the design analysis of a corrosion engineer indicates cathodic protection is recommended

to assure corrosion will not compromise system operation for the 50 year infrastructure design lifetime of the facility.

3.6.5. Mass Notification

A Mass Notification System (MNS) shall be integral to the fire alarm system and shall be connected to the base MNS. Speakers shall be located throughout the facility, providing total coverage. Announcements or music shall be by all-call or by room. If speakers are mounted on/in a wall, ensure they are mounted at least 8' above the floor.

3.7. TELECOMMUNICATIONS REQUIREMENTS

3.7.1. Design telecommunications design in accordance with the Technical Guide for Installation Information Infrastructure Architecture (I3A). In the I3A Technical Guide, substitute the word “shall” for the word “should” throughout the document.Service

3.7.2. Coordinate service with local DOIM personnel.System

Provide a fully operational system from the demarcation point to each outlet.

3.8. PUBLIC ADDRESS SYSTEM

System may be integrated into Fire Alarm/MNS. Locate the master station at the Control Desk with input for music source. Locate the PA speakers in all hallways, restrooms, locker rooms, gymnasium and exterior areas. If speakers are mounted on/in a wall, ensure they are mounted at least 8' above the floor. Provide announcement configuration capability by room, zone or all-call. Provide commercial grade audio system for each group exercise room with recessed A/V rack and ceiling mounted speakers.

3.9. CABLE TV (CATV) REQUIREMENTS

3.9.1. Service

Cable Television service will be by the Installation provider. The D/B contractor shall provide a two inch conduit with nylon pull cord from the communications room to the designated interface point.

3.9.2. System

Provide a CATV system to distribute incoming television signals and user supplied. Distribution point shall be the communications room. Outlets shall be in the lobby, all exercise modules, break rooms and activity rooms. Coordinate the number of outlets in exercise rooms with the user. Run cables in conduit and install a nylon pull cord in each conduit.

3.10. FIRE ALARM REQUIREMENTS

The fire alarm system shall consist of a fire alarm panel integrated with the MNS, transceiver, initiating devices, and notification devices. The fire alarm system shall be compatible with existing Installation fire alarm system and base MNS, and shall be coordinated with Base Fire Chief and\ or AHJ. The system shall be a Class A, addressable system, Style Z. All audible alarm appliances shall be voice type with a selection of prerecorded announcements.

3.11. Attachments

Attachment A - The Army Standard for Physical Fitness Facilities

Attachment B – Technical Criteria for U.S. Army Physical Fitness Facilities

DEPARTMENT OF THE ARMY
ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT
600 ARMY PENTAGON
WASHINGTON, DC 20310-0600

DAIM-ZA

OCT 16 2009

MEMORANDUM FOR

Commander, US Army Corps of Engineers (CEMP), 441 G St NW, Washington, DC 20314
Installation Management Command (IMCOM), 2511 Jefferson-Davis Highway, Arlington, VA 22202

SUBJECT: Army Standard for Physical Fitness Facility (PFF)

1. The enclosed Army Standard for the Physical Fitness Facility is approved for implementation. The standards apply only to the Active Component and not the Reserve Component. Only the Assistant Chief of Staff for Installation Management has authority to approve exceptions to this standard. Waivers from the Army Standard must be approved in accordance with AR 420-1.

2. These standards are mandatory for Military Construction, Army (MCA) projects in the FY2012 program and beyond. Designs based on these Army Standards, Standard Design, and Standard Criteria will be developed consistent with MILCON Transformation methodologies.

3. The points of contact (POC) for the Facilities Design Team are Mr. Jay Clark, USAESCH, james.t.clark@usace.army.mil, 256-895-1673; Ms. Janet MacKinnon, IMWR-CR, janet.mackinnon@us.army.mil, 703-681-1544; Mr. Hyuk Pak, DAIM-ODF, hyuk.pak@us.army.mil; and Mr. David Marquardt, HQ USACE, David.D.Marquardt@usace.army.mil, 202-761-7419.

Encl
as

ROBERT WILSON
Lieutenant General, GS
Assistant Chief of Staff
for Installation Management

Printed on Recycled Paper

THE ARMY STANDARD FOR PHYSICAL FITNESS FACILITIES

Description:

Physical fitness is the cornerstone of readiness. It is an essential and critical element of Soldiering. The Army emphasizes the importance of a high level of physical capability for the occupational tasks that Soldiers are required to perform. Staying fit is enhanced today with the growing popularity and use of cardiovascular and strength equipment among Soldiers. Physical Fitness Facilities are required by the Army to promote the strength and fitness of the soldiers. Physical fitness and sports support Army Core values. In addition, Physical Fitness Facilities provide one of the most popular sources of recreation for the soldiers and their families. Sample Surveys of Military Personnel (SSMP) consistently show fitness/sports facilities as first in use and importance to soldiers and family members.

Applicability:

- This Army Standard applies immediately to all new permanent Physical Fitness Facilities.
- The Army Standard applies to Army facilities worldwide.
- The Army Standards for Physical Fitness Facilities are derived from the American College of Sports Medicine (ACSM) (as directed by DoD Memorandum), Unified Facilities Criteria UFC 4-740-02, TI 800-01 - Appendix H, and the Technical Criteria for U.S. Army Physical Fitness Facilities dated October, 2003.
- All geographic districts shall incorporate the mandatory design criteria described herein in close coordination with the USACE designated Center of Standardization (COS) for Physical Fitness Facilities.

Waivers:

- Only the Assistant Chief of Staff for Installation Management has authority to approve exceptions to the Army Standards.
- Waivers from the Army Standard must be requested in accordance with (IAW) AR 420-1 and the Army Facilities Standardization Program Charter, latest edition.
- All waiver requests to this Army Standard require COS conflict resolution prior to submission by the Garrison Commander.
- Garrison Army Standard waiver request submissions must be received in sufficient time to allow completion of Facility Design Team review and development of recommendations or course of action for the Army Facilities Standardization Committee (AFSC) to consider prior to implementation into project design.
- Late submissions and/or project delays are NOT sufficient stand-alone justification for accelerated review or other dispensation for not meeting the Army Standard contained herein.
- All waiver requests shall include compelling rationale of functional and operational deviations to include substantiating documentation in sufficient detail for the Army to assess implications of approving the waiver.
- All HQDA approved waivers shall be documented in installation mater plans thereby serving as the installation’s modified standards.

THE ARMY STANDARD FOR PHYSICAL FITNESS FACILITIES

Item	Mandatory Criteria
Facility Size	Physical Fitness Facility (PFF) facility sizes will be determined based on the following installation population table. The "PFF population" includes 100% full-time soldiers (Active, Reserve Component, including other military services), 25% of family members, and 10% of DoD civilians in CONUS (when the civilian workforce is more than 60% of the total work force). At OCONUS locations include 100% of the full-time DoD civilians. Size — Population — Total Gross Square Feet X-small — 251 – 1000 — 27,771 Small — 1001 – 3000 — 44,347 Medium — 3001 – 6000 — 64,799 Large — 6001 – 10,000 — 89,448 X-large — 10,001 – 15,000 — 120,125 For every 5000 in population over 15,000, add increments of 30,677 square feet. These gross building areas are exact.
Facility Consolidation	A PFF may be combined with other facility types of a recreational or support nature, with the approval of FMWRC. Examples of facilities that could be combined are Natatoriums, Outdoor Pools, Outdoor Sport Facilities, Recreation Centers, etc.
Energy and Sustainability	Facilities shall be designed to meet energy and sustainable design and development requirements as established by Federal Law and Department of the Army policy.
Accessibility	All portions of the PFF shall comply with the Architectural Barriers Act (ABA).
Control Desk	Must be located directly inside the main entrance in order to control who enters the facility. Must be located adjacent to, and with direct, unobstructed, visual and physical access to, the free weight area for safety concerns. Shall also be located adjacent to the lobby seating area. Must be able to monitor either visually, or with video-surveillance, the following areas: • Cardio and Circuit areas • Gymnasium • Group Exercise Rooms • Entrance to Locker Rooms • Entrance to Racquetball Courts Counter heights shall be provided for standing height along with a lower area to meet ABA requirements. Lockable storage space must be provided for towels, balls, and other required equipment that will be issued from this desk.

Fitness Module - Cardiovascular Area	Floor mounted electrical outlets in a grid or linear configuration, with circuits sized for the load from fitness equipment, are required to allow flexibility in equipment arrangement and to avoid cord tripping hazards. Cardiovascular area shall be designed to provide a minimum of 2 different “environments”. These environments include Cardio Theater, external views, internal views, large group interaction, and small intimate groupings. Some portion of the Cardiovascular area must be contiguous with the Circuit and Free Weight Areas. Ceiling heights and flooring material must be as specified in the Technical Criteria for U.S. Army Physical Fitness Facilities.
Fitness Module - Circuit Area	Must be designed so that the entire circuit area is contiguous and that circuit equipment space is not dispersed into the Cardiovascular and/or Free Weight areas. In addition, the Circuit Area must be contiguous with the Free Weight Area and a portion of the Cardiovascular Area. Ceiling heights and flooring material must be as specified in the Technical Criteria for U.S. Army Physical Fitness Facilities.
Fitness Module - Free Weight Area	Must be directly accessible, visually and physically, to the Control Desk so that staff may see and respond to any emergency immediately. Mirrors must be provided on at least half of 2 perpendicular walls. Mirrors must extend from 18 inches above the floor to a height that provides full body visibility. For safety reasons for the weight lifters, all lighting fixtures in this area must be primarily indirect (>75% up-lighting). The Free Weight Area must be contiguous with the Circuit Area and a portion of the Cardiovascular Area. Ceiling heights and flooring material must be as specified in the Technical Criteria for U.S. Army Physical Fitness Facilities.
Fitness Module - Receiving/Equipment Repair/Storage	This room must be located on an exterior wall with vehicular access and oversized double doors (8 foot wide minimum) or roll-up doors for delivery of fitness equipment. Doors into the fitness module must also be able to accommodate movement of equipment.
Fitness Module - Fitness Assessment and Stretching	The Fitness Assessment area must be located within the Fitness Module to provide space for fitness testing and consultation. The Fitness Assessment shall provide privacy for talking about sensitive health issues and for testing such as Body Fat Composition and other health tests. The stretching area shall be located near the entrance to the Fitness Module and shall be an open area to allow for stretching prior to working out.

Exercise Module	Shall be 1 room that can be divided into 2 smaller rooms by use of a movable wall. When the area for this function exceeds 5000 square feet, the function may be divided into 2 or 3 smaller rooms. All sections of the room must be accessible from the main circulation path. Dimensions of the room shall ensure that it is a usable space when opened for 1 large class or divided for smaller classes. Mirrors must be provided on the wall behind the instructor and either one perpendicular wall or the back wall, and must extend from no more than 1 foot above the floor to a height that provides full body visibility. Open storage cubbies must be provided for user's personal items. Flooring must be solid maple strip flooring that meets or exceeds the Maple Flooring Manufacturers Association (MFMA) specifications for a "second or better" grade, with an appropriate substrate that eliminates dead spots and provides for adequate impact absorption. Synthetic flooring, designated for aerobic classes, may be provided only if the general population served by this facility is primarily active-duty military, these areas will not be used primarily for standard aerobic classes, and are approved by FMWRC. A waiver will be required for any other type of flooring proposed. Ceiling heights must be as specified in the Technical Criteria for U.S. Army Physical Fitness Facilities. Enclosed, lockable storage rooms, configured for one-way patron flow, must be provided for each room, or section of a room, to provide space for storage of items such as mats, fit balls, medicine balls, bands, steps, dumb bells, etc.
Gymnasium	In facilities with more than 2 basketball courts authorized, courts may be provided in 1 large gymnasium or in a primary and secondary gymnasium. Minimum of 10 foot safety zone required between courts and walls or other surfaces (such as bleachers). Minimum of 15 foot safety zone required between courts. Flooring in the gymnasium shall be appropriate for basketball and volleyball, and shall comply with the appropriate Deutsches Institut für Normung (DIN) standards for gymnasium flooring. Court markings and function fixtures (such as backboards) must comply with the requirements of the Governing body of the sport (such as National Collegiate Athletic Association (NCAA)). The secondary gymnasium will be designed to meet the programming requirements of the installation and shall consider more non-traditional sports such as indoor soccer, in-line hockey, etc. Clear heights must be as specified in the Technical Criteria for U.S. Army Physical Fitness Facilities to accommodate both Basketball and Volleyball. An enclosed, lockable storage room must be provided for each gymnasium for equipment. Doors must be sized to allow for movement of large items such as rolls of floor mats, volleyball standards, portable basketball goals, etc.

Indoor Jogging Track	A 3-lane indoor jogging track with banked corners is required in at least 1 PFF on an installation. For a specific project, this must be programmed as an additional line item in the 1391, as it is in addition to the building areas provided in "Facility Size" above.
Structured Activity Module	The Structured Activity Module provides flexible space that can be used to meet the installation's requirements along with the latest in fitness trends. Must be designed in accordance with the use that the user intends. Structured activities include, but are not limited to, Combatives Room, Racquetball Court(s), Spinning Studio, Climbing Wall, Health and Wellness offices, concessions area (such as a "smoothie bar" or mini-mart), and Child Care. Or, the space for Structured Activity may be used as additional space for one of the other functional modules, to include spectator space for racquetball courts, an additional exercise room, or to provide both saunas and steam rooms. If the user has selected a Climbing Wall for their facility, it must be located so as to be under constant staff supervision. Racquetball courts must be designed in accordance with the rules of the United States Racquetball Association, to include exact court size. Combatives Room shall be designed to accommodate mats on walls and floor, and shall minimize inside corners for safety. Child Care room shall be designed to FMWRC-CYS standards. Enclosed, lockable storage is required for each structured activity other than Racquetball.
Locker Rooms	The following functions are mandatory in the general area referred to as "Locker Room". • Locker/Dressing Area • Grooming Area • Shower Area with private shower stalls and drying booths. Gang showers are NOT allowed. • Restroom facilities • Sauna or Steam Room A separate men's and women's locker room shall be provided. All locker room functions, listed above, must be provided for each gender. Locker Rooms must be arranged so that the restroom functions are close to the entrance of the locker room, and do not require that people needing to use the restroom must pass through the locker and/or shower area. Separate saunas, steam rooms, etc. will be provided for men and women. Lockers must be a minimum of 15 inches wide and 18 inches deep. Minimum height is 30 inches per half locker. Use of "Z" lockers to provide additional height is required. There will be a combination of full-height and half-height lockers, the ratio of which is determined by the installation based on climatic concerns.

Sauna/Steam Room	A sauna or a steam room must be provided in the Physical Fitness Facility. The installation will determine their preference. Separate saunas/steam rooms must be provided for each gender. Shared saunas or steam rooms are NOT allowed. Controls shall be accessible to staff only. Access to the saunas/steam rooms shall be through the locker rooms only.
Laundry	Shall provide adequate area and mechanical/electrical support for industrial style washers (extractors) and dryers (tumblers) with additional space for utility sink, folding table, and storage for a minimum of 2 laundry carts if not located adjacent to control desk.
Administration	An administration area must be provided that includes office space for the facility manager along with other program staff in accordance with the table below. It is not required that the administration area be adjacent to the control desk.
Lobby	Shall be adjacent to the main entrance and control desk. Must be visible from the control desk so staff can monitor the area. Must provide area for seating for approximately 5% of the total number of participants. Must also provide direct access to public toilets.
Public Toilets	Must be accessible from the lobby and gymnasium. Primary users of these restrooms will be spectators.
Elevator	In multi-story applications, an elevator to comply with ABA and to provide a means to move fitness equipment to the upper level(s) is required.
Location	PFF shall be located close to barracks and/or other MWR type facilities to allow users to walk and/or minimize the need to drive.
Private Operated Vehicle (POV) Parking / Service Deliveries	• Minimum of 1 parking space per every 300 square feet of gross building area. A portion of this parking may be in adjacent underutilized parking areas. Additional parking will be required if the gymnasium is used to hold large tournaments. In addition, additional parking will be required if a parking needs survey indicates a lack of parking. • Provide signage and pavement markings per the ABA. • Provide sufficient access for turnaround/backing space for tractor trailer deliveries of equipment to the Fitness Storage/Equipment Repair Room.
HVAC	Physical Fitness Facilities must be conditioned (air conditioned and heated) and must comply with the Technical Criteria Document for Army Physical Fitness Facilities, which is based on the American College of Sports Medicine (ACSM). A waiver is required to deviate from the requirements specified in the Technical Criteria document

Telecommunications	• Telecommunications infrastructure will meet the USAISEC Technical Guide for Installation Information Infrastructure Architecture (I3A) and ANSI/TIA/EIA 568 and 569 requirements. • The facility must connect to the Installation telecommunications (voice and data) system through the outside plant (OSP) underground infrastructure per I3A guidance. Connections to the OSP cabling system shall be from each facility main cross connect located in the main telecommunications room or telecommunications equipment room to the closest OSP access point. • Telecommunications outlets will be provided IAW the Technical Guide for Installation Information Infrastructure Architecture (I3A Guide). Telecommunications outlets will be provided per the I3A technical guide based on functional purpose of the various spaces with the facility as modified by user special operational requirements. • Telecommunications Room. A Telecommunications Room (TR) shall be provided for the voice and data network. There shall be a minimum of one TR on each floor, designed in accordance with the I3A Guide and ANSI/EIA/TIA-569-B.
Drinking fountains	Drinking fountains shall be directly adjacent to, or within, each functional module. Determination of whether the drinking fountain is placed within the module is dependent upon the flooring material and potential for damage or injury. Drinking fountains shall NOT be located on wood floors.

THE ARMY STANDARD FOR PHYSICAL FITNESS FACILITIES

GENERAL DESIGN PHILOSOPHY:

The Army currently has 244 facilities at 110 installations world-wide. The majority of these facilities are in adequate condition, but almost all installations currently have a deficit in the amount of Physical Fitness Facility (PFF) space based on their population. The new standard reflects a modular approach which takes into account the current trends in training, fitness, and recreation, and uses the current PFF inventory at the installation to maximize efficiencies and to provide uniform opportunities across the Army.

The PFF Standard Criteria was developed around standardized modules for various physical fitness activities. The concept was that the Army would look at all of the PFF assets at a given installation and compare what was existing against what is authorized through the use of a Quantity Questionnaire (QQ). The QQ is part of the PFF Standard criteria, and was developed to allow the sports and fitness personnel to determine their existing assets. Once the existing assets have been entered, the form automatically determines deficits. This would then enable Installation master planners to determine whether the addition of some modules to an existing PFF would help alleviate major deficiencies. In addition, these authorized areas could be used to custom design a facility to address major deficiencies in certain modules across the installation. In effect, an installation could choose to build just an aerobics center if there were no exercise module existing in any of the PFF.

GUIDANCE:

Facility Category Code: The Category Code does not automatically imply a specific GSF limit.

CATEGORY CODE	DESCRIPTION
74028	Physical Fitness Facility

U.S. Army Physical Fitness Facilities must comply with the latest version of the Technical Criteria for U.S. Army Physical Fitness Facilities (dated no earlier than October, 2003), to include any amendments issued after the date of the latest publication, except as modified by the Army Standard above.

Reference Criteria: The designs should use latest editions of the following design criteria:
• Architectural Barriers Act (ABA)
• American College of Sports Medicine’s Health/Fitness Facility Standards and Guidelines
• IBC – International Building Code
• NFPA 101, Life Safety Code
• AR 405-70, Utilization of Real Property
• AR 420-1, Army Facilities Management
• DA PAM 415-28, Facility Guide To Army Real Property Category Codes
• UFC 3-600-01, Design: Fire Protection Engineering for Facilities
• UFC 4-010-01, DoD Minimum Antiterrorism Standards for Buildings
• UFC 4-023-03, Security Engineering: Design to Resist Progressive Collapse

• ETL 1110-3-491, Sustainable Design for Military Facilities
• USAISEC Technical Guide for Installation Information Infrastructure Architecture (I3A)
• ANSI/TIA/EIA-568-B Commercial Building Telecommunications Cabling Standard
• ANSI/TIA/EIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces

The Corps of Engineers Center of Standardization (COS) provides the first line technical compliance review. The Facilities Design Team in conjunction with the COS will resolve any issues where there may be conflicting, unclear or no compliance measurement threshold. Resolution may require senior leadership guidance or amendment of the Army Standard. Only the ACSIM can approve adjustments or changes to the requirements in an Army Standard. The Army Standard is not intended to provide compliance criteria detailed in references, regulations, industry standards, or standard design.

Physical Fitness Facilities must be designed to allow natural day lighting while controlling glare and heat gain. Spaces should be provided with large windows, translucent panels, clerestory windows and other techniques to maximize day lighting and improve the quality of life in these facilities.

Army PFF in the past have been a series of dark concrete block rooms with different functions placed inside. The intent of the new standard is to provide open areas appropriately designed for their function. Concepts such as exposed structure in lieu of acoustical tile ceilings may be utilized in many different areas. Also, spaces shall be as open as possible to provide flexibility to accommodate shifts in trends in fitness and recreation. Designers are strongly encouraged to review the State of the Art facilities published each June in the Athletic Business magazine.

Extremely large installations will consider providing mega facilities (larger than the “large” size indicated in the attached Authorized PFF Space Allowance chart), sized by using the increments, to minimize the total number of facilities on the installation to maximize staffing and other efficiencies.

In the attached Authorized PFF Space Allowance chart, all areas provided are the ideal net area based on equipment sizes and other functions. Actual net areas may vary +/- 5% from what is shown unless noted otherwise in this standard.

Traffic patterns must be considered when laying out the lobby and control desk to minimize potential conflicts with cross traffic for people signing in. It is preferable that the control desk be located on the right side when you enter the facility.

Deutsches Institut für Normung (DIN) standards referenced above in the Gymnasium may be found in the American College of Sports Medicine (ACSM) book, “Health/Fitness Facility Standards and Guidelines”.

The preference for flooring in the Gymnasium is an appropriately designed solid maple floor. Where 2 Gymnasiums are provided in a facility, it is recommended that the second Gymnasium be designed to be more multi-purpose oriented. Synthetic athletic

flooring may be used in the primary Gymnasium when requested by the installation and approved by the COS and FMWRC.

It is preferred that the climbing wall be located off of the lobby, under supervision of the control desk, as a design feature of the facility. However, another option would be to locate the climbing wall in a lockable room.

The chart on the following page lists the total area for each functional area that should be provided for an entire installation based on their authorized population. The PFF buildings are allocated on the basis of authorized population (AP) which includes 100% of active duty military and 25% of their dependents. Retirees are not counted in the AP at this time. DoD civilians are included at 10% only if they exceed 60% of the total workforce for CONUS installations. OCONUS installations are authorized at 100% of the civilian population in their AP.

It is difficult to determine the number of parking spaces required for a PFF. Based on the American College of Sports Medicine's "Health/Fitness Facility Standards and Guidelines", for initial parking calculations, assume 1 parking space for every 300 gross square feet of facility. This will provide adequate parking for all staff and approximately 60% of the maximum facility participants. However, many factors may result in the adjustment of this number of parking spaces, either up or down. A parking needs survey needs to be conducted to determine a more accurate need for parking, and the number of parking spaces provided adjusted accordingly. This survey needs to consider the following aspects at a minimum:

1. Current parking available in close proximity to the PFF.
2. The number of spectators that can be accommodated in the gymnasium.
3. Proximity of the PFF to troop housing.
4. Availability and use of public transportation.
5. The type of unit (administrative vs. training, etc.)
6. The amount of shift work.

THE ARMY STANDARD FOR PHYSICAL FITNESS FACILITIES

AUTHORIZED PFF SPACE ALLOWANCE

CRITICAL FUNCTIONAL AREAS & TOTAL PFC BUILDING AREA (Areas in square feet)		X-SMALL (Facility or Post)	SMALL (Facility or Post)	MEDIUM (Facility or Post)	LARGE (Facility or Post)	X-LARGE (Facility or Post)	INCREMENT (each 5000 over 10,000)
	Minimum Population:	251	1001	3001	6001	10001	1
	Maximum Popultion:	1000	3000	6000	10,000	15000	5000
Fitness Module	Cardiovascular Area	550	1,350	2,550	4,000	6,000	2,000
	Circuit Area	800	1,350	1,650	2,300	3,300	1,000
	Free Weight Area	975	1,885	3,055	5,200	7,995	2,795
	subtotal	2,325	4,585	7,255	11,500	17,295	5,795
	Storage - 10% of Cardio/Circuit/Free	233	459	726	1,150	1,730	580
	Stretching/Fitness Assessment	225	400	575	750	925	175
Exercise Module	Large Group Exercise	1,200	1,650	2,800	4,500	6,750	2,250
	subtotal	1,200	1,650	2,800	4,500	6,750	2,250
	Storage - 10%	120	165	280	450	675	225
Structured Activities	Racquetball Court(s)						
	Combatives Room						
	Climbing Wall						
	Spinning Classroom						
	Small Group Exercise Room						
	Concessions Area						
	Child Care						
	Other:						
	Other:						
	subtotal	4,740	5,183	6,310	8,002	12,104	4,102
Gym Module	Basketball Courts (Gymnasium)	9,775	17,400	25,200	33,000	41,400	8,400
	Storage	700	1,050	1,400	1,750	2,100	350
	subtotal	10,475	18,450	26,600	34,750	43,500	8,750
TOTAL NET OF MODULES		19,318	30,892	44,546	61,102	82,979	21,877
SUPPORT AREA ALLOWANCES:							
Sauna, Lockers, Showers, Toilets		2,400	3,800	5,850	8,800	11,800	3,000
Admin (Including internal circulation)		514	741	1,377	1,471	1,589	120
Lobby (Including control desk & public toilets)		817	1,467	2,226	3,098	3,617	519
Misc. (M/E, Circ., Struct., other functions not listed)		4,722	7,447	10,800	14,978	20,141	5,161
TOTAL GROSS AREAS:		27,771	44,347	64,799	89,449	120,125	30,677

Note: Areas are not provided for the individual functions within the Structured Activity Module as these are determined in conjunction with the Installation during the Design Charrette. The spaces selected must total no more than the Structured Activities subtotals shown above.

Technical Criteria

Technical Criteria for U.S. Army Physical Fitness Facilities

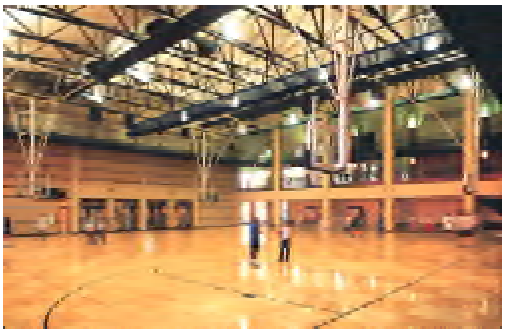
Standard Criteria

Updated June, 2010

Originally developed for the Corps of Engineers
by
Hastings & Chivetta Architects in association with **Construction Engineering & Management**

Updated by the US Army Engineering and Support Center, Huntsville

Technical Criteria for U.S. Army Physical Fitness Facilities



Developed for the Corps of Engineers

Updated April, 2010

U.S. Army Engineering and Support Center, Huntsville

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V **Appendix**

A. Utilization Study

I Executive Summary

A. Summary of Findings

Facility Allocation

Four Physical Fitness Facility (PFF) building programs are developed and presented herein. The PFF buildings are allocated on the basis of authorized population (AP) which includes 100% of active duty military and 25% of their dependents. Retirees are not counted in the AP at this time. DoD civilians are included at 10% only if they exceed 60% of the total workforce for CONUS installations. OCONUS installations are authorized at 100% of the civilian population in theirAP. The four PFF total building program areas include the following:

X-Small	251 to 1,000 AP	27,771GSF (Gross Square Feet)
Small	1,001 to 3,000 AP	44,347GSF
Medium	3,001 to 6,000 AP	64,799GSF
Large	6,001 to 10,000 AP	89,448GSF

To calculate PFF building program forAPs that exceed 10,000, an "Increment" building program is provided to increase the Large building program. The Increment program is intended to serve each additional 5,000 persons over 10,000 and includes 30,677SF. Thus, a total AP of 20,000 would require a Large PFF of 89,448SF + two 30,677SF Increments for a total of 150,802SF.

Facility Evaluation - Program Area

A breakdown of the Critical Function Modules (CFM) or components in the PFF is provided on page 5. Existing and new facilities should be inventoried and measured to assess compliance with these program areas. A PFF is considered to be in compliance with the PFF requirements when the following occurs:

- *If Fitness, Exercise and Shower/Locker/Toilet CFM components and their subcomponents individually meet a minimum of 95% of the net square foot required space, the CFM are considered in compliance.*

- *If the number of Racquetball or Squash Courts required in the Structured Activity Component is met, even if the courts are smaller than the required area, the component is considered to be in compliance. If compliance is not met, the required courts should be added by using a net increase of 850SF per court.*

- *If the Gymnasium component has the required number of courts sized at 50'x94' regardless of whether the required bleacher and storage areas are met, the Gym Component is considered to be in compliance. If this requirement is not met, new Gymnasium modules should provided per the PFF Space Allowance Table shown on page 5.*

- *If there is one track, and the gross area of the PFF meets area required to serve the AP, regardless of whether the track meets the required CFM area, this component is considered to be in compliance.*

- *If PFF components are brought into compliance with the above standards and the facility is a maximum of 10% over the allowed gross square foot area, the facility is considered to be in compliance. If the component sizes cannot be sized to meet the space standards defined above without exceeding a 10% overage, the PFF should be renovated or replaced to achieve a more efficient building design.*

Facility Evaluation - Quality Standards

Standards for new construction should meet the quality standards described in Section IV - Building Design Criteria. Renovation of existing facilities should be evaluated on a case by case basis.

II Design Concepts

A. Background

History of Development

Headquarters, Family, Morale, Welfare, and Recreation Command (FMWRC), with the Corps of Engineers, have developed new design standards for Physical Fitness Facilities (PFF) for military bases in and out of CONUS. This report presents four PFF buildings to serve authorized populations ranging from 250 to 10,000. The facilities are categorized as X-Small, Small, Medium and Large. Standard increments have also been developed to accommodate populations over 10,000.

In order to function as a PFF, a facility must, at a minimum, include the following Critical Function Modules (CFM):

- Fitness Module (cardiovascular, circuit and free weight areas)
- Exercise Module (exercise rooms for instruction i.e. aerobics)
- Structured Activity Module (racquetball and other activities)
- Gymnasium Module (suitable for basketball and volleyball)
- Locker / Shower / Sauna Module

To test the adequacy of the indoor spaces for each PFF, national participation statistics were used to predict the recreational interests of active duty personnel. The national participation statistics, from a civilian survey of approximately 50% men - 50% women, were adjusted to fit a military base demographic of 80% men - 20% women. National survey responses were narrowed to the 18-44 year age group which represents 96.9% of the active duty army personnel.

Each module was tested and adjusted to verify its ability to accommodate the recreation, fitness and health interests of Active Duty (AD) personnel during peak times. Peak use varies from activity to activity. For activities requiring instruction or teams, peak use fluctuates between 50-60% of the hours of operation. For walk-in and individual activities such as fitness or running peak use varies between 80-90% of operating hours. The total hours of operation are 100 per week and reasonable attendance is assumed. Utilization worksheets for all four facilities are provided in the Appendix.

Findings

Utilization testing of Fitness, Exercise and Non-Structured Modules confirms that program areas are adequately sized to meet demand even when civilian statistics for fitness are nearly tripled. Module areas that fall short of meeting peak demand are Gymnasium (Medium and Large), Racquetball (Medium and Large) and Jogging Track (Large)

Recommendations

Gymnasium Module

a) Constructing additional courts is not recommended to meet the short fall. A 50' x 94' court is a large area relative to the number of participants that can be accommodated for a basketball or volleyball game. Constructing and maintaining new courts is not an economically feasible solution to providing more game time. Programming half-court games, extending program hours, and providing outdoor courts are all viable alternatives.

b) Recreation trends over the past ten years show steady interest in basketball but a downward trend in volleyball. Overall, national participation for volleyball for all age groups dropped from 25.1% in 1989 to 11.7% in 1999. This trend may result in a lower demand for volleyball court time.

Racquetball Court

a) Recreation trends over the past ten years show a steady decline in racquetball of 8.2% in 1989 to 3.2% in 1999. Meeting the shortage in peak demand can be satisfied by using the Structured Activity Space for an additional court. The contingency space for every building size easily accommodates an additional racquetball or squash court.

Jogging Track

a) Exercise walking, jogging and running are popular activities. Walking has grown 20% over the past ten years and is becoming a staple of recreational activity for all age groups. National statistics do not separate survey responses by indoor track, treadmill or outdoor participation. Notwithstanding, each facility will provide a minimum of one suspended track surrounding the gymnasium. Facilities in extreme climates can expand track areas by looping the track around other indoor components. Need should be reviewed on a case by case basis.

B. Physical Fitness Facility (PFF) Space Allowance Table

Net and gross areas PFFs are itemized below. These spaces have been sized and tested for ability to meet peak demand based on a recommended square foot per person area published by the National Intramural-Recreation Sports Association (NIRSA) Space Standard for Indoor Facilities.

CFM Component	NIRSA Recommended Area
Exercise Module - Aerobics	50SF per participant
Exercise Module - Non-Structured	125SF per participant
Gymnasium Court - Basketball	14 participants + 4 rotating in
Gymnasium Court - Volleyball	16 participants + 4 rotating in
Fitness Module	50SF per equipment station 65SF per free weight station
Structured Activity - Racquetball	4 participants per 800SF Court
Indoor Track	1 runner/ 20 lineal feet

An "Increment" program area is provided to increase the X-Large facility to serve authorized populations that exceed 15,000. The Increment area will serve 5,000 persons. Thus, a population of 19,000 requires an X-Large PFF plus one Increment.

AUTHORIZED PFF SPACE ALLOWANCE

CRITICAL FUNCTIONAL AREAS & TOTAL PFF BUILDING AREA (Areas in square feet)		X-SMALL	SMALL	MEDIUM	LARGE	X-LARGE	INCREMENT
	Minimum Population:	251	1,001	3,001	6,001	10,001	1
	Maximum Popultion:	1,000	3,000	6,000	10,000	15,000	5,000
Fitness Module	Cardiovascular Area	550	1,350	2,550	4,000	6,000	2,000
	Circuit Area	800	1,350	1,650	2,300	3,300	1,000
	Free Weight Area	975	1,885	3,055	5,200	7,995	2,795
	Stretching/Fitness Assessment	225	400	575	750	925	175
	Storage	233	459	726	1,150	1,730	580
Exercise Module	Large Group Exercise	1,200	1,650	2,800	4,500	6,750	2,250
	Storage	120	165	280	450	675	225
Structured Activities	Racquetball Courts, Climbing Wall, Spinning Classroom, Combatives, Concesssions, Child Care, etc.	4,740	5,183	6,310	8,002	12,104	4,102
Gym Module	Basketball Courts (Gym)	9775	17,400	25,200	33,000	41,400	8,400
	Storage	700	1,050	1,400	1,750	2,100	350
TOTAL NET OF MODULES:		**19,318**	**30,892**	**44,546**	**61,102**	**82,979**	**21,877**
SUPPORT AREA ALLOWANCES:							
Sauna, Lockers, Showers, Toilets		2,400	3,800	5,850	8,800	11,800	3,000
Admin	Director's Office	120	120	120	120	130	10
	Program Mgr's Office	0	100	100	100	110	10
	Support Staff Workstations	128	128	256	320	384	64
	Copy/file/work/break Room	160	240	160	170	180	10
	Storage	20	29	32	36	40	5
	Classroom/Training Room	0	0	420	420	420	0
	Classroom/Training Storage	0	0	60	60	60	0
	Internal Circulation (20%)	86	123	230	245	265	21
Lobby	Estimated Lobby	230	440	650	880	1,090	210
	Est. Control Counter/Storage	300	512	725	938	1,151	213
	Estimated Public Restrooms	287	515	851	1,280	1,376	96
Miscellaneous (M/E, Circ., Struct., and other functions not listed – janitor, laundry, etc.)		4,722	7,447	10,800	14,978	20,141	5,161
TOTAL GROSS AREAS:		**27,771**	**44,347**	**64,799**	**89,448**	**120,125**	**30,677**

C. Allocation of Facilities – Programming

Method of Allocation
Physical Fitness Facilities are allocated on the basis of Authorized Population (AP). Authorized population is counted as follows:

100% of Active Duty personnel (AD)
25% of AD Dependents
10% of Civilians (in CONUS) if they are 60% of the total workforce
100% of Civilians (OCONUS) regardless of percentage of workforce

New Construction
If no PFF exists on post, the procedure for allocating facility size is to calculate AP and reference the Authorized PFF Space Allowance Table on Page 5. Recommendations are presented in Section III of this manual to establish criteria for designing, constructing and equipping a new facility.

Existing Facilities
If there is an existing PFF on the installation, the procedure for assessment is:

- Calculate total AP
- Determine the Authorized PFF Space Allowance (see below)
- Measure PFF from outside wall to outside wall (gross square feet)
- Inventory and measure interior spaces (net square feet)
- Compare actual net and gross areas to Authorized PFF Allowances
- Identify deficits
- Identify surplus
- Analyze the facility for conformity to minimum ISR quality standards
- Record inadequacies or inefficiencies (surplus areas)

Since facilities are allocated solely on the basis of authorized population, it is important to accurately calculate the total authorized population. Army guidelines provide for only 25% of dependents to be counted in the AP. DoD statistics report that Fifty-percent of active duty personnel are married with an average of 2.83 dependents. Failure to accurately count the total Authorized Population may result in a facility that is undersized. Some of the consequences of an under-programmed PFF will be overcrowding and shortened life-span of building resources and equipment.

Assumption
A chart illustrating a prototypical demographic breakdown of an Authorized Population of 1,000 persons is shown on the next page. Studies to test module sizes assume the peak user group for this prototype is AD personnel that makes up 74% of the total AP. The current DoD demographic profile for activity duty personnel in the DA is 85% Men and 15% Women. The DoD projects that within ten years the demographic split will be 80% Men and 20% Women. An overall male/female demographic for a total installation with an AD split of 80/20 Men/Women is estimated to be 60% Men and 40% Women.

	Estimated Authorized Population			1000	total
	Active Duty			**739.0**	**74%**
A	Married			369.5	
B	Unmarried			369.5	
C	Ratio of Dependents/Married (based on DOD statistics)	2.83 x	369.5	1045.7	
D	**Actual Base Population**			**1784.7**	
E	Married	100% x	A	369.5	
F	Unmarried	100% x	B	369.5	
G	Dependents	25% x	C	261.4	
	Total Authorized Users			**1000.4**	

10-Year Projected AD Breakdown = 80% Men, 20% Women

	Demographic Profile of Adult Population			
H	100% of AD Unmarried Men	80% x	B	295.6
I	100% of AD Unmarried Women	20% x	B	73.9
J	100% of AD Married Men	80% x	A	295.6
K	100% of AD Married Women	20% x	A	73.9
L	Female Spouses	100% x	J	295.6
M	Male Spouses	100% x	K	73.9
	Adult Population			**1108.5**

Projected Males on Base	**60%**	H+J+M	**665.1**
Projected Females on Base	**40%**	I+K+L	**443.4**
			1108.5

The two charts above illustrate the demographic profile of a CONUS installation with a civilian workforce of less than 60%. This installation qualifies for an X-Small PFF. The AP of 1,000 is comprised of 50% unmarried AD and 50% married AD with 2.83 dependents. This emulates the 2001 DoD statistic for the DA overall. The chart demonstrates that a PFF designed to accommodate an AP of 1,000 may have an actual installation population of 1,784.

The total Dependents (G) are assumed to be spouses and children. Children are expected to visit the PFF during off-peak times. The peak user group, creating demand in early morning and after-work hours, is expected to be adults. The lower chart illustrates that the actual adult population is 1,108 with a projected demographic of 60% Male and 40% Female.

It is unlikely that all 1,108 adults will visit the PFF at peak times. Some AD will be on-duty and spouses may be at home with children. For purpose of this study, the peak user group for all facilities is assumed to be 74% of the AP which equates to almost 100% of the AD personnel. The demographic profile of 80/20 Men/Women is used, even though 60/40 represents the overall base demographic. Depending on the MACOM and installation mission, the AD demographic may change, affecting participation statistics and utilization. Adjustments should be made to PFF Space allowances if the Male/Female population shifts more than 10% in either direction. See Section IV - Appendix for guidance in making adjustments.

Programming

Programming a Physical Fitness Facility (PFF) requires several steps to accommodate the Army's goals to provide adequate PFF facilities at every installation.

1. Determine if there are any PFF(s) existing on the installation already. If a PFF(s) already exists on the installation, determine whether the existing PFF(s) will be demolished or converted to some other use as part of this project, or shortly after the new facility is constructed, such that this new facility will be the only PFF on the installation. If no PFF exists, or the existing one will be removed from the inventory once the new one is built, use the gross areas provided in the PFF Space Allowance Table on Page 5 which is based on the authorized population of the installation. This includes instances where a entirely new community is being developed away from the main installation.

2. If there are PFF facilities that will remain after the new facility has been constructed, determine if a Quantity Worksheet has been completed for the installation, which shows the total gross area of the facility as well as the net areas of all the functional modules.

   a. If the Quantity Worksheet has been completed, use the results from the worksheet to program the new facility. If the result indicates that you must build more than authorized in order to meet C1 status, please obtain MACOM approval as required. Also, evaluate the space in your existing PFF(s) to determine if the space could be utilized more efficiently, or if it would be wise to remove some of the facilities from your inventory. Utilize the Quality Worksheets from the ISR to help determine if a facility should be removed or renovated.

   b. If a Quantity Worksheet cannot be completed before programming the new facility, use the Standard Criteria to determine the allowed area for the authorized population of the installation. Subtract from that number the total gross building area of any PFF that will remain. The result is the amount that may be programmed for a new PFF. Realize that without the Quantity Worksheet, this new building may not meet the requirements for C1, and another construction or renovation project may be required in the out years.

3. In the overall gross areas for PFF, a "Miscellaneous Area" has been provided to accommodate circulation, wall thickness, and mechanical/ electrical spaces, and other required spaces not identified elsewhere. This area is calculated at 20% of the total net area of the functional modules. If there are larger mechanical and/or electrical requirements, this additional space must be added during the programming phase. FUNCTIONAL MODULES MAY NOT BE REDUCED IN AREA TO ACCOMMODATE MECHANICAL AND/OR ELECTRICAL REQUIREMENTS. Areas provided for each functional module are directly related to the requirements in the Installation Status Report (ISR). Reduction of these areas will result in a lower "C" rating for the installation, even after the construction of a brand new facility.

4. Computation of Gross Areas. The gross area of facilities will be computed according to the definition in Chapter 5 of TI 800-01.

5. New PFF(s) will be designed in accordance with this document, the approved Army Standard, the UFC 4-740-02, and other criteria maintained by the US Army Corps of Engineers Center of Standardization.

III Functional Relationships & Module Design Criteria

A. Component Descriptions

Lobby

A well-designed lobby serves to not only welcome visitors to the fitness facility, but also to motivate them. Functionally, the lobby provides a passageway to organize the building. Referred to as "public space" the lobby physically leads visitors from the exterior to the control point. The control desk should be adjacent to the entry for check-in/out and equipment issue. This facilitates monitoring and restricting access to the building and gives all visitors an arrival destination. From the control point, users can be easily directed to major activity areas and support spaces. Open views into the gymnasium, fitness facility and other activity modules instantly define building function and capture user attention. These views also enable supervision of activities from the control desk.

Features that make the lobby an inviting space include lounges to provide refuge for anyone waiting for a friend or for court time. However, recreation facility lounge areas should not resemble airport waiting areas with tandem seating. Instead, seating should be placed to invite socialization and relaxation with features that include an oversized television, comfortable seating and kiosk or message center. Small cafe-style tables and chairs may be provided if vending machines are available.

The shape of the lobby can either be classically geometric or a lineal concourse. The mall concept is newer and integrates retail thinking. A long passageway increases visual connection to fitness elements, thereby advertising activities. Lobby orientation is influenced by other factors including sun angles, tree coverage and pedestrian /vehicular circulation. Site context, massing and material selection also impact lobby design.

The aesthetic impact of the lobby relies on the placement and quality of finish materials. Durability and maintainability play a significant role in the selection of finishes for high-traffic areas. In general, warm colors and soft textures are most successful at creating an ambiance that invites users to linger in the transitory space. Terrazzo or porcelain tile floors add durability and quality. Suitable wall materials include burnished or split-face block, masonry or epoxy-painted concrete masonry units. Lobby lighting should allow for natural light through large windows and clerestories and should be provided with a combination of natural and artificial light sources to utilize daylighting and daylight harvesting within the space. Various ceiling heights and drywall bulkheads help to define lobby functions.

More than any other space in the facility, the lobby furnishings and fixtures contribute to forming the user's impression of the building. Furniture, display cases, refuse containers, plants, graphics and signage should all be carefully coordinated.

Gymnasiums

Large volume gyms are often neglected by designers because function overwhelms creative possibilities. However, with careful planning, these “big-box” spaces will respond to a wide variety of program needs.

No other space can accommodate multiple activities as well as the gymnasium. Through the use of simple devices like divider curtains, concurrent basketball, volleyball, and even tennis is possible. Suspend the running track above the floor and runners or walkers can overlook floor activities. Such a large volume can incorporate interior views at many levels to look across to racquetball courts, high ceiling lobbies, or climbing walls. Views to the exterior offer visual variety from the inside and add interest in the facility to passersby. Windows have the added benefit of bringing in natural light in what traditionally has been an artificially lit and harsh environment. In short, careful planning of even the most utilitarian elements can make the gymnasium the visual and functional hub of the facility.

High performance materials, color, lighting, and ventilation are key elements that make gymnasiums attractive spaces. Ventilation systems should be designed with adequate air changes to maintain a suitable activity environment. Recommendations are provided in Section IV of this report. Color and lighting impact overall design. Neutral colors for walls and white ceilings can be easily combined with accent colors. Light colors are also reflective, making a large-volume space easier to illuminate. Darker colors hide marks on the walls, but absorb light requiring greater levels of artificial illumination. Selection and placement of light fixtures is crucial to achieving even but not harsh illumination. Downlighting alone may cause hot spots and glare on the playing surface. Indirect lighting alone may not provide sufficient light for competitive play. The preferred solution is a combination of indirect and direct lighting that illuminates the entire space with a minimum amount of glare. Recommendations for light level are provided in Section IV.

Suspending the running track helps to reduce the apparent volume of the gym module, as well as provide an opportunity to introduce accent colors and decorative elements via the railings and structural supports for the track. Accenting selected elements within the entire space can create a sense of energy and excitement, or in softer tones create a more relaxed atmosphere. Every element within the volume must be considered for its functional and visual impact on the whole.

Bleacher seating, basketball backstops, and divider curtains are other elements that provide opportunities for accenting and highlighting the space. Not only used for activity control, divider curtains form one of the strongest visual elements in the space. Careful consideration of mounting height and the proportion of solid versus open mesh material can prevent divider curtains from blocking views, lowering light levels, and constricting an otherwise light and open volume.

Flooring materials have the greatest impact on user satisfaction. Select high performance wood floors that utilize neoprene shock pads for impact absorption to reduce injuries while maintaining near perfect ball return characteristics. Maple floors are the industry standard, but a wide variety of appearance grades are possible. Lower grades may reduce cost for the same performance, but allow undesirable visual variation in the boards. Synthetic sports floors also offer competitive cost and performance characteristics while allowing the introduction of colors and durability. To repeat, careful planning and a reasonable understanding of how each element affects the visual quality of the space are key to creating a superior gymnasium. Technical guidelines for track and flooring elements are in Section IV.

The layouts follow regulations from nationally recognized sports associations like the United States Volleyball Association (USAV) and the National Collegiate Athletics Association (NCAA). It is required that new courts conform to competitive standards nationwide. The correct volume for the gymnasium module starts with the proper court dimensions, clear heights, and sideline allowances. Minimum clear height of the gymnasium is 28’ from floor to lowest element.

As of October, 2003, the governing bodies for Volleyball and Basketball, along with some of the facility requirements, are listed below. Current regulations shall be followed. Actually Army requirements are defined further in this document.

Regulation Information from the USA Volleyball Rule Book
USA Volleyball (USAV) is the national governing body for the sport of volleyball in the United States and is recognized by the Federation International de Volleyball (FIVB) and the United States Olympic Committee (USOC).

Ceiling Height
The playing space is free from any obstructions to a height of 7 m (23') from the playing surface.

Playing Court
The playing court measures 18 m x 9 m (59' x 29’6").

Center Line
The axis of the center line divides the court into two team courts measuring 9m x 9 m (29’6" x 29’6") each.

Lines
All lines on the court are 5 cm (2") wide.

Boundary Lines
Boundary lines: Two sidelines and two end lines mark the playing court. All boundary lines are drawn inside the dimensions of the playing court.

Attack Lines
Attack lines are drawn in each team court so that the edge of the attack line farthest from the center line is 3 m (9’10") from the axis of the center line. Extensions of the attack lines outside the court shall be marked with five 6" lines spaced 8" apart to a total length of 70" (for national competition).

Area Around the Court (Free Zone)
The free zone surrounds the court with a recommended minimum width of 2 m (6’6").

Net Height FIVB, USAV, California Beach Volleyball Association (CBVA), Women’s Professional Beach Volleyball Association WPVA

Net height for men, cooed mixed 6, & outdoor is 2.43 meters or 7’11-5/8".
Net height for women, boy’s 14-and-under & reversed mixed 6 is 2.24 meters or 7’4-1/8".
Net height for 12-and-under is 2.13m or 7’0".
Net height for girl’s 10-and-under is 1.98m or 6’6".

Information from the NCAA for Basketball Court Dimensions and Markings
The ideal playing area is 50 feet wide by 94 feet long with at least 3 feet (preferably 10 feet) of open area outside the boundaries.

In addition to sidelines and end lines, markings include a center circle; a division line through the center circle from sideline to sideline, dividing the court into two equal parts; a free-throw lane (12 feet wide) and free-throw line (15 feet from the backboard) at each end of the court and a broken restraining line outside the court 6 feet from, and parallel to, the end lines. The center circle has a 6-foot radius. The area inside the circle may not be occupied by the eight nonjumpers until one of the two jumpers has tapped the ball.

The three-point arc, measured 19 feet 9 inches from the center of the basket, serves as the boundary line to let the referee know that three points shall be awarded for a successful field-goal attempt from beyond the line.

Fitness Module

Strength, cardiovascular and free-weight areas have moved from the dark recesses of gymnasium basements to become the most sought after and visible components of fitness facilities. High schools have incorporated fitness training into standard curriculum. Colleges now recognize that students come to their campus with a well-founded interest in fitness and wellness pursuits. Most young recruits will also be familiar with an array of workout equipment. Since military readiness is inextricably connected with fitness, this component should offer a stimulating environment that promotes an ongoing interest in physical proficiency.

Because of this enhanced purpose, army fitness modules should be designed for function and aesthetics. Many private sector facilities are used as much for socialization as fitness. Aesthetics in these private niche facilities is largely market-driven with interiors that sometimes resemble a nightspot. Community and collegiate recreation centers must appeal to a wider group satisfying more diverse expectations. These facilities generally benefit from a timeless design approach. Army fitness facilities should adopt a similar tactic. Newer thinking in fitness design integrates all equipment into one area, but creates separations in function by using halfwalls, dropped ceilings, and changes in flooring materials. Free weight equipment must be directly visible and directly accessible to the reception (control) desk. Recommended free weight flooring is rubber or synthetic flooring material. Dispersing cardiovascular equipment within lobbies or overlooks helps to bring movement throughout the facility and addresses differing individual workout needs. Army fitness facilities shall have cardiovascular equipment located in at least 2 areas of the facility. Cardiovascular “theaters” include overhead mounted television monitors. In all, electrical considerations must be taken into account to power not just existing equipment, but future equipment as well. In addition, future needs and flexibility must be considered.

Lighting is crucial to providing a stimulating fitness environment. Indirect lighting and a visual connection to indoor and outdoor vistas will have a positive influence on the users’ frame of mind. For safety reasons, primarily indirect lighting must be used in the free-weight area. An exposed, painted ceiling can contribute a high-tech look, providing some other acoustical elements are incorporated to offset the hard-surface. Wall materials should be durable but not institutional. Mirrors, graphics, soft textures and wallcarpeting will help to soften the entire fitness environment. Recommendations for finishes are provided in Section IV of this report.

Regardless of the finishes and other design features, inadequate ventilation and temperature control will result in an undesirable workout experience. Mechanical systems should be capable of adjusting to different internal loads and occupancies at different times of the day. Recommendations for temperature and humidity levels are provided in Section IV of this report.

Exercise Module

Over the past 30 years, group fitness activities have maintained steady growth and progression. Aerobic classes of the seventies were characterized by strained muscles and high impact movement in bare feet. Frequent injuries quickly taught instructors serious lessons about exercise safety. Since that time, improvements in flooring, footwear, equipment and instruction technique have helped to generate safer, low impact movements that prevent injury.

Today, the list of popular classroom activities continues to grow including step aerobics, conditioning, yoga, martial arts, kick-boxing, dance, urban rebounding, etc. All of these activities provide aerobic or "cardio" conditioning. Some programs incorporate strength training by using steps, handheld weights, elastic bands and stability balls.

Fitness programs that support military readiness may include many of the above activities combined with individualized workouts in the fitness module. Providing adequate programming will be the greatest challenge for PFF facility operators. In addition, young recruits may have a desire for activities that imitate extreme sports. Flexibility in classroom design will be essential to accommodate a variety of programs.

The staff for each PFF should monitor the popularity of programs and equip the exercise modules accordingly. The desire to participate in group exercise will be influenced not only by trend, but also by the quality of the space. In addition, the quality of the instructors will play a significant role in the participation in exercise programs. A skilled and enthusiastic instructor will quickly create demand. Hiring and retaining proficient instructors is key to filling group programs.

Each PFF is programmed with a minimum of 1 large group exercise studio, which is provided with a movable wall to allow for dividing the space into 2 separate spaces. Storage is provided for both sides of the room and is designed for flow-through circulation to minimize down time during the class. Design criteria for the exercise module is provided in Section IV and includes data for flooring, lighting and environmental conditions.

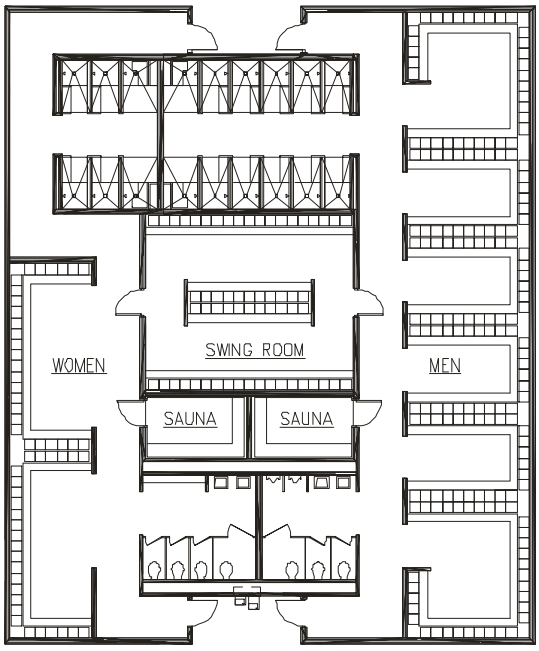
Structured Activity Module

Structured activity areas have very specific design requirements. However, the orientation of these components is subjective.

Racquetball courts can be provided with this allocation, or other elements that could include a spinning studio, climbing wall, squash court, etc.

Racquetball participation is on the decline in the United States decreasing from 8.2% in 1989 to 3.2% in 1999. These spaces are expensive to construct and are not easily adapted to other use. A careful review of the need for racquetball courts should be reviewed by each installation before constructing new or additional courts. That said, court play is exciting to watch. A highly competitive game will draw spectators who may be on the way to or from their own activities. Views into racquetball from the lobby or main corridor system add vitality to the building.

The United States Racquetball Association (USRA) and International Racquetball Federation (IRF) provide specification criteria for court design and construction. Courts shall be built to USRA/IRF standards to ensure they are suitable for all types of play, including international matches. Design criteria for racquetball courts is provided in Section IV of this report.



Sauna, Lockers, Showers, Toilet

Important locker room design elements include aesthetics, environment, layout and location. Every effort should be made to provide a direct connection between locker facilities and major activity spaces. Design options for consideration include family change rooms or satellite uni-sex change rooms for after-hour use. Convertible locker room space that is accessible from both male or female locker rooms will provide a "swing" space to increase locker room capacity for special events. An example of a locker room design incorporating swing space is shown in the left margin.

Other key objectives in locker room design include selecting eye catching colors, using maintenance-free materials and providing an adequate ventilation system. Every material used in the shower, toilet, locker and sauna area has color. Coordinating these color finishes, as well as other building materials, should be done in consultation with design professions. In general, multicolored schemes are more appealing than pallets that are limited to shades of gray or neutrals. Manufacturers have broadened color options over the last decade and simplified the specification process. Most tile manufacturers provide preset tile patterns in sheets. Standard patterns are cost effective and require minimal color selection. These floor patterns are an excellent method of adding design quality for very little money. Coordinating wall tile patterns, wall graphics, paint, toilet and shower partitions, and locker room flooring will tie these elements together and unify the entire locker room space.

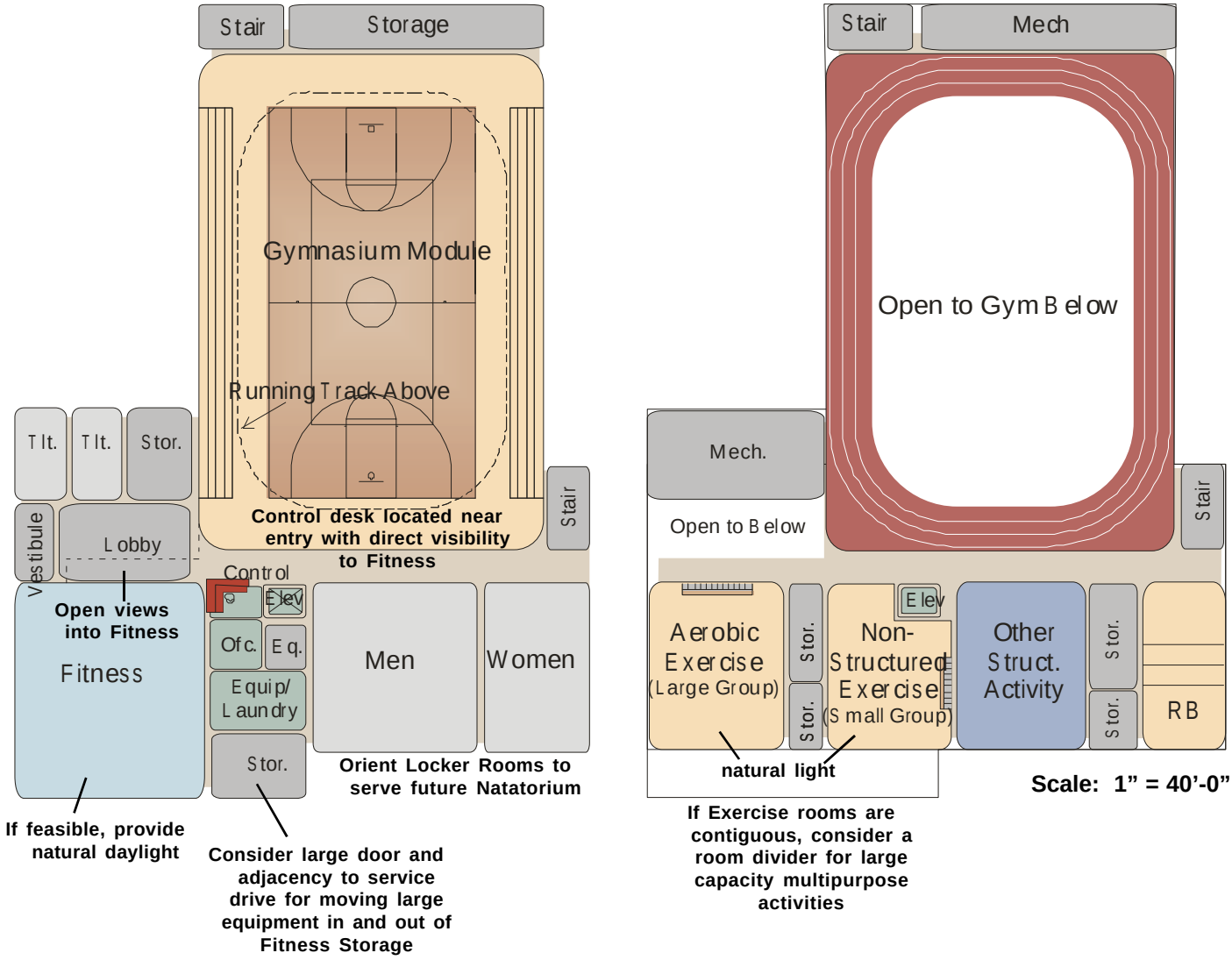
Concrete masonry unit (CMU) wall construction is recommended for locker room areas. Wall finishes in wet areas should be nonporous materials such as glazed ceramic wall tile, glazed CMU, or unglazed porcelain tile. Wall tile can be carried throughout non-wet areas or CMU can be filled and painted with an epoxy coating. Slip resistant materials or unglazed porcelain tile should be used for floors in all wet areas. Epoxy grouts for floor tile should be darker to offset the discoloration that will come with time. Antimicrobial, pvc-backed carpet with welded seams is an ideal finish for locker areas. The carpet provides an acoustical element to help muffle the sound of metal locker doors.

Recommended ceiling materials include plaster ceilings in wet areas and a moisture-resistant suspended ceiling in locker room areas.

Maintenance of wet areas and locker rooms is the final, and most important, component in providing an appealing recreational experience. Even though most users may change and shower in a short period of time before departing, every user in the facility will take notice of neglected locker room areas. Instituting adequate procedures and daily inspection will go a long way to extending the life-span of finishes.

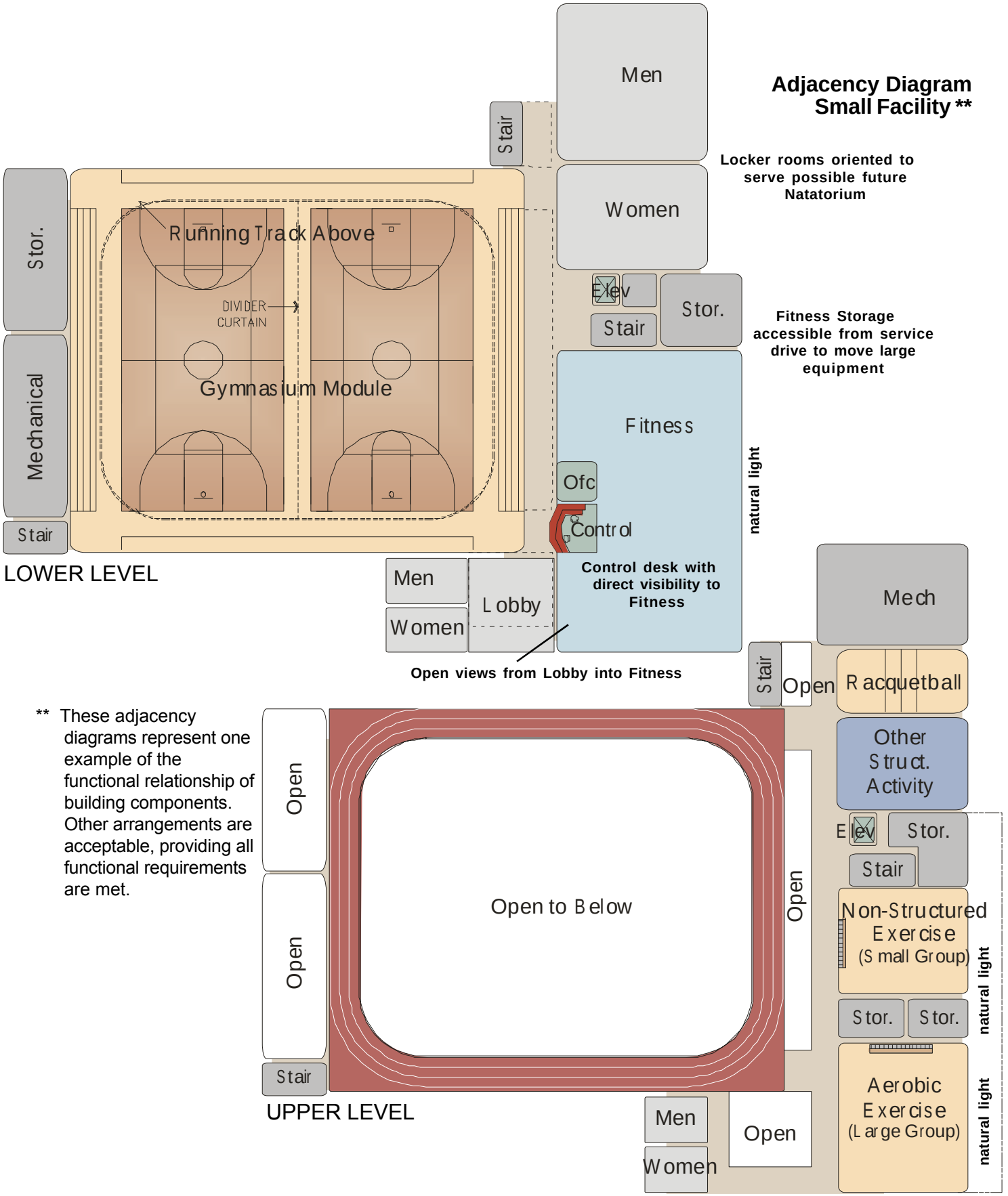
Specific recommendations for materials and finishes can be found in Section IV of this report.

Adjacency Diagram - X-Small Facility **



** These adjacency diagrams represent one example of the functional relationship of building components. Other arrangements are acceptable, providing all functional requirements are met.

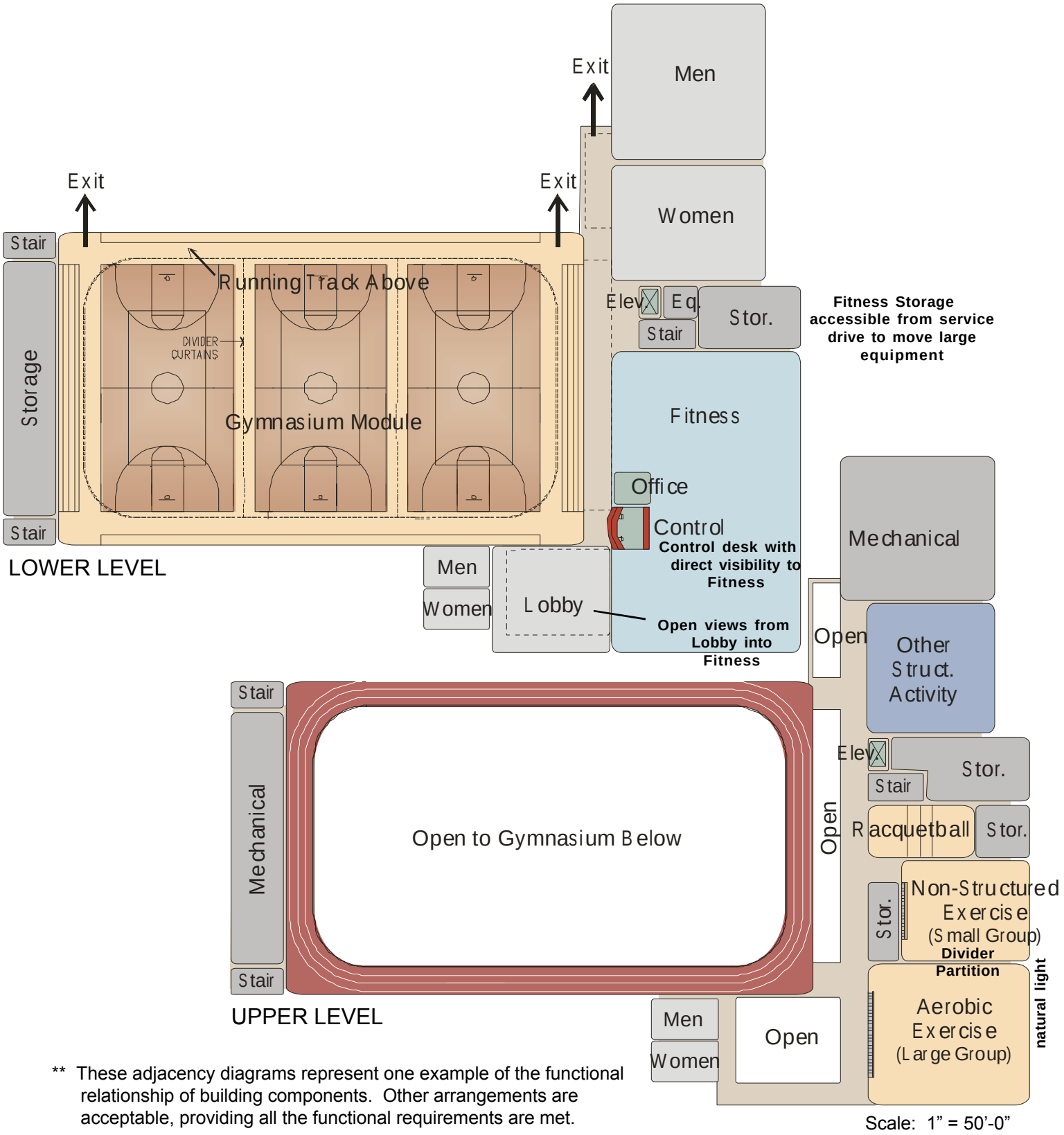
Adjacency Diagram Small Facility **



** These adjacency diagrams represent one example of the functional relationship of building components. Other arrangements are acceptable, providing all functional requirements are met.

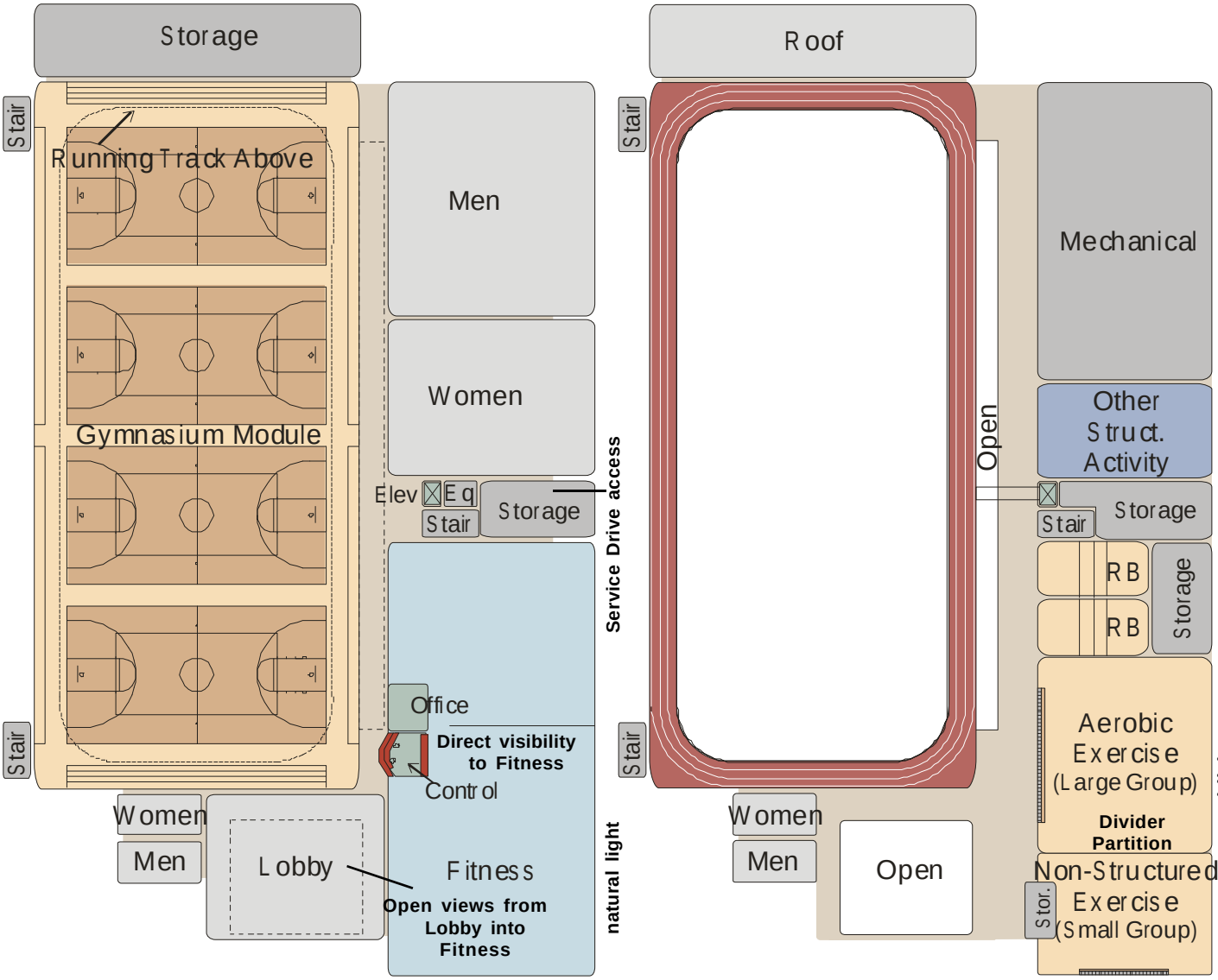
Scale: 1" = 40'-0"

Adjacency Diagram - Medium Facility**



** These adjacency diagrams represent one example of the functional relationship of building components. Other arrangements are acceptable, providing all the functional requirements are met.

Adjacency Diagram - Large Facility**



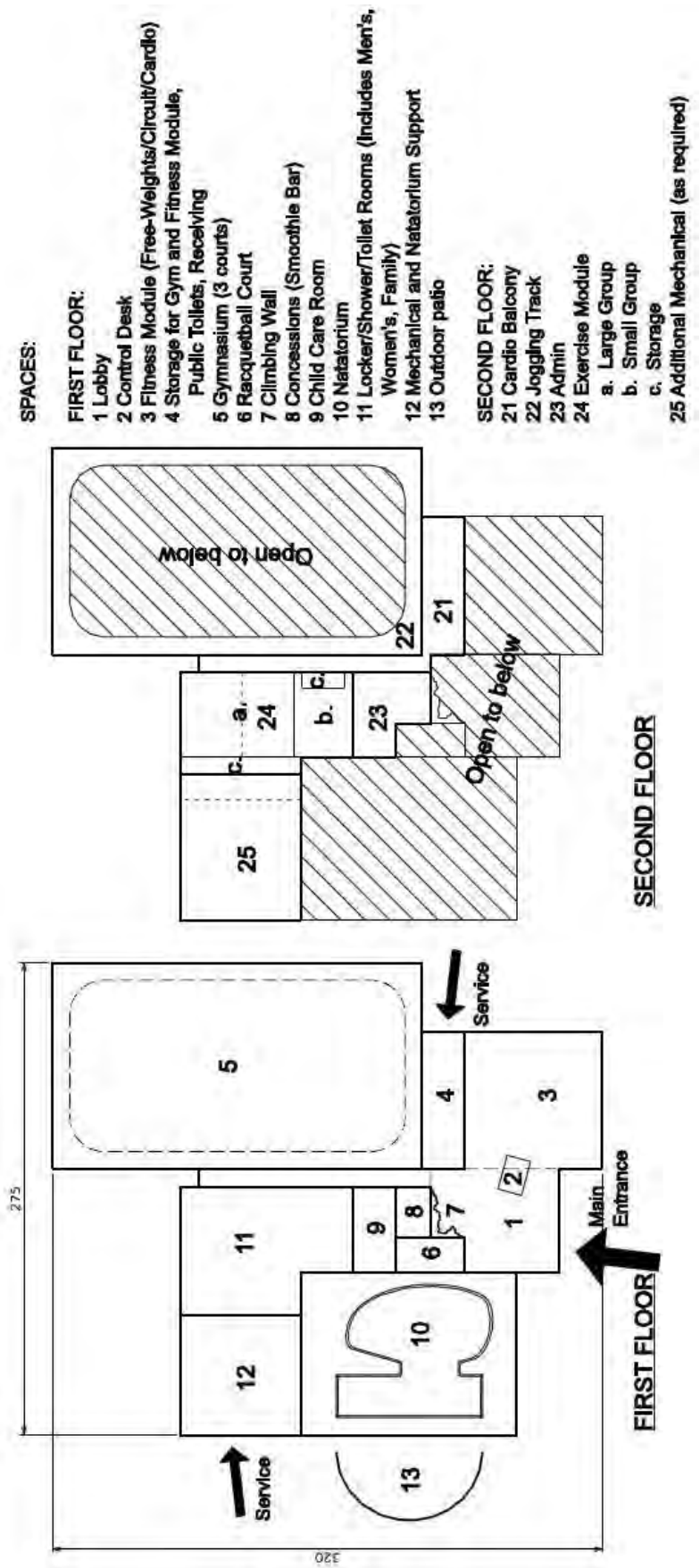
LOWER LEVEL

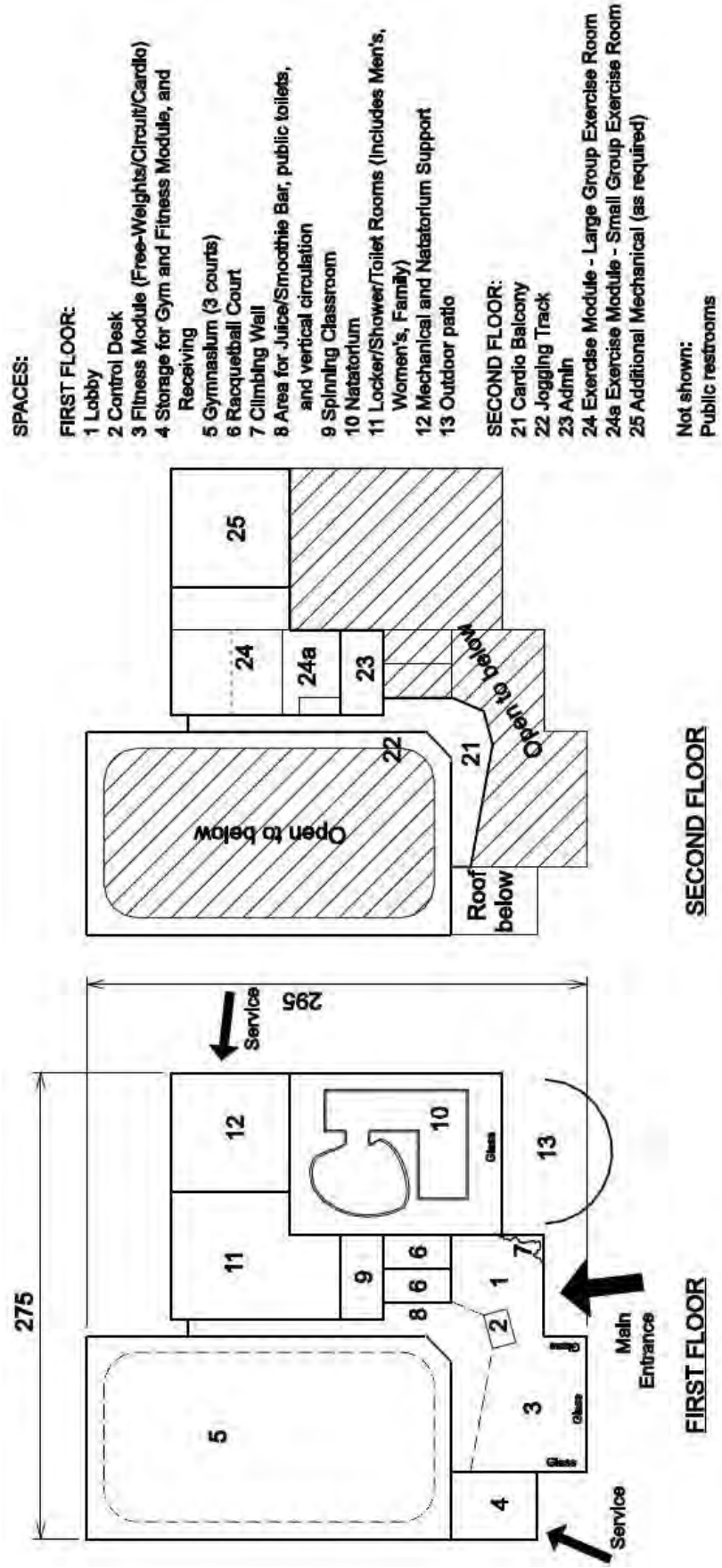
UPPER LEVEL

Scale: 1” = 60’-0”

** These adjacency diagrams represent one example of the functional relationship of building components. Other arrangements are acceptable, providing all the functional requirements are met.

The diagrams on pages 22 and 23 indicate other possible arrangements for a Medium PFF. Both of these illustrate an attached natatorium.




SPACES:
FIRST FLOOR:
1 Lobby
2 Control Desk
3 Fitness Module (Free-Weights/Circuit/Cardio)
4 Storage for Gym and Fitness Module, and Receiving
5 Gymnasium (3 courts)
6 Racquetball Court
7 Climbing Wall
8 Area for Juice/Smoothie Bar, public toilets, and vertical circulation
9 Spinning Classroom
10 Natatorium
11 Locker/Shower/Toilet Rooms (Includes Men's, Women's, Family)
12 Mechanical and Natatorium Support
13 Outdoor patio
SECOND FLOOR:
21 Cardio Balcony
22 Jogging Track
23 Admin
24 Exercise Module - Large Group Exercise Room
24a Exercise Module - Small Group Exercise Room
25 Additional Mechanical (as required)
Not shown:
Public restrooms
SECOND FLOOR
FIRST FLOOR
Open to below
Roof below
Service
Main Entrance
295
275

A. Component Descriptions

A. Site Criteria

Site considerations for recreation facilities are generally no more restricting to placement and orientation than general construction of any large facility. The few exceptions are critical for proper performance of the most common site failures; water transmission and uneven settling under the 35K/ square foot or greater loads typical to recreation facility foundations. If feasible, building siting should be close to outdoor sports fields.

Soils testing: Retain a qualified geo-technical engineer to take borings on site and recommend foundation systems and pavement designs. Update existing soils testing older than 5 years, with new borings intermediate to the old locations. With new, undeveloped sites, it is recommended to increase the number of test borings beyond the four corners and one to two intermediate borings typical to a soils report of minimum scope. Maintaining floor flatness for slabs on grade and minimizing cracking requires an understanding of soils conditions across a 170' x 170 to 285' proposed footprint. To avoid being over-conservative in foundation sizing, in soils replacement, or groundwater protections allow the geo-tech to take ample borings to allow for a firm judgment. A 40 to 60 foot boring grid across the site, in variable soils conditions, is considered minimum. Expect a minimum 100 foot grid in historically stable soils.

Soils analysis will reveal most potential problems with situating a recreation facility on a particular site. Typical recreation facility foundations require a drilled or driven pier and grade beam application. Spread footings have a limited application to resist recreation facility loading, and would be confined to smaller one-story projections off the larger two story, open volumes.

Electrical system grounding and lightening protection grounding should be coordinated with the project geotechnical engineer.

Groundwater and runoff: The control of water flow around the site, site runoff and below grade ground water is critical to ensuring the long term viability of activity spaces that utilize special sports flooring. The technical guidelines point out that sports floor products are susceptible to failure in the presence of below grade moisture. Moisture contribution to concrete slabs on grade will warp wood floors and delaminate the adhesives in synthetic flooring. Properly installed vapor barriers beneath slabs can resolve most problems.

Caution: the presence of ground water within the frost depth of the foundation system typically warrants the use of a complete subsurface drainage system and/or the use of perimeter foundation drains. Loose or clayey soils will argue for piping all roof and site runoff into a controlled storm drainage system. Water flow across the recreation facility site from other properties will argue for foundation drains for the entire facility perimeter. Minimum recommendation for any soils conditions are: 1) foundation drain, and 2) minimize roof runoff onto grade. Pipe water away whenever possible.

Site drainage design must meet local agency requirements.

Substandard soils: It is not uncommon for recreation facility slab-on-grade tolerances to require the removal and replacement of subsurface soils unable to reach proper compaction, offer the engineer reasonable confidence that compaction will be consistent, or provide adequate resistance to overall loads. One element often overlooked in judging the adequacy of soils is the ability of the construction crew to use heavy crane equipment, without risk to the stability of a prepared subbase. Soils must be capable of resisting rutting and pumping while maintaining an optimum moisture content. All other elements being equal, the stability of the subbase to an adequate depth, and the consistency of the same over the whole area of the proposed slabs prevent the most common slab failure problems. Explain floor tolerance and moisture content requirements to the geo-technical engineer at the time of testing.

Potential actions to be taken to meet these criteria are, from least to most expensive:
1) straight compaction of existing soils, 2) amendment and "churning" of soils to a recommended depth followed by compaction of existing soils, 3) removal and replacement of defective soils to recommended depths.
Project engineer should reserve a contingency budget amount to anticipate some replacement of deficient soils. If soils are deficient throughout the site, drilled piers may extend further into the ground than anticipated. It is recommended that a reserve of an additional 20% of the estimated cost of drilled piers, be held against the cost of correcting unexpected soils conditions. If not used, the amount can revert to a general building contingency.

Rocky conditions are another category of deficiency in that drilled piers must find stable stone to rest upon if piers are not designed to resist loads via the friction of the entire surface area of the pier. Stone layers of uncertain thickness must be removed. A unit price per cubic yard for stone removal should be set at the beginning of the project. Soils testing cannot pinpoint all areas of unacceptable stone that would impede drilled piers. Rock removal is therefore by nature an unknown quantity. The best the engineer can do is anticipate the potential expense based on soils testing report and size the contingency fund accordingly. For any project of large scale, "getting out of the ground" is the most potentially trying part of the process. Awareness of the problems involved in any project, will help reduce after the fact finger-pointing.

Parking: It is difficult to determine the number of parking spaces required for a PFF. Based on the American College of Sports Medicine's "Health/Fitness Facility Standards and Guidelines", for initial parking calculations, assume 1 parking space for every 300 gross square feet of facility. This will provide adequate parking for all staff and approximately 60% of the maximum facility participants. However, many factors may result in the adjustment of this number of parking spaces, either up or down. A parking needs survey needs to be conducted to determine a more accurate need for parking, and the number of parking spaces provided adjusted accordingly. This survey needs to consider the following aspects at a minimum:

1. Current parking available in close proximity to the PFF.
2. The number of spectators that can be accommodated in the gymnasium.
3. Proximity of the PFF to troop housing.

4. Availability and use of public transportation.
5. The type of unit (administrative vs. training, etc.)
6. The amount of shift work.

Parking shall comply with ABA and Installation requirements. Vehicular access is required to the Mechanical Room and the Storage Room serving the Fitness Module at a minimum.

B. General Systems Criteria

HVAC: Outside mechanical heating and cooling is not recommended. Air movement should be controlled with use of a vestibule / airlock with two sets of entry doors

Mechanical System Noise Control: Noise from the building services should not interfere with the usage of the space. Noise criteria (NC) are a generally accepted, single number standard to determine what amount of sound can exist in a space and still allow full usage. The NC standards are subjective criteria but derived from multiple signal curves calculated along the entire audible range. The NC measure mechanical noise, and more specialized criteria for dampening specific sound frequencies require further engineering. NC standards simply establish how much sound can be contributed to a space before it becomes annoying and no longer falls within the accepted NC class for that usage.

To achieve the criteria at any level, follow these general guidelines: Provide mass in the walls around mechanical equipment spaces. Recommend concrete block masonry be used, whenever possible.

All ductwork shall sheet metal and be constructed for laminar airflow, in accordance with SMACNA guidelines. Minimum 2” thick insulation in all large ductwork, plenums, and fan casings. 1” minimum thickness elsewhere. Liner shall be an erosion resistant glass fiber duct lining. Minimum density should be 2.0 pcf.

Large ducts over 60” shall be subdivided into chambers with metal septums to avoid rumbling (oil canning) of the duct.

Flex duct is suitable for branch ductwork only. Flex duct leading to diffusers or grilles should be at least 5 feet in length and have one 90 degree bend before reaching the diffuser.

Select air handling units to minimize noise generation. Acoustically isolated enclosures and floor supports are common. (Even a lined fan housing can achieve significant reductions of 8 to 10 db in noise level over the system.) Manufacturers of sound isolated pre-engineered housings must provide guarantees that the internal isolation is free from short circuiting.

Avoid locating roof top units RTU’s directly overhead or horizontally adjacent to noise sensitive spaces. Recommend locating RTU’s only over support spaces such as storage rooms or rest rooms. When located on roofs, provide concrete curbs and sound isolating spring cushions. Roof structure shall be designed to resist static deflection below .025” under dead load and dynamic deflection under unit operation.

Avoid direct metal to metal contact between RTU and ducts by utilizing neoprene or canvas duct connectors.

Rotating variable speed drives must be designed to prohibit sustained rotating speeds of less than 400 rpm.

All pumps require flexible connections for all attached piping and conduit.

Airflow velocity shall be held to the criteria established for the particular NC standards. Refer to NC criteria set for each module. (Assumes 1" duct liner and ducted return) All values in feet per minute (FPM)

Lobby:	NC 30 to 35	840 to 1020	Main Supply 460 to 540 Branch w/ 5' runout
Gyms:	NC 30 to 35	1020 to 1200	540 to 640
Fitness:	NC 30 to 35	1020 to 1200	540 to 640

Utilize low velocity and pressure air distribution system to prevent airflow noise at diffusers. Generally the closer the diffuser to the occupants, the greater the NC reduction *at the diffuser* below the ambient noise level expected for the usage. NC reductions of 8 NC (where diffusers are 12' or less away) to only 3 NC (where diffusers are 20' or more away) are recommended.

Initial duct system design shall plan for medium pressure drop silencers. Silencers shall be located about 3 duct diameters from fan housings.

Fan powered terminals or variable air volume (VAV) boxes shall not be located directly over noise sensitive spaces (NC 35 or less). Volume dampers shall not be located at the diffusers but back at the takeoff point of the branch duct. Recommend locating no closer than 10' from discharge point, with one 90 degree bend between dampers and diffusers.

Avoid using perforated face diffusers, double vane grilles and registers of any kind.

[Each value to be inserted under Acoustical Performance for their respective modules]

Lobbies:	NC-30-35
Gymnasium:	NC-30 to 35
Fitness:	NC-30 to 35
Racquetball	NC-40
Sauna	NC-30

C. General Construction and Design Criteria

Data and design information for each module follows.

General

In addition to this document, compliance with UFC 4-740-02, Fitness Centers, is required. Where the information in this document conflicts with the UFC, this document takes precedence.

PROGRAM AREAS:

Refer to the table at the end of the Army Standard for Physical Fitness Facilities for the square footage for each of the functional areas of a Physical Fitness Facility (PFF).

RESTROOMS:

Restrooms shall be provided on each level of the PFF to accommodate staff and users.

CEILING REQUIREMENTS:

Where acoustical lay-in ceilings are provided, the following recommendations apply:

Surface light reflectance: No less than 0.80. Lighting placement and lamping types shall be considered when designing the ceiling. Increase lighting output with off-white colors and/or panels with not less than 0.80 light reflectance.

Sound absorption for acoustical panels: No less than .55NRC

Overstock: Provide 2% for future replacement.

WALL MATERIALS:

Walls through out the Physical Fitness Facility shall be extremely durable and impact resistant. Use bullnose CMU corner units at all outside corners. On gypsum board walls, use corner protectors on outside corners in high traffic areas, or where the potential for impact is significant.

WALL FINISHES:

Where paint is used, paint shall be water based epoxy, semi-gloss finish. Apply one coat compatible primer with two finish coats of 5 to 6 mils DFT.

Surface light reflectance: No less than 0.50. Lighting placement and lamping types shall be considered when designing the walls. Increase lighting output with light colors and/or panels with not less than 0.50 light reflectance.

Ferrous metals (window and door frames): water based epoxy. Apply one coat primer compatible with finish coat, and as barrier coat to factory primer. Two finish coats of 5 to 6 mils DFT.

FLOOR FINISHES:

VCT is not allowed in the PFF unless specifically allowed in this document.

Surface light reflectance: No less than 0.20. Lighting placement and lamping types shall be considered when designing the floor. Increase lighting output with off-white colors and/or textures with not less than 0.20 light reflectance.

OPTIONS:

Consider using electronic locks, with codes established by the patron, on lockers.

In addition, consider providing lockable cubbies, similar to those shown below, where cubbies are required. Coordinate with the users for their preference.

FITNESS MODULE (Cardio, Circuit, and Free Weights)

FUNCTION/DESCRIPTION:

Dedicated area providing space for three separate functions within the Fitness Module (Cardiovascular (Cardio), Circuit (Selectorized), and Free Weights). Cardiovascular: training equipment such as treadmills, stationary bicycles, stair climbers, ellipticals, etc. Free Weight: free weight and plate loaded equipment, benches, and storage racks. Circuit: equipment with pin selected weights.

Because participants have different personal requirements for the environment in which they work out, the cardiovascular area shall be divided into at least 2 different areas to provide different opportunities.

The circuit area and free weights must be collocated in the same area. In addition, at least 50% of the cardio area shall be collocated with the circuit and free-weights. The rest of the cardio area shall be in a different area(s) of the facility. Options for the rest of the cardio requirement include a balcony overlooking other activity areas, nooks with views to the outside or other activity areas, an area close to the entrance to the jogging track, etc. A cardio theater shall be provided in at least one of the cardio areas. Cardio theaters, open ceilings, color and lighting will all help to draw users into the space.

Also within this area shall be an open space for stretching, along with an enclosed office type area for fitness assessments.

ESSENTIAL DESIGN REQUIREMENTS:

- Free weight area must be visually and directly physically accessible from the control desk to ensure staff can monitor the activity in the free weight area. There are no exceptions to this requirement.
- For safety reasons, primarily indirect lighting (minimum 70% indirect) is required in the free weight area, as a minimum, so that users are not looking directly into overhead lighting while lifting weights.
- Approximately 50% of the Cardiovascular area must be contiguous with the Circuit Area and the Free Weight area. The installation may desire a visual/acoustical separation between the free weights and the other functions. The remaining portion of the Cardiovascular area shall be located elsewhere throughout the facility.
- Mirrors are required in the free weight and circuit areas as a minimum.

DIRECT ADJACENCIES:

- For safety reasons, the free weight area must be visually and directly physically accessible from the control desk. The free weight area has the highest potential for injury, and staff at the control desk must be able to see and to respond to any incident or unsafe activity within the space. Separation between the free weight area and the control desk by walls, other equipment, or major circulation is detrimental to complying with this requirement.
- A direct adjacency to the lobby and open circulation will accommodate supervision from the control area, and allow this space to become a major focal point.

- The Fitness Module Storage/Equipment Repair area shall be adjacent to and directly accessible to the Fitness Module. This storage/repair area must also have exterior access for transfer of fitness equipment. Doors shall be minimum of 8' wide to facilitate the moving of equipment.
- Other key adjacencies for this function include Control Area and Locker Rooms.

CEILING HEIGHT:

Minimum of 12'-0" ceiling height with 14'-0" preferred. This clear height is to the lowest element. This becomes especially important where the structure is left exposed, thereby exposing pipes, ducts, conduit, structure, etc. It is also strongly recommended that at least a portion of this space be two-story in height.

CEILING FINISHES:

In lower spaces, provide ceilings of highly light reflective and sound absorbent materials. Consider 2'x 2' lay-in, wet-formed mineral fiber acoustical panels, on standard "T" shaped pre-finished metallic grid system. 15/16" or 9/16" wide "T" grids are preferred. Non-directional fissured face designs are preferred to reduce installation cost and waste. Tegular (routed edges) tiles are preferred. In taller spaces, exposed structure is acceptable provided acoustical treatment is provided in the space.

WALLS:

Provide ¼" tempered mirror glass with 15 year warranty silver coating on at least half of two perpendicular walls in free weight and circuit area. Mount bottom of mirrors at 18" above the finish floor, to a height that provides full body visibility or align with door head height. Provide a solid molding (solid rubber, wood, metal) at the bottom of the mirrors to help ensure weight plates leaned up against the wall will not come in contact with the mirror. Molding shall extend ¾" – 1 ½" from wall at a distance of no more than ¾" below the mirror (1 ½" half-round mounted at the bottom of the mirrors would work, as would a piece of 1x or 2x wood mounted at the bottom of the mirrors).

Wall Base: Extend the flooring material (see below) up the face of wall to approximately 18" a.f.f. and cap with a finished hardwood wainscot trim or other molding as defined in "Walls" paragraph above. Above average physical abuse to the lower half of walls is typical to Fitness modules. Rubber wainscot resists foot scuffs, "tipping" of free weights against walls, and impact from equipment. To optimize adhesion, the paint finish must be deleted directly behind rubber wainscots. Utilize the molding to conceal and secure the top edge of this material. Other materials may be used between the floor and the molding as long as equal or better protection is provided to the wall to greatly reduce the damage caused by free weights, shoes, etc.

Some portion of the wall must also be glazing to the exterior. Around the cardio and circuit there must be clear glazing. Translucent glazing may be used in all areas and may supplement the clear glazing mentioned above.

FLOORING:

Rubberized flooring:

Recommended for use throughout the Fitness Module, to include Free-weights, Circuit, and Cardio.

Critical item: It is recommended to perform a moisture test in order to measure retained and film forming moisture at the surface of the slab. The directly adhered rubber products recommended herein have maximum moisture content standards that cannot be exceeded prior to application of the flooring and over the entire warranty period of the floor. In deficient substrates, additional floor treatment may be necessary to meet these moisture constraints. It is recommended that the selected flooring manufacturer make recommendations suitable to their products and warranty requirements.

Type: Granulized new rubber, granulized EPDM, or both used in combination with polyurethane binders. Directly adhered. Recycled rubber not acceptable due to potential of off-gassing. Tiles are not recommended due to difficulty of cleaning joints. Surface shall be non-porous with as few joints as possible, and all joints shall be tight, and preferably sealed, such that no liquid may enter into the joint.

Finish: Due to color variations inherent to the products, single, solid color floors are not recommended, instead a speckled finish is preferred. Material shall be a minimum of 3/8" thick. Greater thicknesses are available and may be used when above peak-time activity is typical to the facility. Note: Flooring in excess of 3/8" may require special transitions to avoid access conflicts with the Americans with Disabilities Act.

Material Weight: Density no less than 65 lbs./cu.ft.

Durability: Shore A hardness of no less than 60.

Transitions: If required, use solid rubber transition strips sized to match the heights of the dissimilar materials.

PLUMBING:

Water fountains: Required within this module. Provide one unit minimum in the Fitness Module of the X-Small, Small, and Medium PFF. Provide a minimum of two units in facilities larger than a Medium. A unit consists of either two water fountains in a single unit combination, or two separate units side by side to allow for one unit to be mounted at ADA height. Electrically cooled unit required. Water fountains shall be fed from dedicated 120V, 20A circuits. It is recommended that water fountains be placed outside normal traffic paths and recessed into the wall plane if possible.

MECHANICAL (HVAC):

Mechanical heating, ventilation, and humidity control of the module is mandatory. Shall exceed the current ASHRAE requirements.

Operating range: System able to maintain 68 - 74 degrees (F) year-round at 50% relative humidity or less. Shall meet or exceed ASHRAE 62 for the ventilation rate.

Air movement / control: Fully ducted supply. Natural (non-mechanically driven) ventilation is not allowed. Ceiling fans shall be provided throughout. Maximum 144 sq. ft. floor area served per fan. Independent wall mounted or infrared remote controls. It is not recommended that fans be controlled in groups.

Temperature controls: Independent to room, solid state and programmable. Ability to control peak and off-peak temperatures with 24 hour or one-touch setback programming recommended.

LIGHTING

Indirect (80% minimum) direct (20% maximum) lighting is required in the free weight area. If necessary, supplement with other lighting to overcome shadows from obstructions or to highlight certain areas. However, no direct down lighting is to be provided where the free-weight area is located.

Lighting control: Use of occupancy sensors to activate lighting by motion detection, is recommended. In addition, grouping of lights so that a portion of the lights may be turned off, especially if natural daylighting is provided, is required. Independent slide or toggle controls may also be used to control fixtures by groups. Grouping needs and/or preferences will be determined by circuit capacity.

Light level: 40 footcandles at the floor, minimum.

Additional contribution of natural light via windows, clerestories, and/or skylights to utilize daylighting and daylight harvesting within the space is highly recommended. Again, care must be taken to avoid glare and direct illumination over the free weight area.

POWER

Convenience and specialized outlets required.

Convenience power (general cleaning and service): Provide receptacles rated 125V AC, 20A. Space receptacles at 10'-0" o.c. minimum around the perimeter of the room and at freestanding columns located more than 10'-0" from the walls or the nearest outlet.

Specialized (equipment) power: 120V, 20A dedicated circuits, unless equipment manufacturer's data indicates a larger circuit is required for the treadmills. Provide one per piece of equipment, minimum. In addition, convenience outlets must be provided for all of the cardio equipment to support built-in cardio theaters and other personal electrical requirements. In addition, additional electrical power may be required to support the fitness data systems, such as FitLinxx. Use floor mounted, dual or quad outlet, recessed boxes as required to meet equipment count. Solid brass cover plates, flush mounted. Power requirements in this Technical Criteria manual are for CONUS installations. OCONUS power requirements should be addressed on a location by location basis.

Critical item: Floor boxes must be mounted above the substrate at a height equal to the thickness of the finish floor system. (i.e. 3/8" for rubber), including the thickness of the box cover plate. Cover plates with flip-up or hinged lids are not recommended. Where outlets are in use, cover plates should be removable or lay flush so as to not contribute to a tripping hazard.

Critical item: Early determination of equipment purchase and a preliminary equipment layout is highly recommended in order to determine in-floor power needs and box locations. The fitness module should be designed to the equipment whenever possible.

Spacing (preliminary): 8'-0" on center, each way.

TECHNOLOGY/AV:

Data, sound and video required. Provide as required for Cardio Theater and personal fitness tracking systems. Cardio Theater may be mounted to a wall, suspended from ceiling, or supported by posts from the floor. Consult with the user when determining cardio theater requirements.

Data outlets: Dedicated and located at points to be determined by project engineer as follows: Data outlets at cardiovascular equipment floor boxes to accommodate computerized equipment input / outputs, as occurs. 1 data port per each power outlet provided. In addition, data outlets are required in the cardio and circuit areas to support the fitness data systems, such as FitLinxx.

Data ports: required for workstations used to track and/or monitor fitness performance. 1 workstations minimum per 100 patrons / hourly at peak time. Centralized location. Data port required for card access device to monitor access security and peak occupancy. Data ports as required around the perimeter of room for mobile monitoring workstations. 1 data port per convenience outlet location.

SOUND:

Sound system: Flush recessed ceiling speakers, 25 watt minimum output rating, capable of reproducing the entire audible range for (CD quality) music, minimum.

Sound sources: Commercial amplifier, filtered for EM interference.

- Public Address / microphone station
- Cassette / CD combination unit
- Television monitors.
- Optional: VHS or DVD playback device.

Locate sound equipment in a centralized control location. Typically provide a lockable, glass door vertical rack for mounting the A/V equipment. Sound amplification requirements are determined by the combined sound source output and the desired reproduction sound level minus the acoustical performance rating of the space. See "acoustical performance" guidelines below.

ACOUSTICAL PERFORMANCE:

Acoustic performance: No extraordinary sound reduction treatments are required. In order to analyze the potential need for additional sound reduction, the following criteria apply: Optimum peak sound level is 40 to 50 db constant (at 1000hz minimum), during peak operation times. - PNC (Preferred Noise Criteria) Curve 55 to 60. Recommended average

coefficient of sound absorption of all materials in combination is no less than .50. ("Live" acoustics are desirable). Acoustical ceilings that follow these guidelines are mandatory. Sound absorption via ceiling materials shall be no more than 5db of the total desired reduction. Provide acoustic wall panel material where needed to bring noise levels and reverberation down to acceptable levels.

WINDOWS AND DOORS:

Provide views into adjacent spaces and/or public ways. Aluminum or hollow metal frames are recommended. Tempered glass should be typical to the module.

FIXED EQUIPMENT:

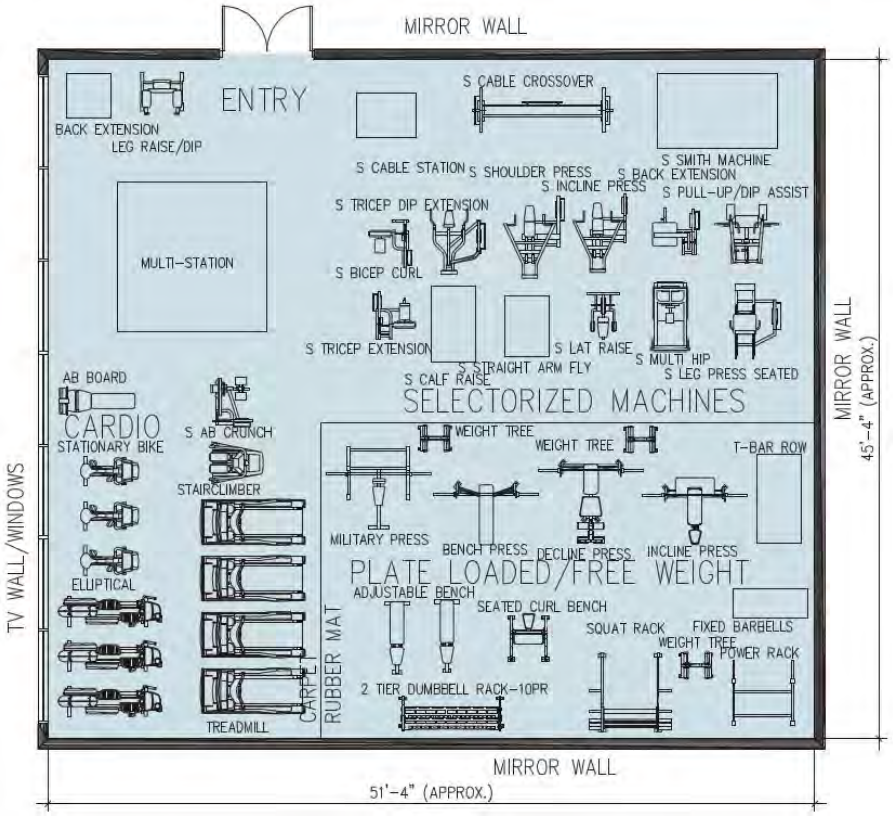
Cubbies: Provide storage cubicles (minimum quantity based on ½ of the number of pieces of equipment) within the room for personal items. These may either be open, or may be provided with a lockable door. If doors are provided, provide an electronic combination locking mechanism for each door that allows the user to set their own combination. See “Architectural Casework” in the Exercise Module for more details.

ARRANGEMENT:

Provided below are diagrams for different sizes of the PFF that illustrate all of the equipment provided within the required space. As mentioned earlier in this document, a portion of the Cardio will be located elsewhere throughout the building. The equipment and space shown is the minimum to be provided. Other arrangements are allowed as long as all criteria is met. The diagrams do NOT indicate the relationship to the Control Desk, which MUST be physically and visually accessible to the Free Weight area.

Following the diagrams is the listing of equipment that will be provided as the standard for each size of facility.

X-Small:



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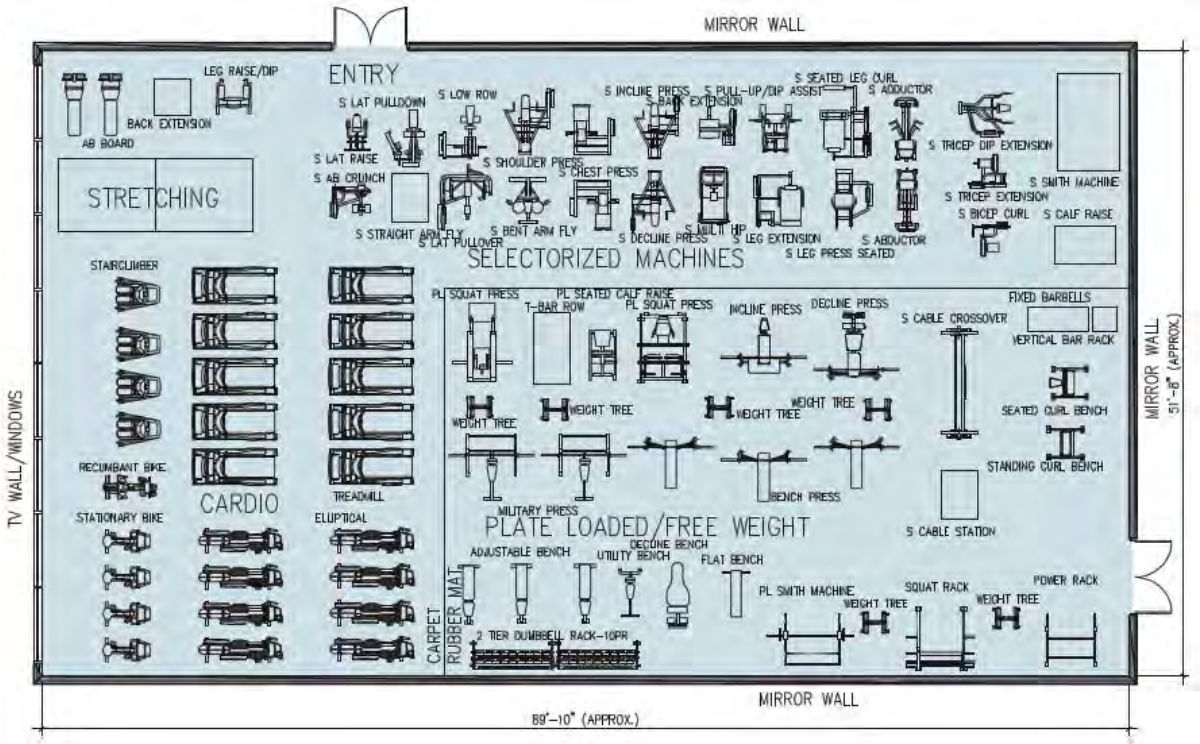

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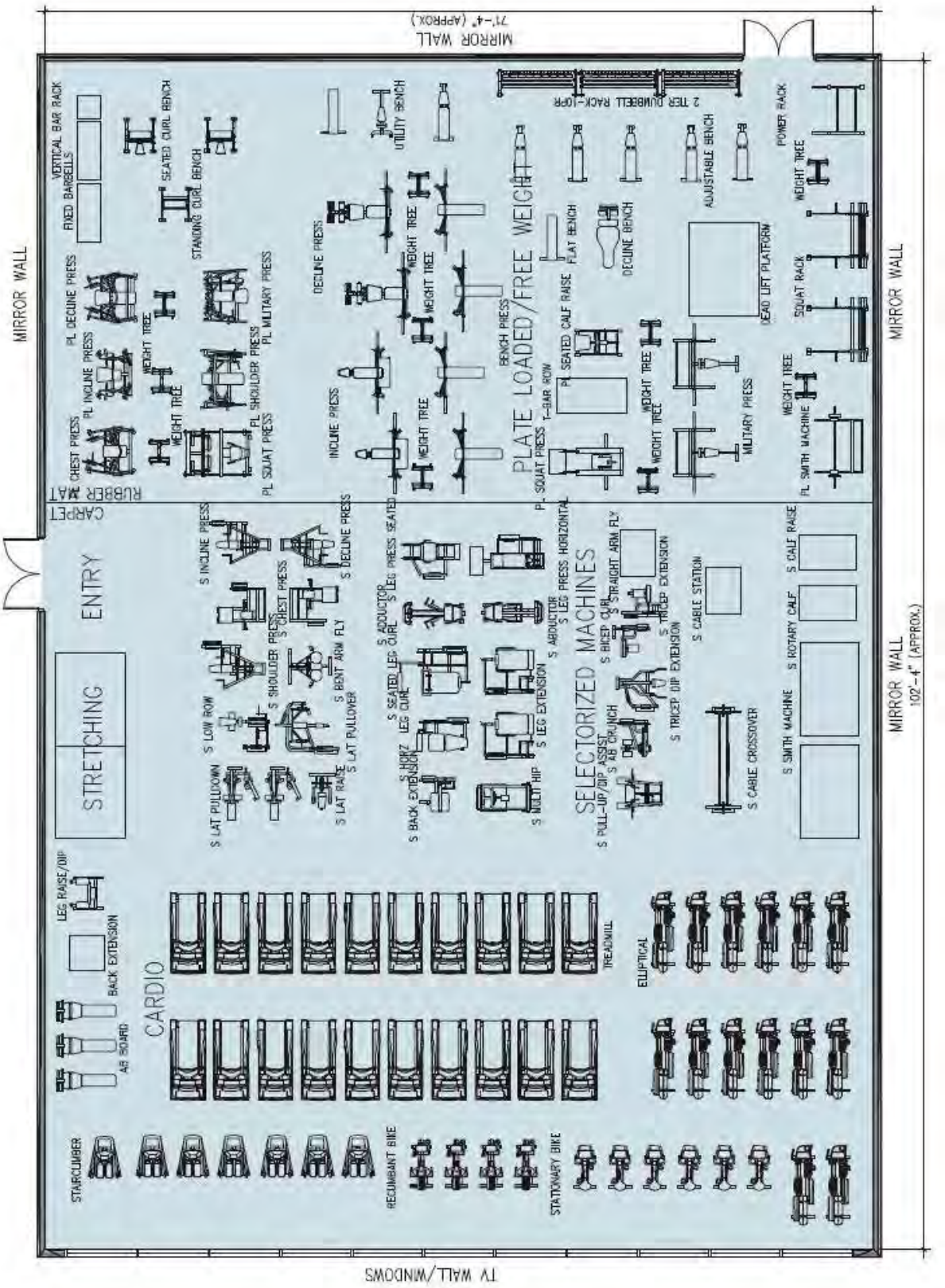
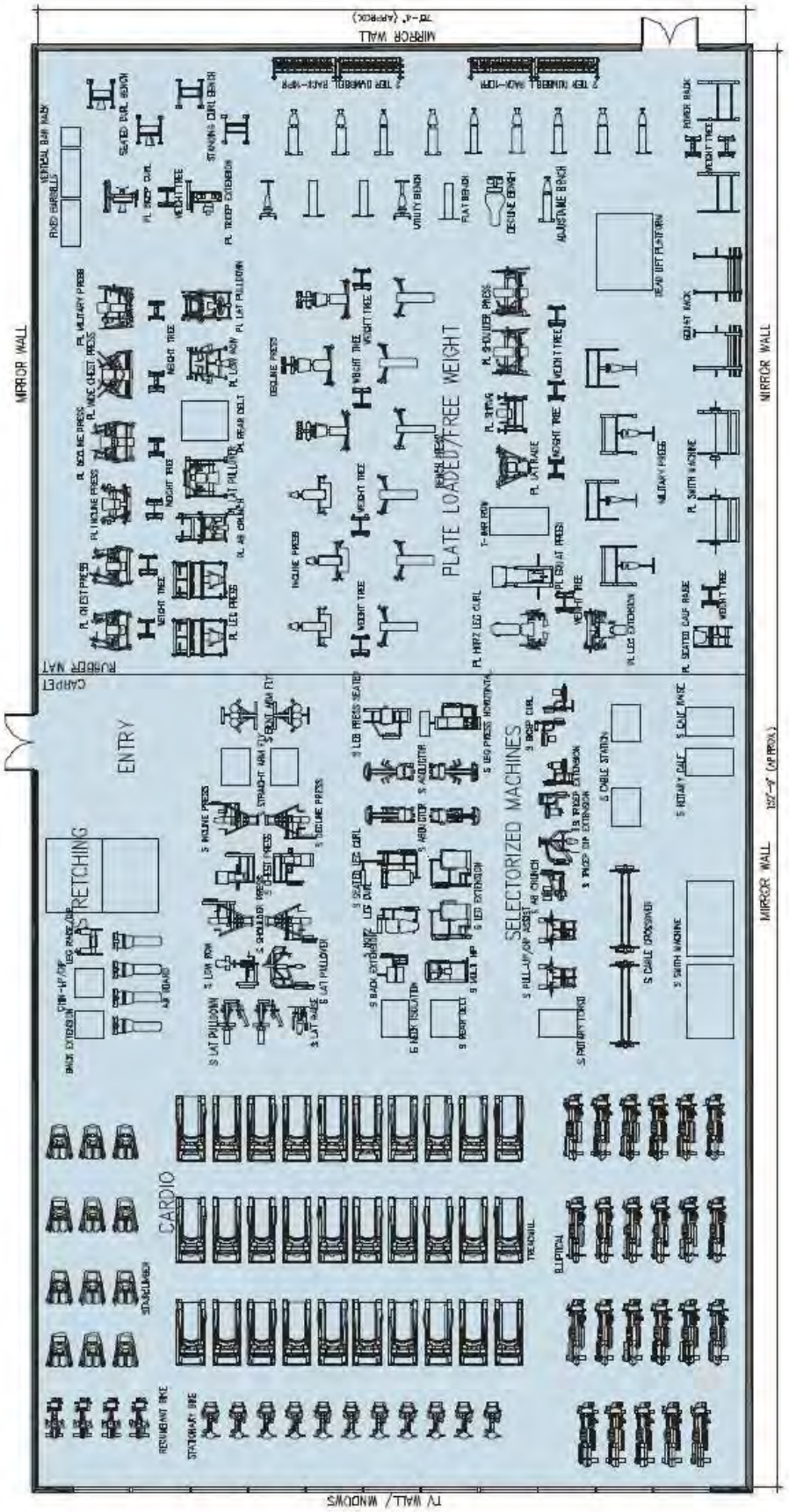

MIRROR WALL
71'-4" (APPROX.)
MIRROR WALL
102'-4" (APPROX.)
TV WALL/WINDOWS
RUBBER MAT
CARPET
ENTRY
STRETCHING
CARDIO
PLATE LOADED/FREE WEIGHT
SELECTORIZED MACHINES
VERTICAL BAR RACK
FIXED BARBELLS
SEATED CURL BENCH
STANDING CURL BENCH
UTILITY BENCH
2 TIER DUMBBELL RACK-10PR
POWER RACK
ADJUSTABLE BENCH
DEAD LIFT PLATFORM
SQUAT RACK
WEIGHT TREE
PL SMITH MACHINE
MILITARY PRESS
PL SEATED CALF RAISE
T-BAR ROW
PL SQUAT PRESS
BENCH PRESS
FLAT BENCH
DECLINE BENCH
DECLINE PRESS
INCLINE PRESS
PL MILITARY PRESS
PL SHOULDER PRESS
PL SQUAT PRESS
PL DECLINE PRESS
PL INCLINE PRESS
CHEST PRESS
S INCLINE PRESS
S DECLINE PRESS
S CHEST PRESS
S SHOULDER PRESS
S BENT ARM FLY
S LAT PULLOVER
S LAT RAISE
S LAT PULLDOWN
S LOW ROW
S ADDUCTOR
S LEG PRESS SEATED
S LEG PRESS HORIZONTAL
S ABDUCTOR
S SEATED LEG CURL
S LEG CURL
S HORZ LEG EXTENSION
S BACK EXTENSION
S MULTI HIP
S LEG EXTENSION
S PULL-UP/DIP ASSIST
S AB CRUNCH
S BICEP CURL
S STRAIGHT ARM FLY
S TRICEP EXTENSION
S TRICEP DIP EXTENSION
S CABLE STATION
S CABLE CROSSOVER
S SMITH MACHINE
S ROTARY CALF
S CALF RAISE
LEG RAISE/DIP
BACK EXTENSION
AB BOARD
TREADMILL
ELLIPTICAL
STAIRCLIMBER
RECUMBANT BIKE
STATIONARY BIKE

Large:


MIRROR WALL
PLATE LOADED/FREE WEIGHT
SELECTORIZED MACHINES
CARDIO
STRETCHING
ENTRY
MIRROR WALL
TV WALL / WINDOWS

Cardiovascular Equipment

Commercial Grade Electronically Controlled	MODULE SIZE X-SMALL	SMALL	MEDIUM	LARGE	INCREMENT
Treadmill	4	10	20	30	16
Elliptical Trainer	3	8	14	23	10
Cross Trainer/Hiker	A	A	A	A	A
Stationary Bike (Upright)	3	5	10	15	8
Stationary Bike (Recumbent)	B	B	B	B	B
Stairclimber/Stepper	1	4	7	12	6
Rowing Machine	0	0	0	0	0
Skier	0	0	0	0	0
Kayak Machine	0	0	0	0	0
Skate Machine	0	0	0	0	0
Subtotal	**11**	**27**	**51**	**80**	**40**

Strength Equipment

Commercial Grade Selectorized/Stack Weight Machines

	X-SMALL	SMALL	MEDIUM	LARGE	INCREMENT	
	MODULE SIZE					
Multi-Station (Ex. 6 stations)	1	0	0	0	0	
Leg Extension	C	1	2	2	1	
Leg Curl (Seated)	C	1	1	1	1	
Leg Curl (Horizontal/Prone)	D	D	1	1	D	
Leg Curl (Standing/Kneeling)	D	D	D	D	D	
Leg Press (Seated/45deg)	1	1	1	1	1	
Leg Press (Horizontal/Supine)	D	D	1	1	D	
Leg Press (Lunge)	0	0	D	D	D	
Calf Raise (Seated)	1	1	1	1	1	
Calf Raise (Standing/Donkey)	D	D	D	D	D	
Calf Raise (45deg)	D	D	D	D	D	
Rotary Calf	D	D	1	1	D	
Abductor	0	1	1	2	0.5	K
Adductor	0	1	1	2	0.5	K
Multi-Hip Machine (Rotary Hip)	1	1	1	1	0.5	K
Hip Extension	0	0	0	0	D	
Glute Isolation	0	0	0	0	D	
Bent Arm/Pectoral Fly	C	1	1	2	0.5	K
Straight Arm Fly/Rear Delt	1	1	1	2	0.5	K
Chest Press (Seated)	C	2	2	2	1	
Chest Press (Horizontal/Supine)	D	D	D	D	D	
Incline Press	1	1	1	1	0.5	K
Decline Press	0	1	1	1	0.5	K
Lat Pulldown	C	1	2	2	0.5	K
Lat Pullover	0	1	1	1	0.5	K
Low Row	C	1	1	1	0.5	K
High Row	0	0	0	0	D	
Rear Deltoid (Seated)	0	0	0	1	0.5	K
Rear Deltoid (Horizontal/Prone)	0	0	0	D	0	
Back Extension	1	1	1	1	1	
Lateral/Deltoid Raise	1	1	1	1	1	
Shoulder/Overhead Press	C	1	1	2	1	
Bicep Curl	1	1	1	2	1	
Tricep Extension	1	1	1	2	1	
Tricep Dip Extension (Press)	1	1	1	1	0.5	K
Wrist Curl	0	0	0	0	0	
Neck Isolation	0	0	0	1	0	
Smith Machine (H)	1	1	2	2	1	
Cable Crossover w/ Chin-up Bar	1	1	1	2	1	
Cable Station (2 sided)	1	1	1	2	0.5	K
Ab Crunch	1	1	1	1	0.5	K
Rotary Torso	0	0	0	1	0.5	K
Pull-up/Dip Assist	1	1	1	2	0.5	K
Subtotal	**16**	**27**	**33**	**46**	**20**	

Strength Equipment

Commercial Grade Plate Loaded Machines

	MODULE SIZE					
	X-SMALL	SMALL	MEDIUM	LARGE	INCREMENT	
Leg Extension	0	0	0	1	0.5	K
Leg Curl (Seated)	0	0	0	1	0.5	K
Leg Curl (Horizontal/Prone) (F)	0	0	0	D	D	
Leg Curl (Standing/Kneeling)	0	0	0	D	D	
Squat Press (Seated/45deg/Hip) (F)	0	1	1	2	1	
Squat Press (Vertical/Hack) (F)	0	1	1	1	1	
Squat Press (Horizontal/Supine) (F)	0	D	D	D	D	
Squat Press (Jammer/Ground Based) (F)	0	0	0	D	D	
Calf Raise (Seated)	0	1	1	1	1	
Calf Raise (Standing)	0	D	D	D	D	
Calf Raise (45deg)	0	D	D	D	D	
Rotary Calf (F)	0	D	D	D	D	
Tibia Dorsi Flexion	0	0	0	0	D	
Abduction (F)	0	0	0	0	0	
Adduction (F)	0	0	0	0	0	
Glute Isolation	0	0	0	0	0	
Chest Press (Seated) (F)	0	0	1	2	1	
Chest Press (Horizontal/Supine) (F)	0	0	D	D	D	
Wide Chest Press (F)	0	0	0	1	0.5	K
Incline Press (F)	0	0	1	1	1	
Decline Press (F)	0	0	1	1	1	
Military/Shoulder Press (F)	0	0	1	1	0.5	K
Lat Pulldown (F)	0	0	0	1	1	
Lat Pullover (F)	0	0	0	1	0.5	K
Low Row (F)	0	0	0	1	0.5	K
High Row (F)	0	0	0	0	D	
Rear Deltoid (Seated) (F)	0	0	0	1	0.5	K
Rear Deltoid (Horizontal/Prone) (F)	0	0	0	D	D	
Back Extension	0	0	0	0	0	
T-Bar/Lever Row (J)	1	1	1	1	0.5	K
Lateral/Deltoid Raise (F)	0	0	0	1	0.5	K
Shoulder Press (F)	0	0	1	2	0.5	K
Shrug (F)	0	0	0	1	0.5	K
Bicep Curl	0	0	0	1	1	
Tricep Extension	0	0	0	1	1	
Tricep Dip Extension (F)	0	0	0	0	D	
Wrist Curl	0	0	0	0	0.5	K
Hand Grip Isolation	0	0	0	0	0.5	K
Neck Isolation (F)	0	0	0	0	0	
Smith Machine (F)	0	1	1	2	0	
Ab Crunch	0	0	0	1	0.5	K
Rotary Torso	0	0	0	0	0	
Subtotal	**1**	**5**	**10**	**26**	**16**	

	X-SMALL	SMALL	MEDIUM	LARGE	INCREMENT
	MODULE SIZE				
Strength Equipment					
Commercial Grade Free Weight Equipment/Benches					
Dumbbell Sets (10pr)	G	G	G	G	G
Dumbbell Rack-1 Tier/5pr	0	0	0	0	0
Dumbbell Rack-2 Tier/10pr	1	2	3	4	2
Fixed Barbell Set (10 Assorted)	1	1	2	2	1
Fixed Barbell Rack	G	G	G	G	G
Weights (Assorted 2.5#-45#)	G	G	G	G	G
Weight Tree/Rack	G	G	G	G	G
Bars (Assorted/Loose)	G	G	G	G	G
Bar Rack	G	G	G	G	G
Benches (Assorted)	2	6	10	16	9
Squat Rack (F) & Bar	1	1	2	2	1
Bench Press (F) & Bar	1	3	4	6	4
Incline Press (F) & Bar	1	1	2	3	1
Decline Press (F) & Bar	1	1	2	3	1
Military/Shoulder Press (F) & Bar	1	2	2	4	1
Dead Lift Platform/Rack (F) & Bar	0	0	1	1	0.5 K
Power Cage/Rack (F) w/ Bar	1	1	1	2	1
Curl Bench (Seated)	1	1	2	2	1
Curl Bench (Standing)	0	1	1	2	D
Leg Raise/Dip	1	1	1	1	1
Chin-Up/Dip	0	0	0	1	0.5 K
Back Extension	1	1	1	1	1
Abdominal Board	1	2	3	4	2
Subtotal	**14**	**24**	**37**	**54**	**27**

Equipment Summary

Cardiovascular Equipment					
Electronically Controlled	11	27	51	80	40
Subtotal	11	27	51	80	40
Strength Equipment					
Selectorized/Stack Weight Equipment	16	27	33	46	20
Plate Loaded Equipment	1	5	10	26	16
Free Weight Equipment/Benches	14	24	37	54	27
Subtotal	31	56	80	126	63
TOTAL	**42**	**83**	**131**	**206**	**103**

Notes:

(A) Cross Trainer may be substituted for Elliptical Trainer.

(B) Recumbent may be substituted for upright configuration.

(C) Inclusive in Multi-Station machine as an example.

(D) Alternate configurations may be substituted for typical exercise configuration (Ex. Horizontal, Standing, Kneeling, etc.).

(E) Dip extension may be substituted for extension configuration.

(F) Integral weight storage consideration to reduce Weight Tree & space requirements.

(G) Actual count dependant on station count & requirements.

(H) Plate Loaded Smith Machine may be substituted for Selectorized/ Stack Weight Smith Machine

(J) Rear Deltoid may be substituted for T-Bar Row

(K) For ".5" Equipment quantity for "Incremental" Module Size, select a total quantity of pieces that does not exceed the allowance shown in the Subtotal.

EXERCISE MODULE (Large Group Exercise)

FUNCTION/DESCRIPTION:

Classroom(s) to accommodate instructional fitness programs that may include aerobics, martial arts, yoga, step-conditioning, kick boxing, etc. The exercise module shall be one large room that can be divided, through use of a movable wall (not accordion fold partition), into 2 separate group exercise areas. Consider use of an electrically operated wall system. Rooms shall facilitate flexible arrangements for a variety of setups. Equipment setup and tear down time will affect the rollover of exercise modules.

ESSENTIAL DESIGN REQUIREMENTS:

- Storage rooms for convenient access to exercise equipment. The storage room shall be a flow-through design. In other words, the storage room shall be a linear arrangement with adjustable shelves/bins on both sides with a door at each end, so that patrons may enter one end of the room, pick up their equipment, and leave from the other end, without causing a traffic flow problem.

DIRECT ADJACENCIES:

- Storage rooms shall be provided for each side of the group exercise room it the room can be divided.
- Drinking fountain shall be located directly outside of this space if a wood floor is provided. Otherwise, the drinking fountain may be located within the space.

CEILING HEIGHT:

10'-0" minimum.

CEILING FINISHES:

Provide ceilings of highly light reflective and sound absorbent materials. Consider 2'x 2' lay-in, wet-formed mineral fiber acoustical panels, on standard "T" shaped pre-finished metallic grid system. Tegular (routed edges) tiles are preferred.

Accent functional areas or improve aesthetics by the addition of single layer, gypsum board "dropped" soffits or bulkheads on metal studs. Use of dropped soffits allows concealment of lower items (i.e. ceiling fans, structure, or utilities) while allowing the majority of ceiling to be increased in height. Install around perimeters of rooms, or across ceilings in an arrangement of "false beams." Area of solid, sound reflective surfaces should not exceed 15% of the total ceiling area. "Modular" soffit arrangement: Where possible, design and size soffits and bulkheads to allow the use of full acoustical panels in each direction. For non-modular areas, center ceilings by using balanced border widths where panels are cut to fit. Coordinate lighting: With direct lighting (recessed in ceiling) locate bulkheads and acoustical panel arrangements with the optimum lighting locations first, then consider the pattern of the panels and placement of bulkheads. Where soffits exceed 36" in width and/or 12" in depth, consider supplemental lighting in the bottom of the soffit to avoid shadowed areas across the ceiling plane or at upper portions of wall planes.

An open ceiling, exposed to the structure, is also acceptable as long as acoustic panels and/or banners are provided to provide the same level, or better, of acoustical treatment as an acoustical tile ceiling would.

WALLS:

Mirrors: Provide ¼" tempered mirror glass with 15 year warranty silver coating on 50% of at least two perpendicular walls. Mount mirrors with the bottom no more than 12” (8" preferred) above the finish floor to a height that provides full body visibility or align with door head height.

FLOORING:

Aerobic floor: Machine milled and formed solid maple strip flooring that meets or exceeds MFMA (Maple Flooring Manufacturers Association) specification for a "second or better" grade.

Size and construction: 25/32" thick x 2 ¼" width minimum. Provide a floating system with two bonded bi directional plywood backing layers, supported on neoprene cushion pads (3/4" high) and continuous 7/16" to ¾" thick EPDM cushion pad or other approved flooring system which is DIN certified for aerobic use. Floor will have noticeable flex but with firm feel during aerobic activities.

Alternate floor: Synthetic flooring, designated for aerobic classes, may be provided only if the general population served by this facility is primarily active-duty military, and these areas will be used more for martial arts, boxing, etc., with very limited aerobic classes with repetitive impact on the legs and joints.

PLUMBING:

Water fountains: Required within or adjacent to this module, as described above. Provide one unit minimum with any size module. A unit consists of either two water fountains in a single unit combination, or two separate units side by side to allow for one unit to be mounted at ADA height. Electrically cooled unit required. Water fountains shall be fed from dedicated 120V, 20A circuits. It is recommended that water fountains be placed outside normal traffic paths and recessed into the wall plane if possible. Do not install water fountains where wood flooring is located.

MECHANICAL (HVAC):

Mechanical heating, ventilation, and humidity control of the module is mandatory. Shall exceed the current ASHRAE requirements.

Operating range: System able to maintain 66 - 72 degrees (F) year-round at 60% relative humidity or less. Shall meet or exceed ASHRAE 62 for the ventilation rate.

Temperature controls: Independent to room, solid state and programmable. Ability to control peak and off-peak temperatures with 24 hour or one-touch setback programming recommended.

Air movement / control: Fully ducted supply and return. Use spiral duct if existing ceiling is exposed structure. Directional diffusers mounted to spiral duct system shall be engineered for maximum throw and even distribution. Ceiling-mounted diffusers will be standard 2x2 units with directional vanes. Return air may be centralized. Natural (non-mechanically driven) ventilation is not allowed. Provide ceiling fans.

LIGHTING:

When ceilings heights do not allow pendant mounted or suspended lighting, indirect 2 x 2 or 2 x 4 lay-in fluorescent fixtures may be used. Direct 2 x 2 or 2 x 4 lay-in fluorescent fixtures may also be used, but are not recommended due to lower light quality (excessive glare and static light distribution; e.g. causes greater eye fatigue over long periods of time). Lighting shall be switched to allow for different levels of lighting. Natural light via windows may be provided, but direct sun-light and glare must be avoided. Windows providing internal views to other spaces is desirable.

Lighting control: Use of occupancy sensors to activate lighting by motion detection, is recommended. In addition, grouping of lights so that a portion of the lights may be turned off, especially if natural daylighting is provided, is required. Independent slide or toggle controls may also be used to control fixtures by groups. Grouping needs and/or preferences will be determined by circuit capacity. Lighting on each side of the movable wall shall be controlled separately so each side of the room can function independently.

Light level: 40 footcandles at the floor, minimum.

POWER

Convenience outlets required.

TECHNOLOGY/AV:

Provide recessed A/V rack with commercial grade amplifier, or amplifier and input/output control device, with minimum 2 microphone inputs. 400 watt minimum continuous output rating. CD/DVD/MP3 player with remote control. Provide two microphone outlets wired to locations remote from one another within the module for directed activities.

SOUND:

Ceiling mounted speaker for music reproduction. Sound system: Recessed ceiling speakers, 50 watt minimum output rating, capable of reproducing CD quality sound.

ACOUSTICAL PERFORMANCE:

Aerobic activity will require partitions to be sound rated to 53 STC minimum. Where glass walls are used to enhance interior views, front these walls to interior circulation and not into other activity spaces. One exception is the gymnasium. All other sound performance characteristics are comparable to the Fitness Module.

WINDOWS AND DOORS:

Hollow metal interior windows from traffic or lobby areas are recommended. Tempered safety glass is typical where glazing is 18" or closer to the floor. Tempered or laminated

safety glass above that point depends on the potential for impact from adjoining activities. It is recommended tempered glass be used when precise potential cannot be determined. Adding horizontal mullions at 32-36" A.F.F. also reduces risks from casual contact with glazing. Aluminum frames should be used when consistent with the interior design of adjacent spaces.

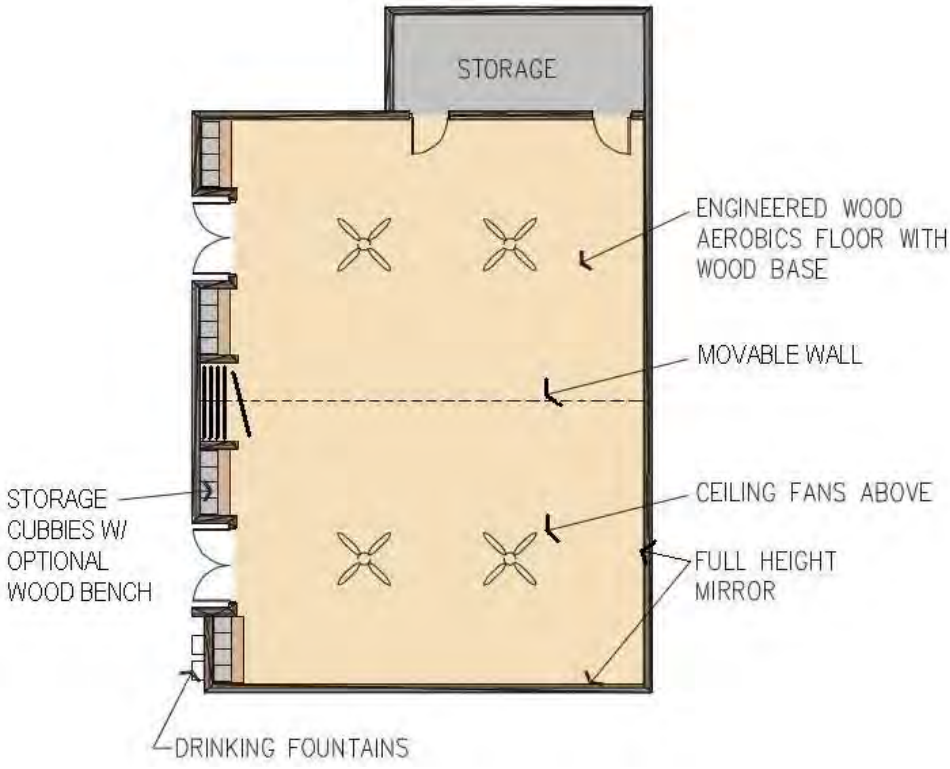
FIXED EQUIPMENT:

Architectural Casework: Provide storage cubicles along one wall of the module for incidental storage during activities: Provide minimum of one cubicle foe 75% of the total number of participants at room's maximum occupant load (based on 50 sq. ft. per person). Cubicle design is generally an open face cube in modular "banks" aligned on one wall to counter top height or vertically with the tallest cubicle 5'-0" above finish floor. Cubicles shall be minimum 14" x 14" (18" x 18" preferred) face opening x minimum 15" deep. Construct cubicles of ½" minimum particle board shell with ½ plywood horizontal shelves. Entire construction veneered with .048 horizontal grade, high pressure plastic laminate. As an alternative, if solid wood or hardwood veneer-core plywood is used throughout, the surfaces may be finished and sealed with a polyurethane, or equal, coating. The coating must be cleanable and able to withstand moisture without degrading. Edge trim of cubicle frames shall be solid hardwood (bonded) or 3 mil PVC edging routed into panel edge. Use of plastic laminate edges is not allowed. If counter height, provide solid surfacing counter top with eased edge front and minimum 1" tall lip where the counter abuts the wall.

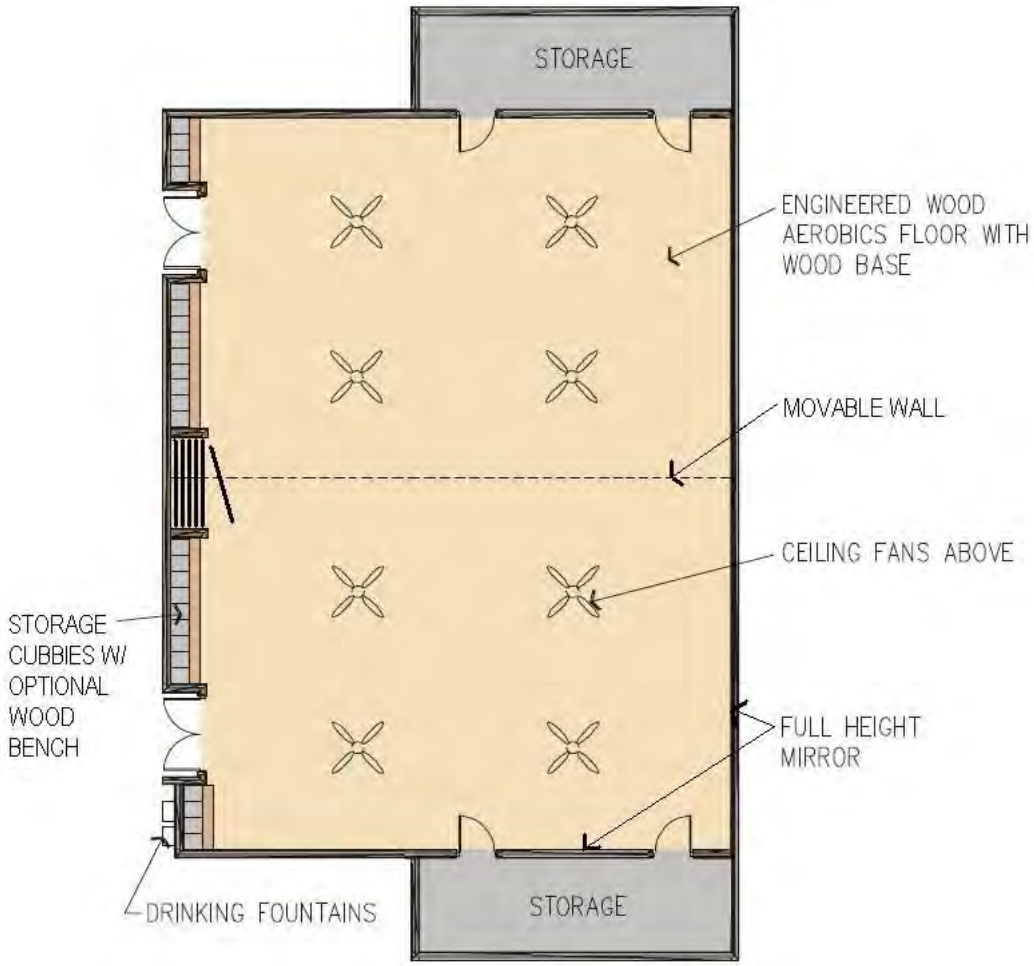
ARRANGEMENT:

Provided below are recommended arrangements for a X-Small and Small facility and for a Medium and Large facility. It is desirable for storage to be provided for both halves of the X-Small and Small facilities provided the space provided in each storage room is adequate to be functional and meet the needs of the user.

X-Small/Small:



Medium/Large:



STRUCTURED ACTIVITY MODULE

FUNCTION/DESCRIPTION:

The Structured Activity Module is discretional space allocated for each facility size to allow the installation to determine what other activities are required at their installation. This space must be designed to accommodate the unique requirements of each activity. Some uses of this space may include a climbing wall, spinning studio, racquetball or squash court(s), permanent combatives room, small group exercise room, increased fitness areas, etc. Other uses could include a Health Assessment area, child care, and concessions area. The installation will determine the required areas during the design process.

RACQUETBALL

ESSENTIAL DESIGN REQUIREMENTS:

- It is preferred that these are located in a visible area, such as off the lobby. Courts shall be provided with full-height glass back walls for spectators. An area shall be provided for spectators. Seating may be accomplished by movable or built-in seating.
- Inside dimensions of Racquetball courts are 20' x 40' x 20' high. Finished assembly size of courts, including wall thicknesses, are approximately 1'-2" larger than interior dimensions.
- Strongly recommend use of panelized racquetball court construction, as opposed to plaster on concrete.
- Racquetball facilities are essentially rooms within a room. Exterior envelope, floor and roof system are assumed to be existing. With regard to special treatment of the building envelope: the floor substrate should follow the same guidelines for the Fitness module whether wood floors for courts or synthetic floors in the adjacent seating / waiting area are under consideration. Floor tolerances and wall tolerances require precise construction in court systems. If space is tight, the exterior walls or interior partitions must be plumb to within ¼" in 10'-0" in the vertical and horizontal planes prior to starting the walls for the courts. Courts construction must also wait until environmental conditions within the building envelope meet recommended minimums and can be maintained during and after construction.

FINISHES:

General: The necessary clear space above the inside height of the Racquetball court must take into account the thickness of the court roof, the height of lighting housings, clearance for ductwork overhead, and the depth of structural elements that are part of the floor/roof assembly above. As a preliminary guideline, allow 2'-0" plus the depth of the structure system above 20'-0" to accommodate these elements.

Material: Pre-formed high density (62 lbs / cu.ft.) resin core racquetball court panels on concealed T- spline system. Prefinished systems are preferred for their reduced life-cycle maintenance. Face design: Smooth. Recommend use of the same panels for the entire ceiling.

Panel Edge design: Flush butt joints with no more than a 3/32" gap between panels. Impact resistance: high impact and 80 shore A durability rating.

Metal wall studs: 33ksi yield strength, load bearing studs, 18 gauge minimum. Typically 4" studs for 20' height, spaced at 16" o.c. Six inch (6") studs are preferred.

Face finish: Smooth and flush. Surface variations equal to or less than 3/32" gaps or variations in plane at panel joints. System walls "float" in relation to one another. Inside corners are kept loose with 1/16"- 1/8" gap at the vertical corners.

Critical item: Wall finish panels do not extend to the floor. End of panels are held off the substrate ½" minimum to allow walls to contract and expand without warping the surface. See floor guidelines below.

Back wall: Glass wall. Competition courts generally prefer that the back wall run full height, but can use an 8'- 12' high glass partition at the floor line and use a solid wall panel system for the remaining height. Glass wall system: ½" thick tempered glass walls and doors. Tall vertical walls (above 8'-0" a.f.f.) will require use of vertical glass stiffeners. Glass is structural and utilizes upper and lower channels only to retain 8' - 10'-0" high glass systems, with added edge panel hardware for tall glass systems.

Caution: Review glass panel attachments to floor line with supplier to provide proper support and understanding of the floor to floor transition between spectator floor and the court floor. If both systems are not wood systems, court substrate will be recessed approximately 2 ½" in relation to the spectator area. Back wall doors shall be frameless glass doors with face finish to match wall system. In resin core applications, manufacturers of panels offer face panels for door applications. Door frames, where used, shall be heavy gauge aluminum with adjustable stops to provide a flush installation within regulation tolerances for court wall faces.

Critical Item: No surface fasteners or projecting hardware shall be used on the interior court face for any components. Accessory items, including doors and frames shall all use concealed fasteners. Door hardware shall be flush and recessed in the face of the door on the court side. Door width shall be no less than 34" clear for ADA use.

Sound absorption for panels: Fiberboard may be mounted directly behind resin core panels to reduce "drum" effect of hard panels systems. Sound batts are also provided to reduce transfer noise to other spaces or in multi-court applications.

Surface light reflectance: No less than .80.

Humidity resistance: No special protection.

Fire resistance: Use only Class A rated materials as determined by Underwriters Laboratories (UL) Fire resistive gypsum board mandatory when used as part of the ceiling system.

RACQUETBALL COURT FLOORING:

Floor tolerances: No more than ¼" in 10'-0" each direction, non-averaged for the full length of the floor. Follow wood flooring supplier's recommendations for leveling uneven substrates.

Materials: Machine milled and formed solid maple strip flooring that meets or exceeds MFMA (Maple Flooring Manufacturers Association) specification for a "second or better" grade.

Size and construction: 33/32" thick x 2 ¼" width minimum, bonded to 2 layer bi-directional ½" thick plywood panels. Provide a system with ¾" thick wood or metal and wood composite support sleepers mechanically fastened to floor panels or equal system. Cushion pads on the underside of the sleepers is optional. Expansion control is critical to floor system. DIN certified system for court use.

Floor Edge treatments: Racquet ball court floors do not extend to the wall surfaces. Floor edge is held back from wall a maximum of 3/16" at head walls and ½" maximum at side walls, to allow for expansion and contraction of floor system.

Floor finish: Catalyzed polyurethane finish system requiring multiple sanding and application steps for a sanding sealer / primer base coat and two finish coats of gloss urethane. Floor striping is accomplished between the first and second finish coats.

Court striping: Flooring striping is handled by the flooring manufacturer. Front and side wall striping is prefinished with resin core laminate panels. Consult with a national racquetball association like USRA (United States Racquetball Association) for standards particular to competition in the project region.

PLUMBING:

Water fountains: 1 per 150 patrons at peak time use. Provide one drinking fountain near spectator area, but not necessarily directly adjacent to courts. It is undesirable for water to be available where it could be carried onto courts. Electrically cooled unit required. Water fountains shall be fed from dedicated 120V, 20A circuits.

MECHANICAL (HVAC):

Mechanical heating, ventilation, and humidity control of the module is mandatory. Shall exceed the current ASHRAE requirements.

Operating range: For racquetball courts, system shall be able to maintain 60 - 68 degrees (F) year-round at 50% or less relative humidity.

Air movement / control: Fully ducted supply and return. Passive or plenum return not recommended. Supply diffusers are to be heavy gauge fixed metal grilles with four-way air movement and blade-type vanes. Return air grilles may be perforated plate or blade type. All diffusers to be prefinished, designed to be impact resistant. Preferred location is back wall supply and return. Natural (non-mechanically driven) ventilation is not allowed.

Temperature controls: Independent to courts, with all controls centrally located, solid state and programmable. Ability to control peak and off-peak temperatures with 24 hour or one-touch setback programming recommended. Ductwork shall be insulated sheet metal rectangular or circular duct routed adjacent to diffuser locations. Use flexible duct drops to diffusers. Natural (non-mechanically driven) ventilation is not allowed.

TECHNOLOGY/AV:

No technology requirements.

SOUND:

Sound system: Flush recessed speakers, 25 watt minimum output rating, capable of reproducing the entire audible range for human speech. Link speakers to paging system with input / output modes for single court or all court paging. Provide at least one speaker location in spectator / waiting area with court speaker at back upper wall.

WINDOWS AND DOORS:

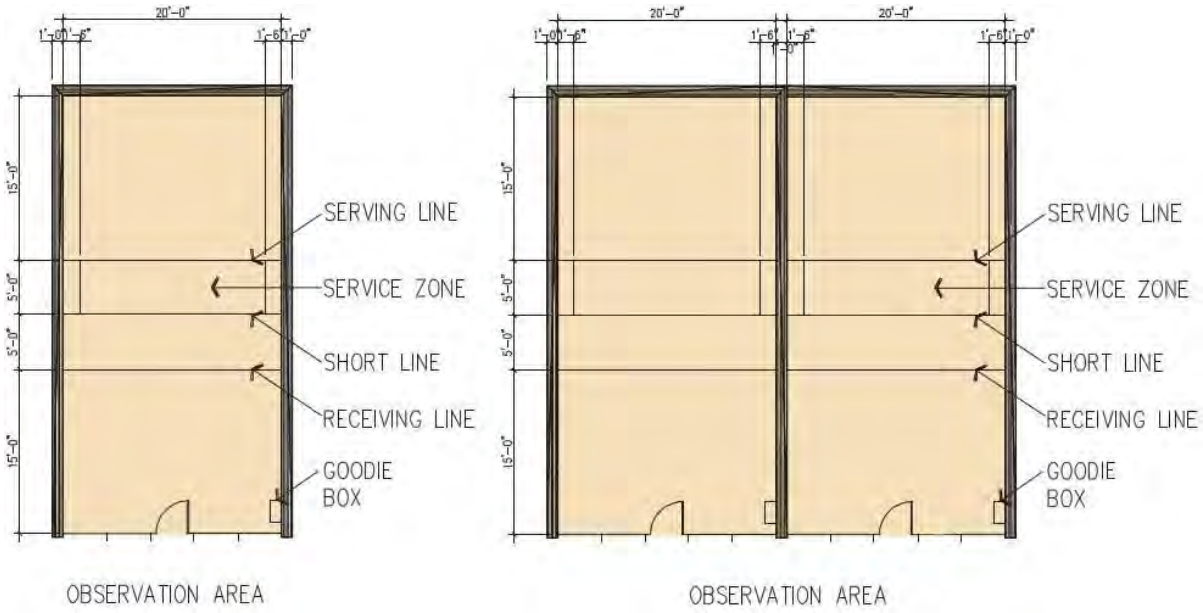
Glass doors integral to the glass wall system shall be provided.

FIXED EQUIPMENT;

"Goody box:" A “goody box” shall be provided in each court as a place for the storage of small valuables during play be provided for each court. Court manufacturers offer a recessed metal box with flush cover and concealed fasteners, accessible from the interior side of the court only.

ARRANGEMENT:

Provided below are arrangements for 1 and 2 racquetball courts. Markings must meet the current guidelines of the governing organization. Based on user preferences, more than 2 courts may be provided.



SMALL GROUP FITNESS

ESSENTIAL DESIGN REQUIREMENTS:

- Small Group Exercise Room: follow the requirements for the Exercise Module (Large Group Fitness) above.
- Must have one-way flow-through storage room directly accessible to the space.
- Cubbies shall be provided based on 75% maximum occupancy based on 125 square feet per person.
- Mirrors and flooring shall be coordinated with the users prior to design to determine anticipated usage of the room.

CLIMBING WALL

ESSENTIAL DESIGN REQUIREMENTS:

- Climbing wall must be controlled for safety concerns.
- Appropriate and adequate flooring and safety zone is required. Assume a depressed slab in this area.
- Consider a bouldering area in this area as well.

DIRECT ADJACENCIES:

- The climbing wall must be visually and physically accessible from the Control Desk or a fully staffed area for control and safety. The climbing wall should be located in an open area, preferably off of the lobby and in direct view of the Control Desk. Locating it in a separate locked room is acceptable, but not desirable.

CEILING HEIGHTS:

25'-0" minimum. Heights up to 40’ are ideal.

MECHANICAL (HVAC):

Mechanical heating, ventilation, and humidity control of the module is mandatory. Shall exceed the current ASHRAE requirements.

Operating range: If located in the open lobby area, temperatures should be appropriate for a combination of all of the functions. In a separate room, the system must be able to maintain 66 - 72 degrees (F) year-round at 60% relative humidity or less. Shall meet or exceed ASHRAE 62 for the ventilation rate.

Temperature controls: Independent to room, solid state and programmable. Ability to control peak and off-peak temperatures with 24 hour or one-touch setback programming recommended.

Air movement / control: Fully ducted supply and return. Use spiral duct if existing ceiling is exposed structure. Directional diffusers mounted to spiral duct system shall be engineered for maximum throw and even distribution. Ceiling-mounted diffusers will be standard 2x2 units with directional vanes. Return air may be centralized. Natural (non-mechanically driven) ventilation is not allowed.

TECHNOLOGY/AV:

No technology requirements.

SOUND:

Sound system: Flush recessed speakers, 25 watt minimum output rating, capable of reproducing the entire audible range for human speech. Link speakers to paging system.

COMBATIVES

ESSENTIAL DESIGN REQUIREMENTS:

- Room shall not have any external corners within the room. Columns, if required, must be fully buried within the wall, so the wall surface is perfectly flat. The room shall be sized to accommodate 1 or 2 mats as required by the installation. Floors and walls shall be provided with padding. Padding on walls shall be provided to 8' above the floor.
- A storage room must be provided. Unlike the group exercise rooms, this storage room does not have to be a one-way flow-through configuration.
- Space is required for hanging bags.
- Provide cubbies (minimum of 12 for 1 mat, 24 for 2 mats) for storage of small items inside the room.
- The following drawings indicate the preferred arrangement for this space.

DIRECT ADJACENCIES:

- No special requirements.

CEILING HEIGHTS:

10'-0" minimum

CEILING FINISHES:

Provide ceilings of highly light reflective and sound absorbent materials. Consider 2'x 2' lay-in, wet-formed mineral fiber acoustical panels, on standard "T" shaped pre-finished metallic grid system. Tegular (routed edges) tiles are preferred. Hold down clips may be desirable.

PLUMBING:

Water fountains: 1 per 150 patrons at peak time use. Provide one drinking fountain near this function. Electrically cooled unit required. Water fountains shall be fed from dedicated 120V, 20A circuit(s).

MECHANICAL (HVAC):

Mechanical heating, ventilation, and humidity control of the module is mandatory. Shall exceed the current ASHRAE requirements.

Operating range: System able to maintain 66 - 72 degrees (F) year-round at 60% relative humidity or less. Shall meet or exceed ASHRAE 62 for the ventilation rate.

Temperature controls: Independent to room, solid state and programmable. Ability to control peak and off-peak temperatures with 24 hour or one-touch setback programming recommended.

Air movement / control: Fully ducted supply and return. Use spiral duct if existing ceiling is exposed structure. Directional diffusers mounted to spiral duct system shall be engineered

for maximum throw and even distribution. Ceiling-mounted diffusers will be standard 2x2 units with directional vanes. Return air may be centralized. Natural (non-mechanically driven) ventilation is not allowed.

LIGHTING:

Provide indirect 2 x 2 or 2 x 4 lay-in fluorescent fixtures may be used. Direct 2 x 2 or 2 x 4 lay-in fluorescent fixtures may also be used, but are not recommended due to lower light quality (excessive glare and static light distribution; e.g. causes greater eye fatigue over long periods of time). Lighting shall be switched to allow for different levels of lighting.

Lighting control: Use of occupancy sensors to activate lighting by motion detection, is recommended.

Light level: 40 footcandles at the floor, minimum.

POWER

Locate convenience outlets to avoid safety concerns with cut outs in the wall padding. Best locations would be where no padding is required, and at a corner of the floor mat.

TECHNOLOGY/AV:

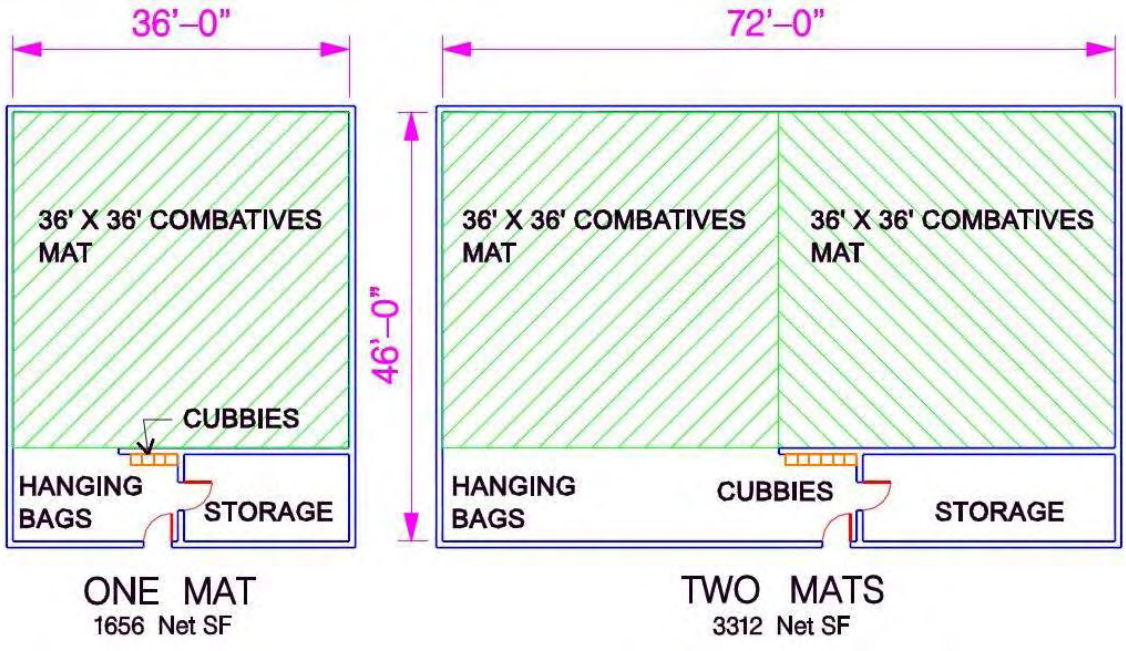
No technology requirements.

SOUND:

Sound system: Flush recessed speakers, 25 watt minimum output rating, capable of reproducing the entire audible range for human speech. Link speakers to paging system.

ARRANGEMENT:

Provided below are recommended arrangements for 1-mat and 2-mat Combatives Rooms.



CONCESSIONS

ESSENTIAL DESIGN REQUIREMENTS:

- This describes the optional food and beverage sales or expanded retail functions that will be provided in a separate area that is highly visible and accessible to patrons to encourage business. Vending can also be provided at a self-service standalone space with vending machines. The vending area, if a standalone space, should be identifiable, visually screened but not totally enclosed, and visually accessible from the control desk.
- Coordinate with the user to determine level of service desired along with the proposed operators. Different operators may have different requirements for security, equipment, layout, etc.

DIRECT ADJACENCIES:

- Should be located adjacent to the lobby to serve spectators, visitors, and users upon entering or leaving the facility.

CEILING HEIGHTS:

9’-0” Minimum

CHILD CARE

ESSENTIAL DESIGN REQUIREMENTS:

- Must comply with all Child and Youth Services (CYS) requirements. Please refer to the Army Standard and the Standard Design for Child Development Centers. These documents may be downloaded from https://eportal.usace.army.mil/sites/COS/CDCIT/default.aspx

DIRECT ADJACENCIES:

- The Child Care area shall be located close to the main entrance/lobby so that patrons may drop off their children shortly after arriving at the facility.
- It may be desirable to provide cardio equipment in an arrangement such that the users can watch their children in the child care area. In this instance, the cubbies and shelves in the attached drawings may be relocated to other walls, and a glass wall provided.
- The layouts shown in the attached drawings are mandatory unless otherwise modified by this section.
- Child Care shall NOT be located on any floor other than the ground floor.
- The Child Care Room must also have direct access to the exterior. It is ideal if this door leads to a playground area.

CEILING HEIGHTS:

8’-0”

CEILING FINISHES:

Salient characteristics include ease of accessibility to mechanical system above ceiling, durable, and shall provide an aesthetically pleasing surface, free of sags or other defects.

WALL FINISHES:

Salient characteristics include easy to clean, repairable, easy to maintain, and durable. Wall material shall have the ability to absorb pushpins. Wall surface shall be able to withstand tape peeling. Where drinking fountains and/or lavatories are provided, a minimum 48” tall wainscot that is impervious to water and able to withstand daily sanitizing is required. This material shall extend to the floor and at least 18” horizontally in both directions from the centerline of the equipment.

FLOOR AND BASE:

Salient characteristics include seamless, easy to clean and maintain. A base material, appropriate for the flooring material used, is required. Base shall be seamless except at inside corners. Base shall be sealed to floor with USDA or NSF approved caulking.

PLUMBING:

A drinking fountain (non-refrigerated, similar to Halsey Taylor model HRFGE) is required on the wall near the toilet area as shown, mounted so that top of drinking fountain is 17” above

finished floor. Plumbing for toilet/lavatory area, diaper changing table, and food preparation snk area is also required.

MECHANICAL (HVAC):

One exhaust fan providing 100 to 150 cubic feet per minute shall be provided directly over the diaper changing station. Room temperature shall be measured and maintained at 1 foot above finished floor. Temperature will be designed for 68 °F in the winter and for 78 °F in the summer.

Humidity Control. A relative humidity of between 35 and 50 percent will be maintained to prevent drying of mucous membranes, to control the spread of diseases, and to prevent mold growth.

POWER:

All electrical outlets, except for those mounted above countertops, shall be mounted 54" above the finish floor, and shall be Hospital grade, tamper resistant safety type. Outlets provided above countertops shall be located no less than 18" from the edge of the countertop. Two electrical outlets to be provided above the backsplash (food preparation counter/sink). Electrical outlet to be provided for under the counter refrigerator. Electrical outlet, data port and intercom phone connection at sign in desk to be provided. Provide task lighting at sign in desk, installed on underside of upper cabinets. A minimum of 1 (one) outlet will be provided above the cubbies in the program area and will be mounted horizontally.

TECHNOLOGY/AV:

No technology requirements.

SOUND:

Sound system: Flush recessed speakers, 25 watt minimum output rating, capable of reproducing the entire audible range for human speech. Link speakers to paging system.

WINDOWS AND DOORS:

Doors, frames, and hardware shall be able to withstand constant opening and closing. Doors shall be provided with finger guards at the hinges, on the Activity Room side, up to a minimum height of 48". Finger guard shall be roll type. On exterior doors, finger guards shall not conflict with weather stripping. Interior doors shall be a minimum of half-height glass, with a clear width opening of 34 inches and shall be provided with a 12-inch wide side lite on the latch side of the door. Exterior door shall be provided with flush panic hardware, shall have a clear width opening of 34 inches, open at least 110 degrees to ensure ease of crib emergency evacuation, and direct exiting onto the outdoor play space. Interior and exterior doors shall swing in the direction of exit travel. Door thresholds and hardware will be designed to facilitate the exit of a crib containing five infants by a single adult. The thresholds will have a low profile. Doors shall be provided with self-closing device.

FIXED EQUIPMENT;

- **CABINETRY:** Salient characteristics include easy to clean, maintain, and repair. Cabinets shall be durable and be able to withstand impacts (examples: food carts, push toys, etc.), without showing damage. Cabinets shall be a minimum of Architectural

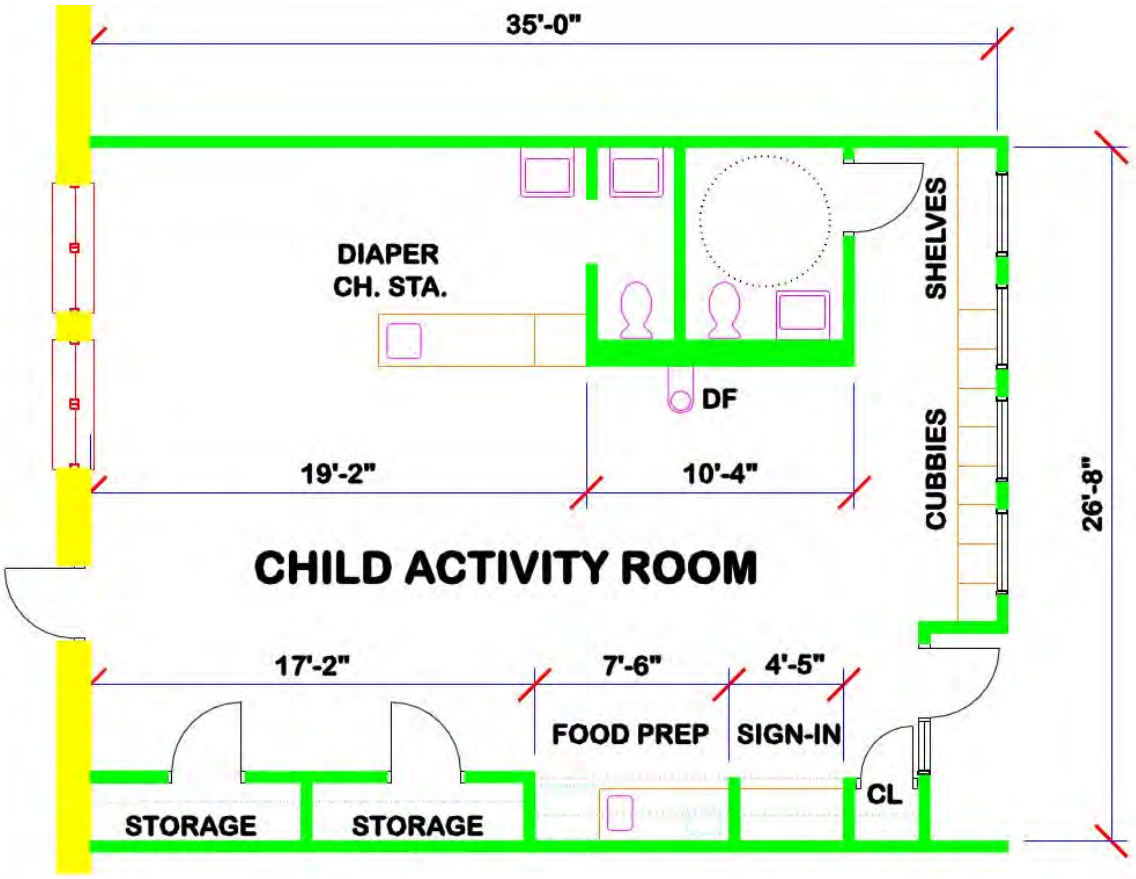
Woodworking Institute (AWI) 400B, Custom Grade, High Pressure Laminate clad. Counter top shall have integral back splash, and shall be solid surfacing, solid phenolic, or better. Counter tops of cabinets will have rounded/radius corners and edges.

(a) A 3'-6" wide sign-in desk with 6 lockable storage units in an overhead cabinet, and an adjacent 18 inch wide coat closet.

(b) 8 foot wide base and wall cabinets with stainless steel sink. Sink shall be provided with gooseneck faucet. Sink bowl shall be a minimum of 21" W x 15-3/4" D x 8" H. Space shall be provided for an undercounter refrigerator. Base cabinets shall be lockable, and may not have a protruding handle. All base cabinets in the facility shall be keyed alike.

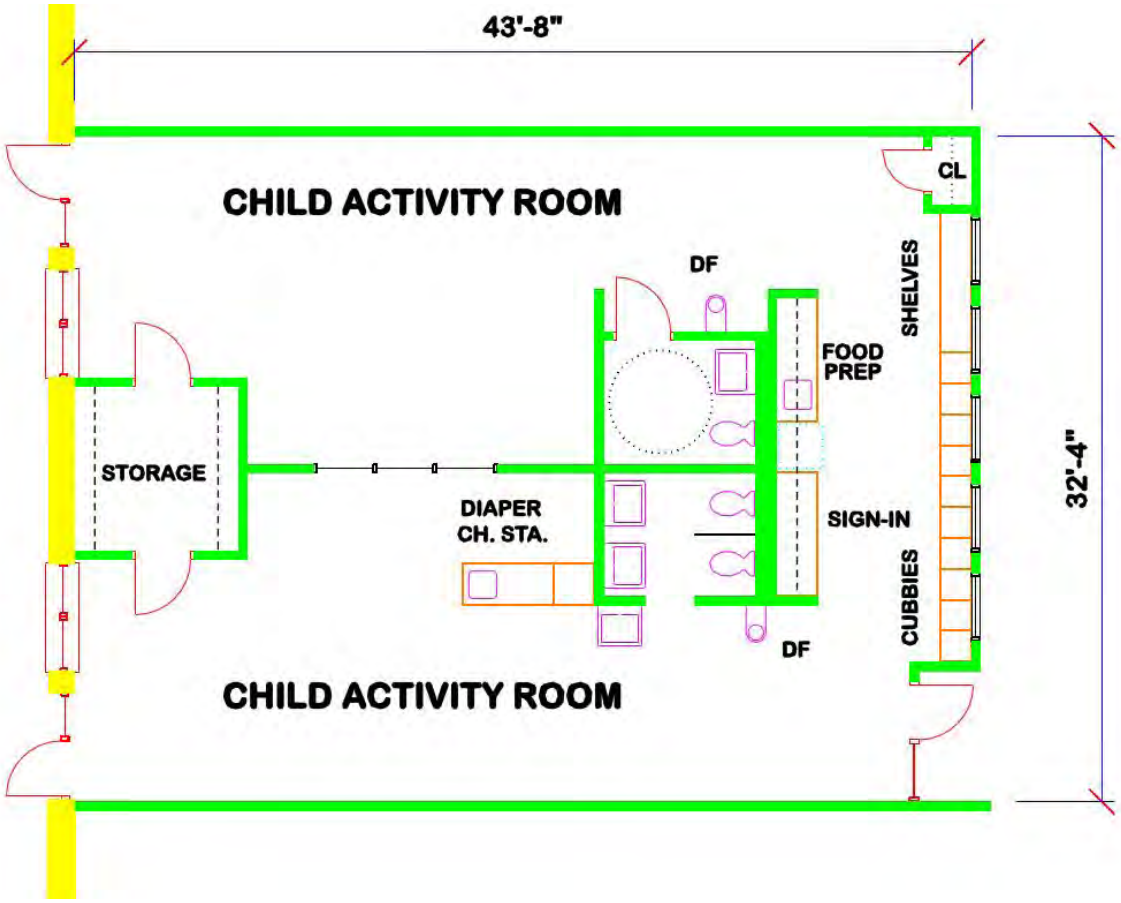
(c) 14-15 pre-school cubbies, 8"-12" wide x 15" deep x 46"-49" tall permanently attached to walls (pre-manufactured). Provided by Building Contractor.

(d) One diaper changing station approximately 2 foot wide by 5 foot long cabinet with sink integral to diaper changing surface, and retractable stairs. Refer to illustrations in the Army Standard Design.



Small Child Care

933 Square Feet



Large Child Care

1412 Square Feet

GYMNASIUM

FUNCTION/DESCRIPTION:

The gymnasium is a dedicated space for team activities and competitive play, which includes basketball and volleyball. Multiple court gymnasiums with divider curtains will accommodate simultaneous activities. In facilities with 3 or more courts, the option exists to provide two separate gymnasiums. One of the gymnasiums shall be provided with the wood floor. The second gymnasium may be more of a multi-purpose space, if desired by the installation. If programmed, a suspended indoor jogging/walking track shall be provided, typically around the perimeter of the gymnasium.

ESSENTIAL DESIGN REQUIREMENTS:

- Minimum clear heights must be maintained.
- Safety padding must be provided on the wall behind backstops. Doors, windows, electrical panels, etc. shall not be located in this area for safety reasons. This will require careful planning of door locations, as well as any other item that may be on or in the wall that would result in no padding.
- Floor must be striped for basketball and volleyball, with a tournament basketball court located perpendicular and centered within 2 regular basketball courts. All basketball courts shall be to NCAA standards.
- Gymnasium storage must be provided that opens directly into the gymnasium.
- If a tournament court is provided, it must be perpendicular, and superimposed over the normal courts. Retractable bleachers must be provided to provide spectator space for the tournament court. It is recommended in gymnasiums with 3 courts, that the tournament court is superimposed over 2 courts. However, if the installation prefers, the tournament court may be centered within the gymnasium.

DIRECT ADJACENCIES:

- Restroom facilities, other than those in the locker rooms, will be provided to support the gymnasium spectators.
- Team Locker Rooms can be provided adjacent to the Gymnasium for game use, but the area for these elements must be deducted from the structured activity module.
- Adjacency to the Control Desk is required for check-in and equipment issue.
- Drinking fountains. Drinking fountains are not to be provided where there is a wood floor.

INDIRECT ADJACENCIES:

- Activity Components
- Locker Rooms

CEILING HEIGHT:

Minimum unobstructed height is 28'-0". Lights, speakers, structure, etc., must be above the 28’ height.

CEILING FINISHES:

General provisions: Exposed structural and mechanical systems are typical.

Structural Considerations: Roof trusses are typically designed to minimum load values for the spans involved resulting in the most economical truss (by weight) that can be provided. Gymnasiums have additional truss mounted loads that must be taken into account:

- Suspension of basketball backstops
- Divider Curtains and drapes for temporary backdrops
- Ductwork
- Lighting, Temporary Theater Lighting and Sound Equipment
- Company or squad decorative banners
- Suspended jogging track

The Engineer also has the responsibility of reviewing the pattern of the truss webs to coordinate passage of HVAC ductwork and installation of the correct lighting pattern. This should be done in consultation with the structural engineer at the earliest possible date.

Acoustical Decking: Provide a flat panel, or exposed cell perforated metal deck with cell depth as required. Minimum sound absorption factor shall be 0.47, with a NRC of 1.00. Absorption values of 0.68 to 0.83 are easily reached for long span acoustical decks. Obtain highest level possible in new construction. Design sound quality should be "lively" with no reverberation.

Critical item: Applied acoustical treatments are not recommended.

Ceiling Finish: "Dry-fall" or "wet-fall" paint system for decking and trusses. Deck painted in white or off white preferred for maximum lighting distribution. Contrasting color of trusses and ductwork offer an opportunity for accent colors.

WALL MATERIALS:

Recommended wall construction for gymnasiums is an interior wythe of 8 inches thick to 12 inches thick concrete block, with 2 inches of rigid insulation in the wall cavity and a veneer system suitable to the context of surrounding buildings. The two most common structural systems for tall multi-wythe masonry walls are 1) load bearing masonry, or 2) steel frame with non-load bearing in-fill partitions. Concrete masonry units (CMU) recommended to be moisture controlled Type 1, normal weight, hollow core.

Safety: Minimum safety requirements provide for wall-mounted padding, meeting all applicable safety requirements, to be permanently affixed to the walls behind each backboard.

WALL FINISHES:

Standard block with water based epoxy coating, semi-gloss. Apply a heavy acrylic block filler spray applied and backrolled to a pinhole free surface, and two epoxy finish coats of 5 to 6 mil Dry Film Thickness (DFT). Ferrous metals (doors and frames): water based epoxy.

Apply one coat primer compatible with finish coat, and as barrier coat to factory primer. Two finish coats of 5 to 6 mils DFT.

FLOORING:

BALLCOURTS:

Substrates: Where possible, provide a min. 4 inch thick, level concrete slab on grade over properly graded crushed stone sub-base, with a 10 mil polyethylene sheet vapor barrier located directly between the slab and the subbase. Where continuous water is anticipated beneath floors due to local conditions, a subsurface drainage system is recommended.

Ballcourt floors: Machine milled and formed solid maple strip flooring that meets or exceeds MFMA (Maple Flooring Manufacturers Association) specification for a "second or better" grade. Expect some visual variation in color in the wood, but otherwise free from defects. Flooring materials to meet DIN Standards. Provide all lines for basketball (per NCAA specifications) and volleyball. In gymnasiums with 2 or more courts, there will be a tournament cross-court as well. Synthetic flooring may only be provided with approval from the Installation and the Center of Standardization (COS).

Size and construction: 25/32 inches thick x 2 ¼ inches width minimum. It is extremely desirable to provide 25/32” thick flooring with the same wear depth as 33/32” thick flooring for extended longevity through multiple sandings. Provide a floating system with two bonded bi directional plywood backing layers, supported on solid neoprene cushion pads (3/4 inch high) for an overall performance of 90% or better ball rebound with 53% or better force reduction, or other approved gymnasium flooring system which meets these DIN standards. Floor will be rigid but with minor "give" during normal play.

Flooring accessories:

Holes for volleyball support posts shall be drilled through the wood floor. Inserts are cast in place with the formation of the slab on grade, or post drilled. Coverplates are used to conceal holes through wood floors when netting equipment is not in use.

Court overruns: Provide 10’-0” of unobstructed space around the perimeter of each regulation-size basketball court. Provide 15’-0” minimum between courts.

NATURAL LIGHTING:

It is recommended that natural light be allowed into gymnasium spaces through the use of windows and / or overhead skylights. Wall construction will control the ease and relative cost of creating such openings. Avoid glare in window placement, and consider use of translucent wall panels to avoid glare and control heat gain. Linear skylights may be used to enhance natural lighting and enhance visual appeal of the module. Recommend an aluminum framed, gable type skylight with laminated safety glass. Glass should have visible light transmittance of no less than 56% to provide significant light to the floor. Again, pay close attention to direct sunlight and glare.

PLUMBING:

Water fountains: 1 unit per two courts. A unit consists of either two water fountains in a single unit combination, or two separate units side by side to allow for one unit to be mounted at ADA height. Electrically cooled unit required. One cuspidor minimum adjacent to fountains. Water fountains shall be fed from dedicated 120V, 20A circuit(s). Water fountains shall be located outside of the gymnasium, in close proximity to an entrance to the gymnasium, to avoid damage to the wood flooring. It is recommended that water fountains be placed outside normal traffic paths and recessed into the wall plane if possible.

MECHANICAL (HVAC):

Mechanical heating, ventilation, and humidity control of the module is mandatory. Shall exceed the current ASHRAE requirements.

Operating range: System able to maintain 68 - 74 degrees (F) year-round at 50% relative humidity or less. Shall meet or exceed ASHRAE 62 for the ventilation rate.

Temperature controls: Independent to room, solid state and programmable. Ability to control peak and off-peak temperatures with 24 hour or one-touch setback programming recommended.

Air movement / control: Fully ducted supply and return. Spiral duct for exposed use within gym module. Main supply with one branch duct per court, minimum. Directional diffusers mounted to spiral duct system shall be engineered for maximum throw and even distribution over courts areas. Return air may be centralized but locate low to floor. No through-wall relief dampers. Natural (non-mechanically driven) ventilation is not allowed. Smoke and combustion duct detectors will be required.

Acoustical performance: Insulate all supply ducts and moderate air flow to reduce noise. Isolate all air handling equipment in a separate mechanical space dedicated for that use. Provide sound dampening for all equipment.

LIGHTING:

High Intensity Discharge (HID) fixtures are not required. Lighting selected shall be identified as suitable for the intended use and lighting design shall meet IESNA recommendations for Basketball Sports-Lighting, Class III (Class of Play). In general, lighting levels shall be a minimum of 50 foot candles at floor level, adjustable up to 80 foot candles. Fixtures shall be mounted not less than 28' above the finished floor. For overhead locations, protect luminaires with wire cages and/or provide appropriate shatterproof enclosed luminaires. Switching for lighting control shall provide different lighting options to take into account natural lighting and different activities (such as boxing matches, etc.). Do not locate fixtures directly above basketball backboards. Lighting control shall be located in a controlled area to avoid accidental and unauthorized switching.

POWER:

Scorer's table is generally located for one designated court, at mid court, and requires one (1) 4-outlet, 20 amp power outlet and two (2) Cat5 or better data connections, both in recessed floor boxes, centered under the anticipated table location, but outside the court

boundaries. Solid brass cover plates shall be provided for these outlets for when scoreboard equipment is not in use to provide good ball return value and skid resistance.

TECHNOLOGY/AV:

At a minimum, all facilities shall provide electronic scoreboards. Scoreboards to be visible to officials and players and be appropriate for programmed sports. If consistent with the mission of the facility, consider providing video connections, wall mounted in gymnasium for portable video camera use, with outlet linked via cable, to monitoring equipment (i.e. video recording, multiplex video control /output, TV monitors, or base wide cable system). Provide one recessed floor box mounted (1) 4-outlet, 20 amp duplex power outlet centered under the anticipated scorer's table location, but outside the court boundaries. Provide two directly interconnected communications outlets in gymnasiums for time clock and scoreboard connections. One outlet shall be recessed floor mounted with cover at the scorer's table location and one shall be wall mounted at the scoreboard location. Each outlet shall consist of one Cat 6 communications jack and one coaxial TV connector.

SOUND:

Wall mounted speakers for public announcements.

Sound system: Built-in system for announcing events in the Gymnasium. Wall mounted speakers, 50 watt minimum output rating, capable of reproducing human speech, minimum. If multipurpose functions are considered, provide speakers capable of CD quality sound reproduction of music.

WINDOWS AND DOORS:

Views into the space from the lobby/control counter are required to the greatest extent possible. Views to other spaces and admittance of natural light are also recommended. Non-operable windows are mandatory for temperature / humidity control. Aluminum or hollow metal frames are recommended. Aluminum only for exterior openings. Tempered safety glass should be typical to the module. The potential for injury does not warrant selective location of safety glass. Avoid locating doors directly behind backstops for safety reasons.

Sun Shading devices: If natural lighting through windows is anticipated, shading devices may be necessary to avoid glare across courts at certain times of the day. Permanently mounted shading elements limit design flexibility and are unnecessary for a majority of module use time. A more cost effective solution to glare is a reduction in visible light transmittance of 38% to 18% in exterior insulated glazing, when floor level or tall windows are desired, without cost of shade devices. It is recommended to minimize east and west facing glazing, and provide adequate exterior shading on south facing glass.

Storage: A storage room is required per the standard. The storage room shall be provided with a minimum of one pair of 4'-0" W x 8'-0" H doors with no center mullion (opening size 8'-0" x 8'-0"). Consider a roll-up door as an option.

FIXED EQUIPMENT:

Basketball backstops: Two per court, overhead mounted and electrically operated forward folding type. Mounted to trusses with provided pipe support frame.

Rectangular glass backboard: NCAA official size (3'-6" x 6'-0") fabricated from ½ tempered glass with continuous edge gasket mounted with aluminum flange and breakaway rims.

Goals: Safety reflex type, with 5/8" steel rod ring and "no-tie" steel attachments. 120 thread, retarding type netting.

Divider Curtains: For multi court gyms, divider curtains shall be provided between each standard basketball court. Curtains to be electrically operated vertical-folding/rolling mesh fabric with solid vinyl bottom panels. Curtain shall be fully retractable to the bottom of the structure. Curtains are mounted to bottom of trusses on steel subframes. Lower panels are of solid polyester reinforced vinyl fabric, 18 oz./ sq. yd. min weight, to a height of 2'-8" above the finished floor. Middle Mesh is vinyl coated polyester mesh weighing not less than 6 oz. / sq. yd.- from 2'-8" to 18' above the finished floor. Upper curtain portion is generally open to structure above.

Volleyball: Steel posts of hollow tubes 3 ½" diameter with powder coated or zinc plate finish. Nets are tensioned to the posts by use of a ratchet winches with removable handles.

Floor plates and sleeves: Galvanized steel tubing, mated to the post diameter, is cast into the floor and the hole is covered with a solid brass plate with removable lid. Solid brass floor covers required to provide good ball return value and skid resistance. Use of flip up cover plates is not allowed. Plate lid must be removed from the area of play to prevent injury.

Nets: Specifically designed for volleyball use, black, with heavy web sides and bottom. Double sewn vinyl top binding with rope cable and antenna (for out of bounds markers).

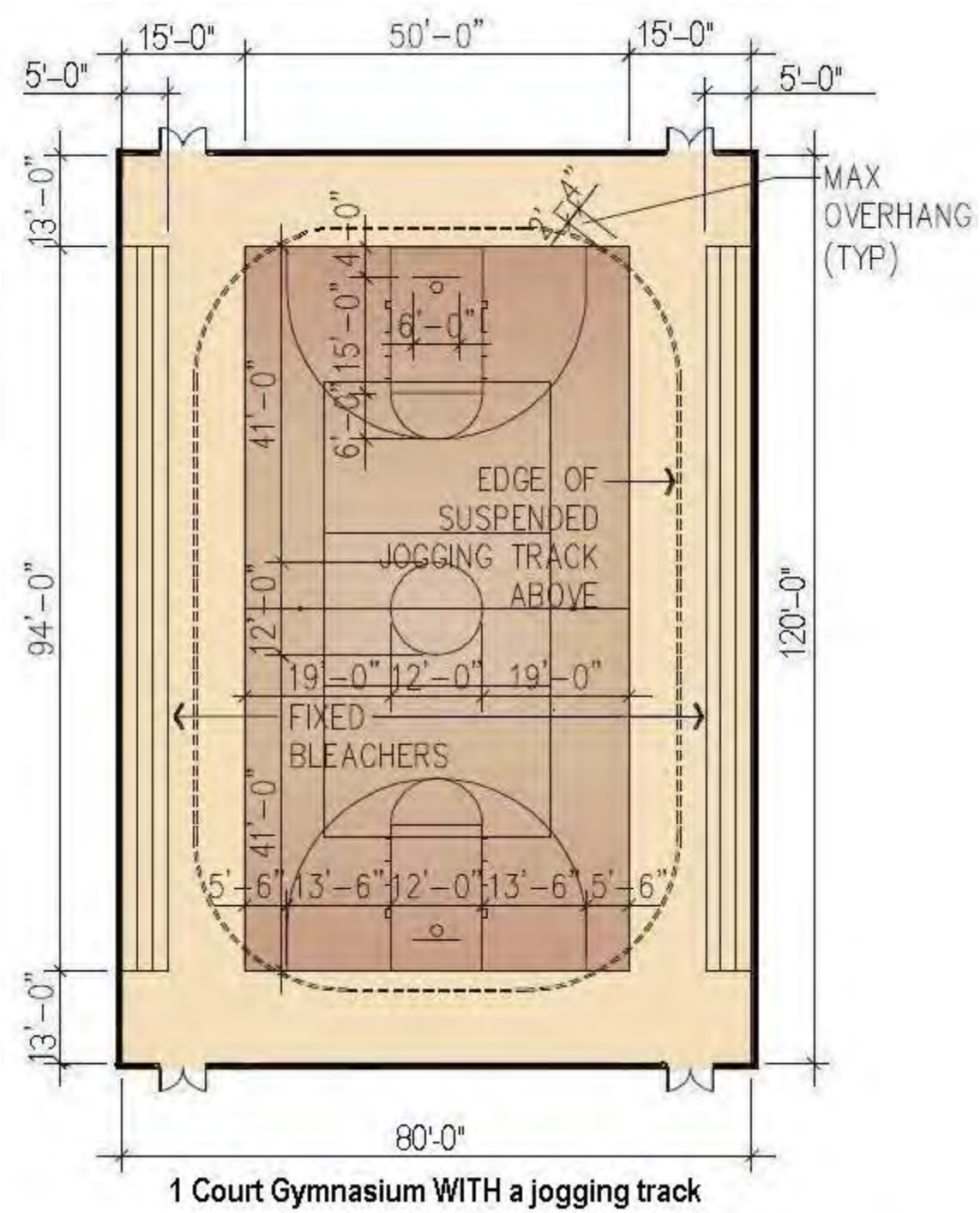
Post padding: All posts must be padded during use. Provide a 6'-0" high, 1" polyurethane foam core, vinyl covered pad. Designed to wrap the pipe with Velcro closures.

Bleachers: If a tournament court is provided (which is typically the case), retractable, wall-mounted bleachers shall be provided on both sides of the tournament court, the full length of the court. These bleachers shall be electrically operable with manual override, and shall be sized to accommodate normal spectator requirements, as allowed to provide the adequate safety zone around the basketball court, and to ensure adequate headroom under the track. Bleachers on the side wall(s) of the standard basketball courts shall be 3 row, tip and roll, aluminum bleachers (purchased by others). In the diagram below, these are referred to as “fixed bleachers” in that the rows are fixed. These fixed bleachers shall be provided for as many courts as possible.

Miscellaneous: Two shot clocks shall be provided for each court (assume 1 shot clock for each backboard). For intramural courts, a minimum of 1 score board is required for each court. Two score boards may be required if a single board can not be viewed by spectators. For tournament courts, either 2 score boards or a center hung 4-sided score board shall be provided.

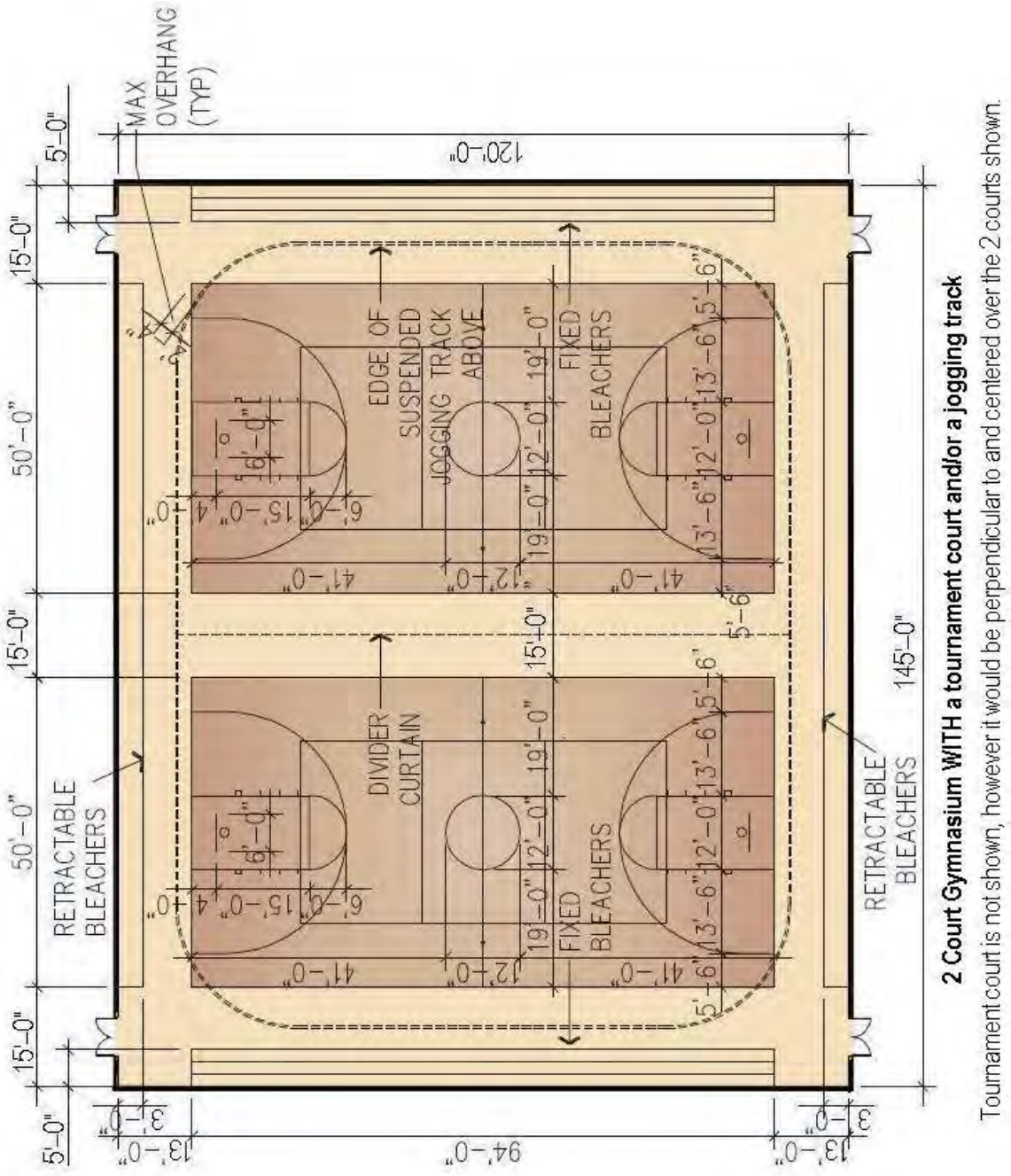
ARRANGEMENT:

Provided below is the recommended layout for a 1-court gymnasium with a jogging track. It is slightly less than the area shown in the Army Standard, however it complies with all safety requirements. If no jogging track is to be provided, the length of the gymnasium may be reduced from 120'-0" to 114'-0", with the extra space added to the Structured Activity Module for use in functional areas elsewhere in the facility.



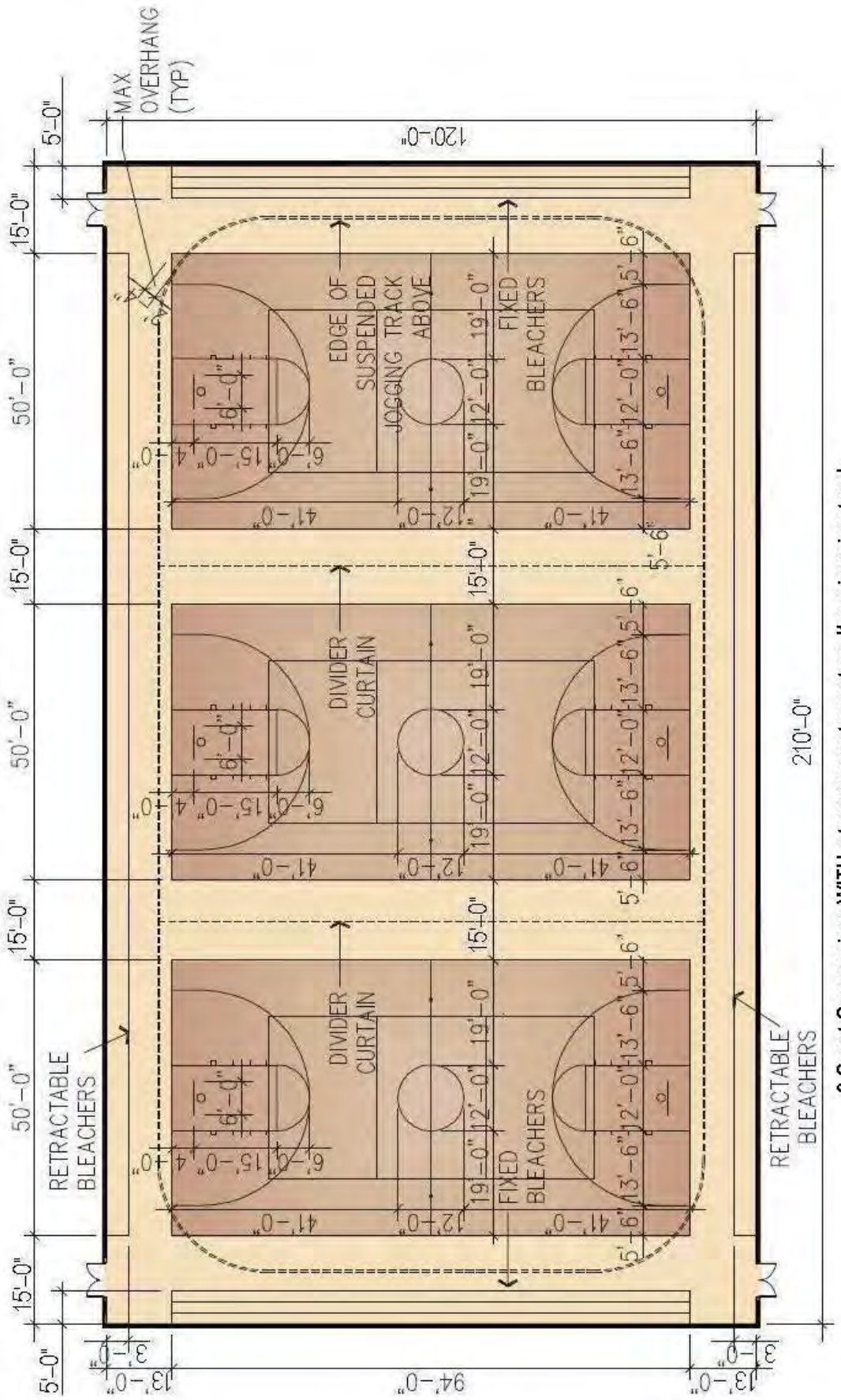
1 Court Gymnasium WITH a jogging track

Provided below are the recommended layouts for a 2-court and a 3-court gymnasium. In most cases a jogging track and/or a tournament court will be provided, which will result in the larger layouts shown below. If a jogging track is provided, but no tournament court, the retractable bleachers shown will not be provided. There will be no reduction in the dimensions. If neither a tournament court nor a jogging track is included in the project, the gymnasium will be reduced to the dimensions as shown in the smaller diagrams on page 37, with the building area saved added to the Structured Activity Module for use in functional areas elsewhere in the facility.

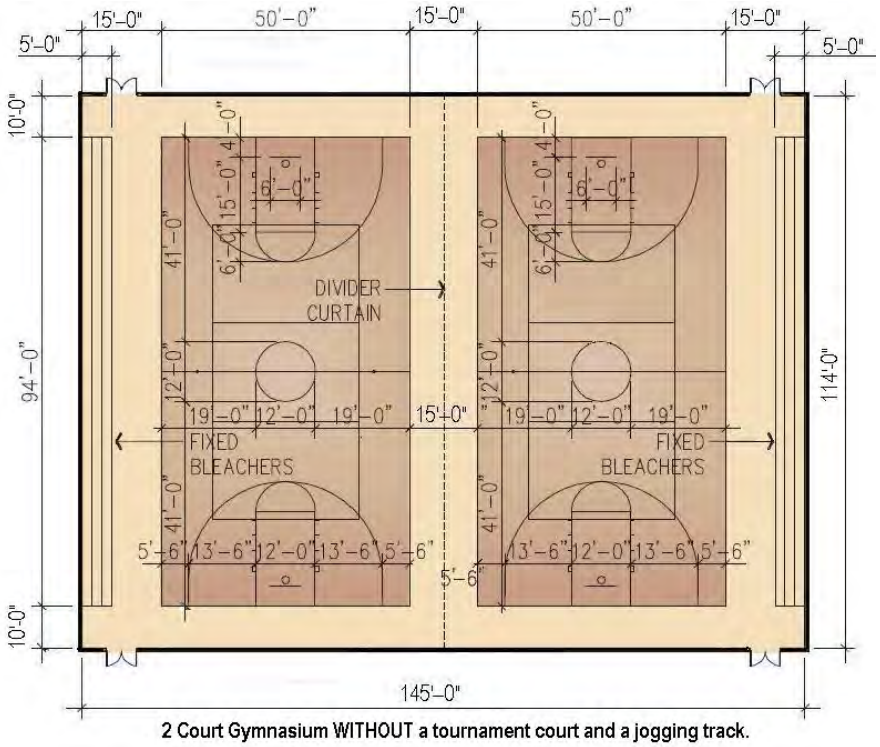


2 Court Gymnasium WITH a tournament court and/or a jogging track

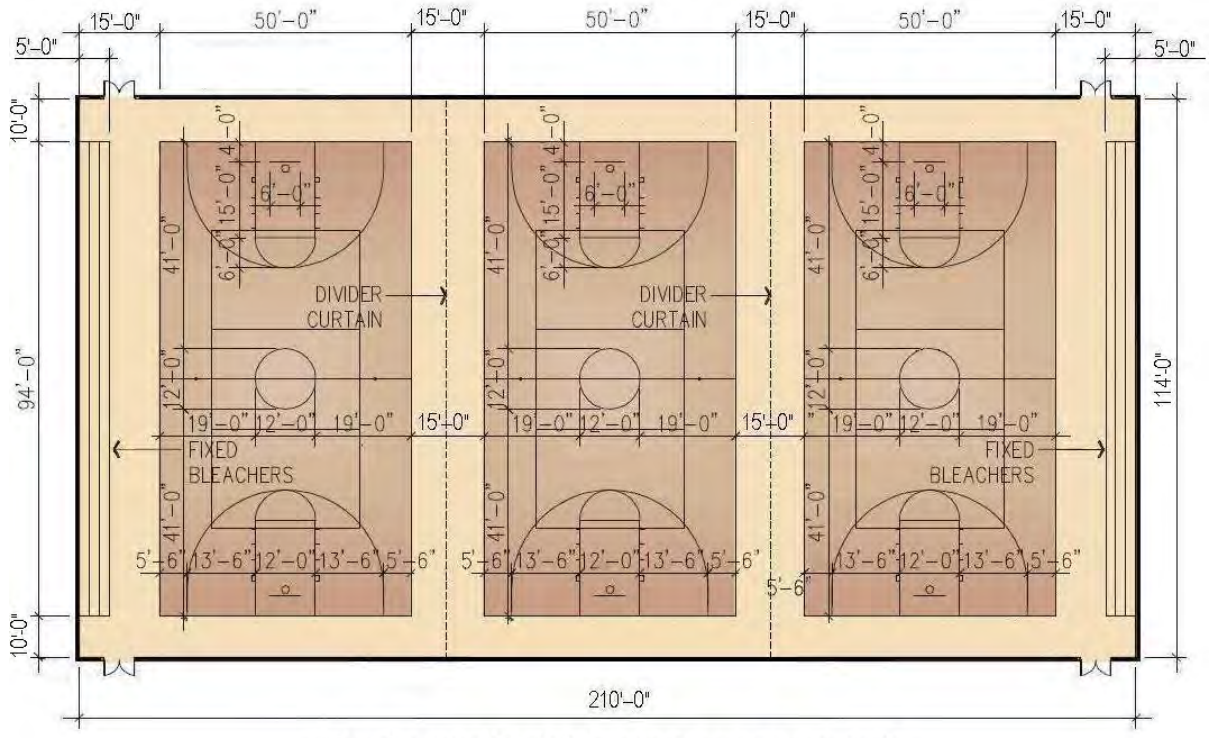
Tournament court is not shown, however it would be perpendicular to and centered over the 2 courts shown.



3 Court Gymnasium WITH a tournament court and/or a jogging track.
Tournament court not shown, however it can be perpendicular to and centered over 2 courts, or over all 3 courts.

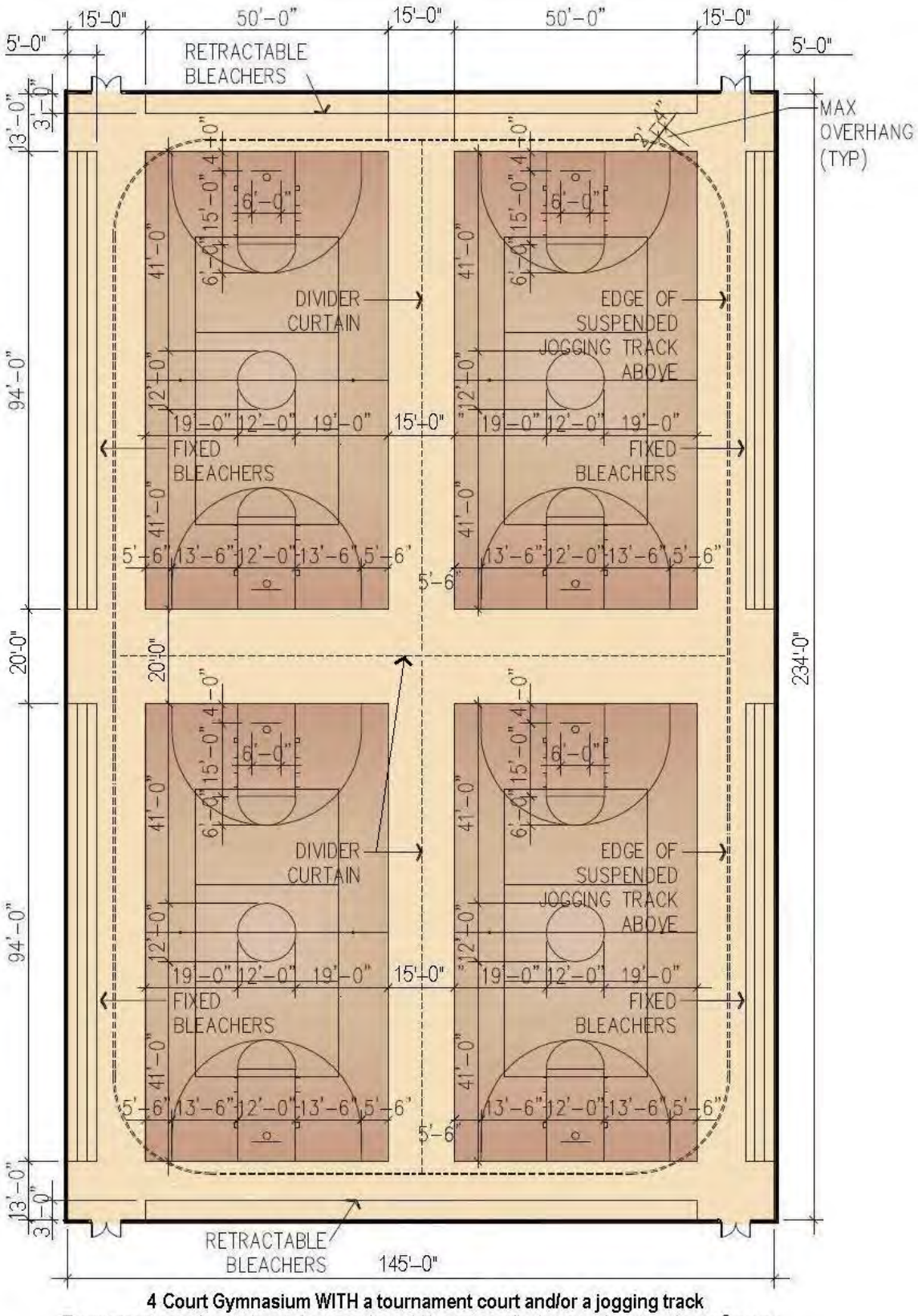


2 Court Gymnasium WITHOUT a tournament court and a jogging track.



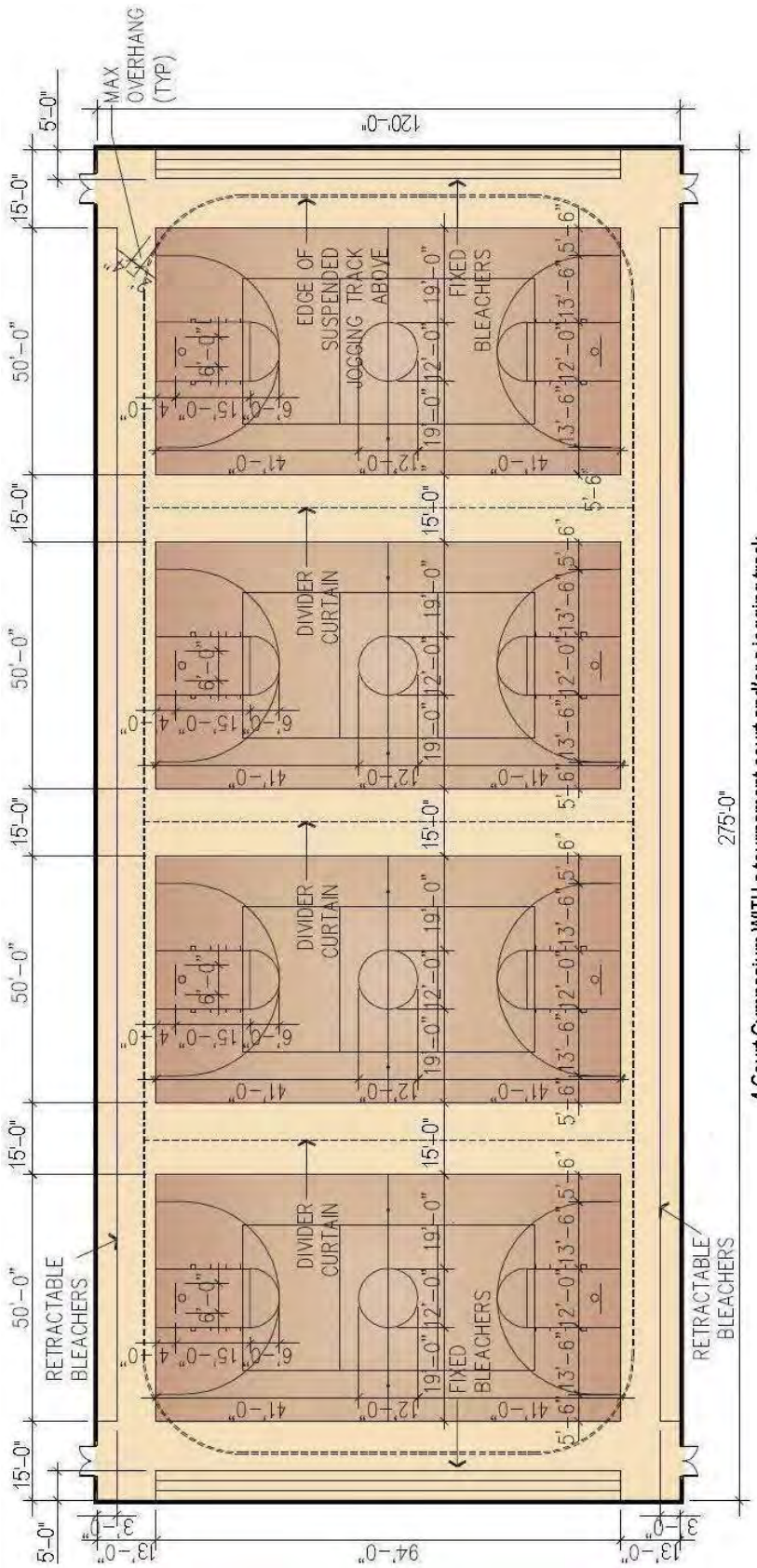
3 Court Gymnasium WITHOUT a tournament court and jogging track

Provided below are recommended layouts for a 4-court gymnasium. Often times, a 4-court gymnasium will be broken into 2 separate gymnasiums. Coordinate with the user to determine their needs. In most cases a jogging track and/or a tournament court will be provided, which will result in the layouts shown below. If all 4 courts are to be in one gymnasium, option A is better for intramural play as fixed bleachers are provided for each court. Option B is better if a tournament court is required, and less emphasis on intramural play since it will allow for the retractable bleachers on both sides. Option A, as shown, is slightly larger than Option B. If a tournament court is not provided, the retractable bleachers will not be provided, however there is no reduction in the dimensions. If neither a tournament court nor a jogging track is included in the project, the gymnasium will be reduced by the 6’ retractable bleachers (2 sets of 3’ deep), and the space savings added to the Structured Activity Module for use in other functional areas.



4 Court Gymnasium WITH a tournament court and/or a jogging track
Tournament court is not shown, however it would be perpendicular to and centered over 2 courts

OPTION A



4 Court Gymnasium WITH a tournament court and/or a jogging track.
Tournament court not shown, however it will be perpendicular to and centered over 2 courts.

OPTION B

INDOOR JOGGING TRACK

FUNCTION/DESCRIPTION:

The indoor track provides space for running, jogging, and walking. It is expected that the track will be suspended above the gym area as shown in the previous diagrams.

ESSENTIAL DESIGN REQUIREMENTS:

- Track shall have 3 lanes.
- The inner-most lane of the track shall NOT have banked corners to accommodate ADA requirements. The other lanes shall have banked corners
- The lobby, and track entrance, shall be located as close to the middle of a straight-a-way as possible.
- Lane width shall be 42".
- The minimum radius of the inside corners is 20'

DIRECT ADJACENCIES:

- The jogging track shall be directly adjacent to a lobby area with space for stretching. In addition, some pieces of cardiovascular equipment may be located in this lobby area. The lobby area will open directly on to the track without a door to avoid potential conflicts of opening the door while standing on the track. The larger the opening between lobby and track, the better.

CEILING HEIGHTS:

Minimum 10'

FLOORING:

Resilient, cushioned running surface, such as rubber or urethane, with permanent lane lines.

PLUMBING:

Water fountains: An electrically cooled water cooler must be provided in or adjacent to the track lobby area.

MECHANICAL (HVAC):

Mechanical heating, ventilation, and humidity control of the module is mandatory. The requirements are the same as the space in which the track is located.

WINDOWS AND DOORS:

It is ideal to provide views to the outside along the track. However, it is important to avoid glare and direct sunlight.

FIXED EQUIPMENT;

Provide cubbies in the lobby area for storage of smaller personal items.

LOCKERS, SHOWERS, TOILET, SAUNA

FUNCTION/DESCRIPTION:

Support space to facilitate showering and changing before and after physical activities. Half and full lockers are provided in each locker room. Showers are programmed to provide individual cubicles with dressing compartments.

ESSENTIAL DESIGN REQUIREMENTS:

- Individual shower stalls and drying booths for both the men's and women's locker rooms are required.
- If a whirlpool is provided within a locker/shower area, ensure that maintenance can be performed outside of the locker/shower area.

DIRECT ADJACENCIES:

- Main corridor system
- Major activity components such as Fitness and Gymnasium
- If a natatorium is included as part of the project, or anticipated as an addition in the future, the locker rooms shall be designed to provide an entrance to the natatorium in the wet portion of the locker/shower/toilet area.

CEILING HEIGHT:

10'-0" minimum in locker area except where furred down. 9'-0" minimum in shower and toilet areas.

MATERIAL DEFINITION:

"Wet areas" are defined as rooms where direct contact at walls and floors with water is expected. This includes showers, drying areas, and toilet / grooming areas directly adjacent to the showers. Wet areas may be considered "humid" space.

"Humid" is defined as above 60% relative humidity during typical room function over the entire period of normal hours of operation. Humid areas include locker rooms adjacent to showers and toilet rooms open to shower areas. Humidity varies by degree with "high" humidity occurring only in areas with continuous open water sources such as whirlpools, steam rooms, and swimming pool areas.

CEILING FINISHES:

General provisions: Highly light reflective and sound absorbent materials for locker areas. Provide 2'x 4' or 2'x 2' lay-in, wet-formed mineral fiber acoustical panels, on "humid" rated "T" shaped pre-finished metallic grid system. 15/16" or 9/16" wide "T" grids are preferred. Non-directional fissured face designs are preferred to reduce installation cost and waste. Provide "Flush" (Square edge) edge design.

Sound absorption for acoustical panels: No less than .55NRC for standard tiles, .70 for film or ceramic faced units.

Locker Room - Humidity and mold resistance: Manufacturers offer "plastic" film faced units, ceramic, and painted finishes for humidity and mold control. Most standard tiles are "non-sag" but not mold resistant. Units should be treated for low moisture absorption and mold formation. The most expensive (high humidity resistant) to least expensive (adequate humidity resistance) ceiling tile options are: 1) Aluminum grid with ceramic faced tiles, rated for wet (pools) conditions. Use with extreme peak load activities and constant humidity (100%) produced by existing, deficient air handling systems or constant shower activity. 2) Factory applied paint finish for steel grids rated for "humid" conditions with ceramic faced "high humidity" tiles or "high humidity," unfaced tiles. Recommended as best cost to benefit ratio. 3) Factory applied paint finish for steel grid with "humid" rated tiles. Lower initial cost offset by higher maintenance costs.

Toilet and Shower - Humidity and mold resistance: Provide veneer plaster finish on gypsum board or true plaster on mesh lath or plaster base (board) ceilings in shower rooms. Toilet rooms can use painted, suspended gypsum board ceilings. Where shower / toilet room combinations exist, use plaster finished ceilings of either type. Epoxy paint system typical throughout. Use dropped soffits or false gypsum board beams between toilet / shower areas and locker rooms. This will divide ceiling systems and provide a barrier, at the ceiling line, for odor and moisture confinement to the higher humidity areas.

WALL MATERIALS:

Provide ceramic tile, full height in showers, behind toilets and urinals (as per most health codes), and as a 4' high wainscot throughout the room(s). Minimum acceptable is "full" height ceramic tile defined as 6' - 8' above the finished floor at toilets, full height at showers and deleted elsewhere. Use gloss finish tiles. Consider creating a pattern of accent tiles or trims in complimentary colors to improve visual appearance. Avoid using darker colors as the main background color. Partial height ceramic tile or fiberglass panels in shower units are not allowed. Use bullnose edge tiles at all outside corners. Use coved base tiles to match wall or floor system. Do not use wood base. Do not use rubber or vinyl base in wet areas.

Where ceramic tile is not used, epoxy paint system is required for optimum moisture and stain resistance.

FLOORING:

Locker rooms: Slip-resistant quarry/porcelain tile floor to match shower and toilet rooms. As an alternative, only when approved by the user, solution dyed, level loop nylon carpet, with microbial treatment for resistance to mold and mildew can be used. Carpet to be 26 oz yarn weight, 45-60 oz finished weight with woven polypropylene backing. 5/64 gauge minimum. 10 year wear / abrasion warranty. Minimum pile height .166" to .1875".

Shower and toilet rooms: Ceramic mosaic tile. 2" x 2" preferred. Mud set with floors sloped to drain. Slope to drain in showers (located one per cubicle), keep flat in toilet rooms with slight depression around floor drains. Overall floor slope should not exceed 1/2" in 10'-0". Wet and dry skid resistance is the priority. Non-glazed mosaic tiles for floor use are typically provided with a roughened face texture. Natural (flat) finish tile may also be satisfactory.

PLUMBING:

Plan on grouping toilets and urinals. Whenever possible, provide back to back plumbing for efficiency. Locker rooms and wet areas should be separated by a full-height barrier. Provide automatic sensors for faucets and toilets/urinals. One, electrically cooled, two station unit, designed for ADA use, shall be provided in each locker room or one unit shall be located directly outside the main entrance to the locker rooms.

Floor drains: Provide one drain per shower, and one floor drain per 250 square feet of floor area. Typically, one drain centered near toilet / urinal wall is adequate for unexpected overflows.

MECHANICAL (HVAC):

Mechanical heating, ventilation, and humidity control of the module is mandatory. Shall exceed the current ASHRAE requirements.

Operating range: System able to maintain 70 - 78 degrees (F) year-round at 50% relative humidity or less. Shall meet or exceed ASHRAE 62 for the ventilation rate.

Temperature controls: Independent to room, solid state and programmable. Ability to control peak and off-peak temperatures with 24 hour or one-touch setback programming recommended.

Air movement / control: Fully ducted supply and return. Dedicated supplemental exhaust for toilets. Passive or plenum return not recommended. Supply diffusers are to be adjustable metal grilles with four-way air movement and blade-type vanes. Return air grilles may be perforated plate or blade type. All diffusers to be pre-finished.

Ductwork shall be insulated sheet metal rectangular or circular duct routed adjacent to diffuser locations. Use flexible duct drops to diffusers. Natural (non-mechanically driven) ventilation is not allowed.

TECHNOLOGY/AV:

Ceiling mounted speaker for public announcements.

Sound system: Flush recessed ceiling speakers, 10 watt minimum output rating, capable of reproducing human speech, minimum. Speakers shall be weatherproof in wet areas.

Provide for wall-mounted flat-screen televisions throughout the locker rooms.

WINDOWS AND DOORS:

Views into the space are prohibited. Aluminum or hollow metal frames are recommended. Natural light can still be provided by use of translucent glazing panels.

FIXED EQUIPMENT:

Lockers, benches, wall mounted hair/hand dryers. Lockers must be a minimum of 15” wide and 18” deep. Minimum height is 30” per half locker. Use of “Z” lockers to provide additional height is required. There will be a combination of full-height and half-height lockers, the ratio of which is determined by the installation based on climatic concerns. Lockers shall not be metal or plastic laminate faced, and shall be durable. Solid plastic or color through phenolic is preferred. Lockers will allow for user supplied locks or be electronically locking, based on installation requirements.

SAUNA

FUNCTION/DESCRIPTION:

General provisions: A sauna is a supplemental space within the locker area. Guidelines for this module assume the presence of changing rooms and construction quality similar to the gymnasium module. Sauna rooms can take the form of:

1) a custom built space of any size with heating equipment and finishes designed specifically for that space,

2) a prefabricated assembly shipped broken down to the site and reassembled in place with all heating, lighting, controls, and accessories provided, or

3) a hybrid of a field constructed enclosure, utilities and controls, and specialized room finishes, purchased separately and installed on site. The guidelines provided herein are suitable for building any of the three types listed above.

ESSENTIAL DESIGN REQUIREMENTS:

- Separate saunas must be provided for men and women. Saunas shared by both genders are not allowed.
- Sauna controls are to be accessible to staff only.
- Provide a panic button in sauna, which is connected to the control desk.

DIRECT ADJACENCIES:

Locker Room, Shower, Toilet, Cool-down area

CEILING HEIGHT:

8'-0" minimum.

CEILING FINISHES:

Plaster veneer over gypsum / cement composition board. Moderately light reflective, smooth trowel finish.

WALLS:

Sauna interior finish: ½" thick x nominal 4" wide natural finish redwood tongue and groove boards.

The veneer wall system should be placed over a 3 mil continuous sheet of polyethylene film to act as a vapor barrier and seal the room. The vapor barrier is attached to 1 ½" thick treated wood furring strips at 24"o.c. To insulate the sauna partition and reduce heat loss, in-fill the space between the furring strips with 1 ½" thick extruded polystyrene rigid insulation.

Ferrous metals: Do not use any ferrous metal products within the sauna interior. It is recommended that all fasteners and hardware are stainless steel. Exceptions are noted below.

FLOORING:

Machine milled and formed ¾" thick minimum, solid redwood strip flooring mounted on cross aligned ¾" thick redwood sleepers. (Overall floor thickness of 1 ½."). Floor boards are visually run in a single direction in an open slat design with ¼" gaps between boards. Floor loose laid in 2' x 2' modules for easy removal for periodic maintenance / cleaning of the concrete substrate. Recess slab as required.

PLUMBING:

No plumbing provisions for this module.

MECHANICAL (HVAC):

Outside mechanical heating and cooling is not applicable. Air movement is accomplished via passive ceiling and floor mounted vents, typically 24 square inches total for every 100 plan square feet, assuming 8'-0" ceiling height.

4 air changes per hour.

Temperature controls: Independent to room - Range 170 to l80 degrees F.

Relative humidity 5%.

WINDOWS AND DOORS:

Door must open outwards.

EQUIPMENT CRITERIA:

Seating benches: Expect to provide continuous 24" deep x 18" high, two tier bench seating constructed from 2 x 4 solid redwood boards. Benches are generally arranged along two walls contiguous with one another. Redwood grade for benches is premium grade. Fully sanded and sealed. All edges of every board in the bench construction shall be eased and sanded smooth.

Sauna dry heat system: Estimate 1.7 KW per 100 square feet of sauna. Coordinate power with electrical provisions for the space. Factory wired timer for the heating unit is typically provided. Thermostatic and / or heat setting control is usually an option purchased with the

equipment. Controls remote from heating unit housing will need to be coordinated in advance and wired by others during construction.

Provide a unit with a grated 30# or 60# (greater heat storage capacity) lava rock compartment.

Sauna accessories: Room temperature and humidity gauge, wall mounted. Optional towel or robe pegs, wall mounted.

ARRANGEMENT:

Provided below are illustrations of locker/shower/toilet/sauna rooms for different sizes of PFF. Another consideration, which is not shown in the diagrams below is the inclusion of a "convertible" locker room. The convertible locker room is a smaller room with lockable access from both the men's side and the women's side. When needs shift, one of the doors can be locked to provide a larger ratio of lockers to a specific gender.

X-Small:

X-Small - Sauna, Lockers, Toilet Module

Sauna, Lockers, Toilet
Total Square Feet = 2,550 (288 total lockers)
Men - 144 Lockers - 48 full, 96 double tier
Women - 84 Lockers - 28 full, 56 double tier

Small:

Small - Sauna, Lockers, Toilet Module

Sauna, Lockers, Toilet
Total Square Feet = 3,630 (354 total lockers)
Men - 231 Lockers - 77 full, 154 double-tier
Women - 123 Lockers - 41 full, 41 double tier

Medium:

Medium - Sauna, Lockers, Toilet Module

Sauna, Lockers, Toilet
Total Square Feet = 5,887 (573 total lockers)
Men - 372 Lockers - 124 full, 248 double tier
Women - 201 Lockers - 67 full, 134 double tier

Large:

Large - Sauna, Lockers, Toilet Module

Sauna, Lockers, Toilet
Total Square Feet = 9,022 (855 total lockers)
Men - 557 Lockers - 185 full, 372 double tier
Women - 298 Lockers - 100 full, 198 double tier

LOBBY AREA

FUNCTION/DESCRIPTION:

A transitional space used for visitors and users to check-in upon entry and orient themselves to various activities. Also provides a waiting area. A control counter is required within the lobby to facilitate security procedures and to issue and collect equipment such as basketballs, volleyballs, towels, etc. The Lobby area consists of the Entry Lobby, Waiting/Display area, Control Counter, Equipment Storage, and Vending. The breakdown of individual spaces in the Lobby Area is provided in the chart at the end of the Administrative section.

ESSENTIAL DESIGN REQUIREMENTS:

Control Counter Requirements:

- Staff MUST have direct visual and physical access to free-weight area. The free-weight area is the location with the largest potential for injury. The staff at the desk must be able to see and respond to any unsafe behavior or incidents immediately. Providing elements that obstruct or impede this are not acceptable.
- Staff must be able to control who enters the building, and be able to provide a convenient check-in arrangement.
- Staff must have visual access or total coverage video-surveillance of cardiovascular area, circuit area, gymnasium and exercise areas.
- Staff must have visual access or video-surveillance of the entrances to the locker room and the general area of the racquetball courts.
- Storage must be provided behind the counter or in an adjacent room for issue items such as balls, towels, racquetball goggles, etc.

DIRECT ADJACENCIES:

- Entry Vestibule and vertical circulation to upper level areas.
- Control Counter must be adjacent to the free weight area, and must have direct access to this area, for safety reasons.
- The preferred adjacency for the lobby is as a link between the gymnasium and the rest of the facility so that the gym can function independently during off hours when the remainder of the building is shut down.

INDIRECT ADJACENCIES:

- Corridor system to activity areas.
- Restrooms.
- Laundry.

CEILING HEIGHT:

10'-0" and above preferred with 9'-0" min. to lowest ceiling element over control desk.

The intent for lobby ceiling design is to encourage interest and traffic into the facility. Bright, open volumes with views into the facility provide that impression. Though higher ceilings will

require an increase in heat / cooling input, it is recommended that the facility utilize the largest volume possible within the space criteria guidelines.

CEILING FINISHES:

Highly reflective and sound absorbent materials. If an acoustical lay-in ceiling system is used, consider options for face design that introduce a distinctive element to the lobby space. Recommend use of tegular tiles if a lay-in system is used. Consider lighting placement and lamping types while considering ceiling design. The lobby is the primary area to consider decorative fixtures which may require areas of the ceiling reserved for pendant hung fixtures and/or up-lighting of ceiling features. See lighting guidelines below.

Additional Considerations: Other ceiling treatments are acceptable, as described below.

Accent functional areas, "mirror" floor patterns, or improve aesthetics by the addition of single layer, gypsum board "dropped" soffits or bulkheads on metal studs. Use of dropped soffits allows concealment of lower items (i.e. ceiling fans, structure, or utilities) while allowing the majority of ceiling to be increased in height. Install around perimeters of rooms, or across ceilings in an arrangement of "false beams." Area of solid, sound reflective surfaces should not exceed 15% of the total ceiling area. "Modular" soffit arrangement: Where possible, design and size soffits and bulkheads to allow the use of full acoustical panels in each direction. For non-modular areas, center ceilings by using balanced border widths where panels are cut to fit.

If the lobby is a part of an overall large volume area, it is also appropriate to not provide a ceiling. Provide sound absorption through either suspended or wall-mounted acoustical panels or baffles. Consider use of a lower element over the control desk to provide a visual focal point and to bring the scale down to a more human scale.

Coordinate lighting: With direct lighting (recessed in ceiling) locate bulkheads and acoustical panel arrangements with the optimum lighting locations first, then consider the pattern of the panels and placement of bulkheads. Consider pendant hung decorative lighting. Where soffits exceed 36 inches in width and/or 12 inches in depth, consider supplemental lighting in the bottom of the soffit to avoid shadowed areas across the ceiling plane or at upper portions of wall planes.

WALL MATERIALS:

Consider use of accent materials or textures.

FLOORING:

Selection criteria are based on appearance, durability, and yearly maintenance.

Recommendations include terrazzo, porcelain tile, and ceramic tile. Each material has certain advantages / disadvantages. Sealed colored and patterned concrete may be considered as an option for lobby and circulation areas. Plain sealed concrete is not acceptable.

Resilient Tile is not allowed for lobby due to aesthetics and durability. Carpet is not allowed due to high frequency traffic and direct adjacency to the outside.

Each entry shall have a recessed mat, constructed of pre-finished metal retaining strips with nylon fiber, or shredded rubber inserts. Semi-open design. Floor mat recesses shall span the width of the entry opening or vestibule and be 4'-6' long in the direction of travel. Mats are intended to be removable to facilitate periodic cleaning of the mat and the floor recess. Floor drains under the mats are optional but recommended for heavy rainfall or snowfall locations.

NATURAL LIGHTING:

Lobby appeal is enhanced by a combination of natural and artificial light. Centrally located skylight or clerestory window for hub type lobby or several smaller skylights/clerestories for linear spaces is highly recommended. Attempt to position natural light to accent control area. The Army prefers the use of clerestory windows over the use of skylights.

PLUMBING:

One, electrically cooled, two station unit, designed for ADA use, linked to the public restroom function in or adjacent to the lobby. The drinking fountain count throughout the facility must meet code for peak occupancy levels.

MECHANICAL (HVAC):

Outside air infiltration should be controlled with use of a vestibule / airlock with two sets of entry doors.

Operating range: System able to maintain 68 to 76 degrees (F) year round at 50% relative humidity or less. Shall meet or exceed ASHRAE 62 for the ventilation rate.

Temperature controls: Independent to zone.

LIGHTING:

Main module lighting to be a combination of 1) recessed fluorescent down lighting (PL lamps) with pendant hung decorative lighting or 2) pendant hung direct / indirect fluorescent fixtures. Decorative wall sconces or other decorative fixtures are recommended to accent functions or highlight focal points.

Provide lobby lighting control center at control desk. Dimming function is not required but should be considered as an option.

Provide down lighting directly over all control desk counters.

Provide display lighting within casework for merchandising or issue functions at Control desk.

Provide under cabinet lighting of counters where wall cabinets are used. Low profile LED lighting is acceptable under cabinet lighting. In addition, linear low profile fluorescent or "puck" style metal halide is acceptable. Metal halide system requires concealed low voltage power supply.

POWER:

Power to circuits as needed to Control Desk, for computer terminals (2 minimum in the X-small and Small, 3 minimum in the medium, 4 minimum in the large and X-large), counter mounted video monitors, multiplex video receiver, tape backup, sound processor for multiple paging sources, music source (such as a CD player) and sound amplifier.

Utilize custom raceway in casework. See Architectural Woodworking guidelines above.

TECHNOLOGY/AV:

Main power and communications needs are at the Control Desk.

Empty conduit routing, (recommend 2" min. diameter) for present or future video cabling from security camera sources around facility. Stub up into base cabinets and continue up into ceiling cavity above control desk.

SOUND:

PA system shall be provided, and shall be controlled from the Control area. PA system shall be able to broadcast through the entire facility at once, or multiple rooms, or a single room. Shall be able to broadcast voice and music.

WINDOWS AND DOORS:

Window and Door requirements shall meet the Force Protection / Anti Terrorism requirements.

Aluminum framing preferred, with hollow metal frames acceptable.

Provide aluminum entrance frames with an insulated aluminum door (i.e. as if for exterior use) with an insulated glass insert for all exterior frames. Option exists to continue use of aluminum framing and aluminum / glass doors within the lobby for openings visible from within the lobby area. Aluminum finishes may then match in color / sheen and durability.

Utilizing aluminum window system framing to create large open views into adjacent activity spaces and /or to the exterior is highly recommended. Window shading devices may become necessary for tall glass with south to southwest exposures. Consider afternoon sun angles and control desk locations to avoid glare conflicting with the control desk monitoring functions.

Tempered glass is typical to the module.

Door hardware: Satin stainless steel or satin finish chrome preferred. High frequency ball bearing butt hinges are an acceptable minimum. Continuous gear-operated hinges preferred. Concealed or surface applied pivot hinges are not recommended. Continuous hinges will require custom color coordination with the door frames.

FIXED EQUIPMENT:

Architectural Woodwork: For the control counter, provide a visually attractive focal point for 1) entering patrons, 2) control and security functions, and 3) information. The control area shall be contiguous with both the Lobby and Fitness modules. Expect to provide counters and casework for a minimum of two stations / control personnel within a desk area in a small facility. Add 1 person for each size larger than a small. Make provisions for lower counter for ADA access. Provide two tier counter system, more to block view of countertop clutter and controls, than as a privacy barrier. Direct visual control of lobby and fitness areas is critical. "Back wall" (if available) counters may be standard seating height for more extended paperwork functions. A minimum of 50% of the counter shall be standing height.

Casework: Premium grade. Recommend all wood construction for flexibility in configuration. Solid wood fronts, veneer plywood exposed sides and knee spaces. Interior dividers may be fused and bonded vinyl or plastic laminate particle board. Recommend only 3/8 inch thick min. plywood for shelving 3'-0" wide and under (1/2 inch thick otherwise), with wood veneer or fused and bonded vinyl finish. Solid wood face edging for shelving and door edges recommended. PVC edging is an alternative.

Counters: Solid ½ to ¾ inch thick polymer resin counters. Provide 1 ½ inch dia. half round edges. Avoid square edges toward patrons. Provide stone or solid surface counters for durability (Plastic laminate is not acceptable). Drawer and door hardware: to be commercial grade. Drawer glides to be side mounted, and use ball bearings and/or nylon wheels with minimum 75 lb. capacity for drawers less than 2.0 cu. ft, minimum 100 lb. capacity for drawers between 2.0 and 4.0 cu. ft., and minimum 150 lb. capacity for drawers larger than 4.0 cu. ft. Guides shall be provided with positive out and in stops. Use concealed door hinges and an integral pull or any metal cabinet pull style. Plastic or nylon pulls are not allowed. Provide through the counter grommets for covering holes needed for computer and device wiring from counter mounted devices.

ADMINISTRATIVE

FUNCTION/DESCRIPTION:

Administration space (offices, work/break room, meeting space) for facility director and staff.

The breakdown of individual spaces in the Administrative Area is provided in the chart at the end of this section.

DIRECT ADJACENCIES:

Typically, offices are centralized with individual offices connected to an open office core for shared administrative services. The office suite does not have to be adjacent to the control desk. It is preferred that this area be away from the main entry, as it is desired that the facility portrays an active facility upon entering, as opposed to an administrative facility. If a large Training/Conference Room is provided, it is strongly desired that this room be accessible from the corridor as well as the admin office area. The door into the admin office area should be lockable to avoid access during after hour meetings or training.

CEILING HEIGHT:

9'-0" minimum.

CEILING FINISHES:

Highly reflective and sound absorbent materials. Provide 2'x2' lay-in, wet formed mineral fiber acoustical panels, on standard "T" shaped pre-finished metallic grid system. 15/16" or 9/16" wide "T" grids are base selection criteria. Tegular (routed edges) tiles are preferred. Random fissured, non-directional face design preferred. Main offices or conference / office space may benefit from continuing a textured or decorative face tile from centralized office entry points in an office suite. Avoid solid gypsum board ceilings. Perimeter soffits are acceptable. Maintain access above ceilings for HVAC maintenance and future data network upgrades.

WALLS:

Acrylic latex paint with "eggshell" finish is minimum. Vinyl Wall Covering may also be considered.

FLOORING:

Carpet is principle material for centralized office suites. Carpet tiles are preferred, the minimum is commercial, solution dyed nylon in 26 oz yarn weight, 45 oz total finished weight. Provide carpet with static control. Increasing total finished weight closer to 60oz is preferred. Carpet should be darker tones and patterned to hide stains. Provide vinyl or rubber base. VCT is allowed in the Administrative areas where carpet is not desired or appropriate.

PLUMBING:

In the copy/file/work/break room, provide a minimum 1 compartment kitchen-style sink, plus water hook-up for icemaker in refrigerator.

MECHANICAL (HVAC):

Outside air is not recommended. Air movement should be controlled with ducted supply to each office. Variable air volume (VAV) devices are recommended for thermostatically controlling individual offices. Office temperature controls may be centralized as a minimum, with individual controls preferred.

Utilize main corridors as ducted or plenum return air paths for office suites.

Provide acoustically lined ducts when routing ducts across several grouped offices.

For sound transfer control between offices, always maintain at least two elbow turns in hard ductwork prior to connecting the main duct run to a flex duct to ceiling diffusers.

Operating range: System able to maintain 68 to 76 degrees (F) year round at 50% relative humidity.

LIGHTING:

Flush edge lens frames are minimum; chamfered lens frames preferred. Indirect lighting, to reduce computer glare, would be preferred. Add recessed fluorescent downlighting for accent effects in main office or waiting spaces to office suites. Lay-in lighting fixtures with integral HVAC diffusers in a slot arrangement on the fixture frame do not provide a good distribution of air and tend to increase air noise; therefore, these are not recommended.

POWER:

In copy/file/work/break room, provide outlets at built-in counter area for microwave, coffee pot, refrigerator, and other cooking devices. Provide ground fault protection of outlets within 6 feet of any water source.

TECHNOLOGY/AV:

Data and telephone cable routed to adjacent to convenience outlets, on desk wall if identifiable at time of design. See furniture considerations below.

Competitive sports or training may require the use of video taping to gauge performance. Offices for fitness directors may benefit from a TV and VCR bracket mounted 72' a.f.f. for the purpose of reviewing video tapes.

SOUND:

None. Avoid extending paging systems into offices or office suites.

ACOUSTICAL PERFORMANCE:

Office walls should maintain an STC (sound transmission class) rating of 45 or better to ensure a minimum level of privacy. This can be achieved typically with a single layer of gypsum board on each side of a metal stud wall extended fully to floor-roof deck above.

If less sound transfer is of primary concern, add 2" thick sound batting to dividing walls in sensitive offices. One additional layer of gypsum board on the room side one is seeking to protect will increase the STC rating to 50-53. Monitor and seal all tops of walls, duct, and pipe penetrations through walls. Sound insulate toilet and roof drain piping in walls shared with offices.

FIXED EQUIPMENT:

Kitchenette Cabinets: Premium grade. Solid wood fronts. Solid wood face edging for shelving and door edges recommended.

Counters: Solid ¾" thick polymer resin counters. Plastic laminate counters not allowed. Drawer glides to use nylon wheels or ball-bearing drawer guides, rated for 50 lbs. minimum.

MISCELLANEOUS:

Furniture Considerations: It is preferred that offices are designed in anticipation of a particular grouping of furniture. It is anticipated that private offices will be outfitted with a modular U-shaped workstation with a conferencing peninsula with 2 guest chairs. Provide adequate shelves and file storage along with a vertical unit to provide space for coat storage. Open offices will typically be a modular 8' x 8' U-arrangement with a guest chair at the end of one leg of the "U". A vertical unit with file drawers and hanging space should be provided at the other end of the "U". Each office will have an ergonomic desk chair. Once satisfied with a basic arrangement, then power and data ports can be located with greater confidence.

Provide space in kitchenette area for a minimum 18 cu. ft. refrigerator at the end of the counter

AUTHORIZED PFF SPACE ALLOWANCE

ADMIN & LOBBY DETAILED AREAS (Areas in square feet) 2/11/10		X-SMALL (251-1000)	SMALL (1001-3000)	MEDIUM (3001-6000)	LARGE (6001-10,000)	X-LARGE (10,001-15,000)	INCREMENT (each 5000 over 15,000)
Admin	Director's Office	120	120	120	120	130	10
	Program Mgr's Office	0	100	100	100	110	10
	Support Staff Workstations	128	128	256	320	384	64
	Copy/file/work/break Room	160	240	160	170	180	10
	Storage	20	29	32	36	40	5
	Classroom/Training Room	0	0	420	420	420	0
	Classroom/Training Storage	0	0	60	60	60	0
	Internal Circulation, (20%)	86	123	230	245	265	21
	subtotal	**514**	**741**	**1,377**	**1,471**	**1,589**	**120**
Lobby	Estimated Lobby	230	440	650	880	1,090	210
	Est. Control Counter/Storage	300	512	725	938	1,151	213
	Estimated Public Restrooms	287	515	851	1,280	1,376	96
	subtotal	**817**	**1,467**	**2,226**	**3,098**	**3,617**	**519**

LAUNDRY

FUNCTION/DESCRIPTION:

Laundry for cleaning and distribution of towels and/or sports gear, and includes extractor(s), tumbler(s), laundry sink, folding table, storage cabinet, and space for laundry carts.

DIRECT ADJACENCIES:

- Laundry may need to be in close proximity to the Control Area depending upon staffing levels and anticipated usage.
- A connection to a service corridor and one outside wall is also preferred.

CEILING HEIGHT:

9'-0" minimum.

CEILING FINISHES:

Highly reflective and moisture resistant materials. Provide 2'x2' or 2'x4' lay-in, wet formed mineral fiber acoustical panels, on phosphatized or otherwise humidity controlled "T" shaped pre-finished metallic grid system. 15/16" or 9/16" wide "T" grids are base selection criteria.

Face design: Random fissured, non-directional face ceramic frit (film faced tile) is minimum and preferred.

Edge design: "Flush" (square) edge. Avoid textured surface tiles or expending resources on decorative tiles. Laundry issue rooms will require flat, cleanable tiles to maintain their appearance.

Impact resistance: Standard durability rating. High impact resistance preferred.

Humidity: Non-sag, humidity controlled tiles.

Material specifications and lighting: 2’ x 2’ or 2' x 4' lay-in recessed fluorescent fixtures with prismatic lenses, mounted in the ceiling grid are minimum. Fixtures to be rated for damp conditions.

WALLS:

Must be appropriate for damp/humid location.

FLOORING:

Sealed concrete floors preferred. Provide 4" raised concrete platforms for washers and dryers.

PLUMBING:

Provide one exposed hot and cold water manifold with taps at each machine, to serve washing machines. Provide one individual floor drain for each machine, located to the back right corner. Manifold and drains should fall within a 2'0" alleyway created behind any bank of machines. Pipe manifold shall be 36" high at individual taps. Insulate all cold and hot water lines. Provide a laundry sink.

MECHANICAL (HVAC):

Outside air is not recommended. Air movement should be controlled with ducted supply and make up air balanced against dryer exhaust. Variable air volume (VAV) devices are recommended for thermostatic control. Ducted return air.

Dryer exhaust ducts will impact headroom clearances if dryers are not located directly on an outside wall. Size dryer equipment as early in the design process as possible. Locate or group dryer ducting and plan for an exhaust route to the outside when locating space.

If gas operated dryers are used, path for vertical flues shall be provided.

Operating range: System able to maintain 68 to 76 degrees (F) year round at 50% relative humidity. Shall meet or exceed ASHRAE 62 for the ventilation rate.

TECHNOLOGY/AV:

One data and telephone port.

SOUND:

None. Avoid extending paging systems into Laundry rooms.

ACOUSTICAL PERFORMANCE:

Guard against sound transfer to adjacent modules with full height walls minimum.

EQUIPMENT CRITERIA:

The following is provided as a planning guideline. Commercial washer extractors and dryer tumblers shall be used.

X-Small: Provide one 25 lb minimum commercial washer extractor and two 25 lb minimum dryer tumblers.

Small: Provide one 35 lb minimum commercial washer extractor and two 35 lb minimum dryer tumblers.

Medium: Provide two 30 lb minimum commercial washer extractors and three 30 lb minimum dryer tumblers.

Large: Provide two 50 lb minimum commercial washer extractors and three 50 lb minimum dryer tumblers.

For facilities larger than a large: Provide three 50 lb minimum commercial washer extractors and four 50 lb minimum dryer tumblers.

CORRIDORS

FUNCTION/DESCRIPTION:

General building circulation serves to connect spaces visually as well as physically. Corridors should be broken into two main functions, central public axis and service corridors. Service corridors are isolated by doors for security and privacy when possible, and connect loading and off-loading entries to mechanical rooms and main corridors, when required.

CEILING HEIGHT:

Public corridors: 10'-0" and above with minimum 9'-0" to lowest ceiling element.

Service corridors: No less than 9-'0"

Ceiling heights serve to identify main public corridors and may vary based on the width and visual axis desired within the facility. Gymnasium and Fitness modules utilize high ceilings and connecting corridors should take advantage of vertical views by use of tall interior window systems when possible. Generally, lobby and main corridor ceiling heights should match, with lower ceilings reserved for service corridors and corridors leading to auxiliary spaces serving the main module. If the corridor ceiling must be lower than the Lobby, then the transition between the lobby and corridor needs to be designed so that it is apparent that the corridor is the primary circulation path.

CEILING FINISHES:

Highly reflective and sound absorbent materials. Provide 2'x2' or 2'x4' lay-in, wet formed mineral fiber acoustical panels, on standard "T" shaped pre-finished metallic grid system. 15/16" or 9/16" wide "T" grids are base selection criteria. See optional considerations below.

Ceiling design: Public corridors are to follow level of finish and design utilized in the Lobby module. This includes continuation of dropped soffits or false beam patterns utilized in the Lobby module. Refer to design considerations in that module for more details. Service corridors out of public view and secondary corridors not visually connected to main corridor ceilings may reduce finishes to minimums.

Material Specification & Lighting: Refer to Lobby module guidelines.

Special considerations: Main corridors will serve as routes for hidden utilities. Use accessible ceilings as much as possible. Avoid large areas of dropped gypsum ceilings as accents in corridors unless dedicated accessible paths for utility routing can be accommodated. Use of gypsum board decorative ceilings should take into account HVAC and plumbing valves, damper and control locations above hard ceilings. These will require access doors to service these devices that will detract from the visual impact of the space.

Where service corridors will be opened to the outside air on a regular basis, use high humidity rated acoustical tiles.

FLOORING:

Public corridors can extend the Lobby module finishes. Hard durable surfaces are required. Resilient (VCT) tile is not allowed.

Service corridors: resilient tile preferred with clear or tinted sealed concrete as a minimum.

PLUMBING:

A drinking fountain may be required along main corridors. When required, provide one electrically cooled two station unit, designed for ADA use.

TECHNOLOGY/AV:

Expect main conduit routing and data cable routing to take place in corridor ceilings.

SOUND:

Ceiling mounted voice quality only speakers every 24'-0" o.c. in Main Corridors for paging system. Option to upgrade to music quality speakers if broadcasting of CD quality source is expected. Provide speakers with wide dispersion, 120 degrees or more, for ceilings 12 feet and lower.

V Appendix

DEMAND-BASED STUDY OF CRITICAL FUNCTION MODULES

A study of utilization for each CFM in the Physical Fitness Facility was conducted using National Sporting Goods Association (NSGA) statistics for indoor activities. The NSGA surveys sports participation annually for 64 indoor and outdoor activities. The results are published as Series I and Series II. For purpose of this study, data for activities deemed to be appropriate for programming in a typical PFC were extrapolated from both Series I and II Publications and include:

CFM Component	NSGA Activity	NIRSA Recommended Area
Exercise Module	Aerobic Exercising	50SF per participant
Exercise Module	Calisthenics	50SF per participant
Exercise Module	Step Aerobics	50SF per participant
Exercise Module	Martial Arts	125SF per participant
Exercise Module	Kick Boxing	125SF per participant
Gymnasium Module	Basketball	14 participants (10 + 4 rotating)
Gymnasium Module	Volleyball	16 participants (12 + 4 rotating)
Fitness Module	Exercising w. Equipment	50SF per equipment station 65SF per free weight station
Structured Activity	Racquetball	4 participants per 800SF Court
Indoor Track	Exercise Walking	1 runner per 20 lineal feet
Indoor Track	Running / Jogging	1 runner 20 lineal feet

Assuming that the recreational interests of the AD population are similar to civilians, NSGA participation data is utilized to test each building component for meeting peak demand. Peak contact times vary from activity to activity. For instance, classroom activities require an instructor and participants meeting at a specific time. In a typical day with 16 hours of operation, it is feasible to program classes for two hours in the morning, two hours over lunch, and four hours in the evening. On weekends peak times are expected to be mid morning to late afternoon. Thus, the analysis tests a projected group of participants against a peak window of time that is approximately 55% of the total hours of operation per week.

Individual activities, such as exercising with equipment, have longer peak times (90% of hours of operation). While busiest peak times are anticipated to be early morning, users will access Fitness at all times of the day and evening.

The Gymnasium component is anticipated to have the greatest difficulty meeting peak demand because this activity requires a large number of users coming together simultaneously. Team activities are usually scheduled at lunchtime and evening. The number of players is small relative to the amount of space required for court play. Some court activities will have to be conducted in later hours of daily operation or throughout the weekend. Peak gymnasium hours are anticipated to be approximately 60% of the total hours of operation.

The Indoor Track is expected to have a shortfall of peak time. However, many participants will satisfy their needs by running or walking outdoors. Peak time for the indoor track is projected to be 80% of operating hours. As with fitness, individual participants can access the track at all hours of the day or evening.

The tables on the following pages show a total of available ***contact hours*** for each activity. A contact hour is defined as one user occupying one station for one hour. For example, if an Aerobics Room is 1,200 SF and NIRSA safety standards require 50SF of space for each occupant, than there are 24 ***stations*** in the room. For each one hour class there are 24 available contact hours. If the facility is operational for 100 hours a week, there are 2,400 available contact hours per week. The objective of this study is to compare the total peak contact hours for each CFM to a reasonable projection of participants to determine if each CFM is sized sufficiently to meet peak demand. Standard hours of operation are estimated to be 100 per week based on the following schedule:

PFC TYPE: (250-1000 Pop.)	**X-SMALL**				**ASSUMED MILITARY PERSONNEL:**		**73.9%**	**x 1,000**	**=**	**739**
WEEKDAY HOURS (M-F)	**6:00**	**to**	**22:00**	=	**16 hrs.**	**5days/wk**	=	**80 hrs.**		
WEEKEND HOURS (SA)	**8:00**	**to**	**19:00**	=	**11 hrs.**	**1days/wk**	=	**11 hrs.**		
WEEKEND HOURS (SU)	**8:00**	**to**	**17:00**	=	**9 hrs.**	**1days/wk**	=	**9 hrs.**		
								100 hrs.		

One-hundred hours is used as a baseline for the study and does not affect an installation's plans for staffing and operation under the Army baseline operating standards.

X-Small Facility - maximum population of 1,000 persons - approx. 74% peak users- 100 hours of operation per week

Aerobic Exercise 1,200 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Aerobic Exercising	11.4%	84	x	3 hrs/wk	252 hrs/wk	50 SF/user	24 stas.		
Step Aerobics	3.0%	22	x	3 hrs/wk	67 hrs/wk	50 SF/user	24 stas.		
Calisthenics	5.7%	42	x	3 hrs/wk	126 hrs/wk	50 SF/user	24 stas.		
TOTALS		**148**			**445 hrs/wk**	**50 SF/user**	**24 stas.**		**2400hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**					**22 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**		=	**55 hrs/wk**	**x**	**22 stas.**	=	**1188hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**1188hrs/wk**	**minus**	**445.16 hrs/wk**	=	**743hrs/wk**

Non-Structured Exercise 1,000 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Martial Arts	3.0%	22	x	2 hrs/wk	44 hrs/wk	125 SF/user	8 stas.		
Kick Boxing	2.2%	16	x	2 hrs/wk	32 hrs/wk	125 SF/user	8 stas.		
TOTALS		**38**			**76 hrs.**	**125 SF/user**	**8 stas.**		**800hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**					**7 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**		=	**55 hrs/wk**	**x**	**7 stas.**	=	**396hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**396hrs/wk**	**minus**	**76 hrs.**	=	**320hrs/wk**

Fitness Module (Weight/Cardio) 2,325 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	24.5%	181	x	3 hrs/wk	544 hrs/wk	55.4 SF/user	42 stas.		
TOTALS		**181**			**544 hrs/wk**	**55.36 SF/user**	**42 stas.**		**4200hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**34 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		=	**90 hrs/wk**	**x**	**34 stas.**	=	**3024hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**3024hrs/wk**	**minus**	**544 hrs/wk**	=	**2480hrs/wk**

Fitness Module (Weight/Cardio) 2,325 SF	LNS Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	65.0%	480	x	3 hrs/wk	1440 hrs/wk	55.4 SF/user	42 stas.		
TOTALS		**480**			**1440 hrs/wk**	**55.36 SF/user**	**42 stas.**		**907hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**34 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		=	**90 hrs/wk**	**x**	**34 stas.**	=	**3024hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**3024hrs/wk**	**minus**	**1440 hrs/wk**	=	**1584hrs/wk**

Gymnasium Module 10,200 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Court Size is 50 x 94 for a total playing area of:						4,700 SF	1 court/s		
Volleyball	6.4%	48	x	3 hrs/wk	143 hrs/wk	392 SF/user	16 players		
Basketball	18.3%	135	x	3 hrs/wk	406 hrs/wk	470 SF/user	14 players		
TOTALS (Average for SF/Per and Stations)		**183**			**549 hrs/wk**	**430.8 SF/user**	**15 players**		**1500hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**15 players**		
PEAK UTILIZATION RATE	**60%**	**of Hours of Operation**		=	**60 hrs/wk**	**x**	**15 players**	=	**900hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**900hrs/wk**	**minus**	**549 hrs/wk**	=	**351hrs/wk**

Note: VB assumes 12 players + 4 rotating players for each court. BB assumes 10 players + 4 waiting to rotate in for each court.

Racquetball Court 850 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Racquetball	3.1%	23	x	2 hrs/wk	46 hrs/wk	213 SF/user	4 occup.		
TOTALS		**23**			**46 hrs/wk**	**212.5 SF/user**	**4 occup.**		**400hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**4 occup.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		=	**50 hrs/wk**	**x**	**4 occup.**	=	**200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**200hrs/wk**	**minus**	**46 hrs/wk**	=	**154hrs/wk**

Jogging Track 3,000 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Running / Jogging	14.6%	108	x	2 hrs/wk	216 hrs/wk		48 occup.		
Exercise Walking	28.8%	213	x	2 hrs/wk	425 hrs/wk		48 occup.		
TOTALS		**321**			**641 hrs/wk**		**48 occup.**		**4800hrs/wk**
PEAK ATTENDANCE	**60%**	**of Stations in Use**					**29 occup.**		
PEAK UTILIZATION RATE	**80%**	**of Hours of Operation**		=	**80 hrs/wk**	**x**	**29 occup.**	=	**2304hrs/wk**
AVAILABLE PEAK HOURS FOR ADDITIONAL PROGRAMMING					**2304hrs/wk**	**minus**	**641 hrs/wk**	=	**1663hrs/wk**

Small Facility - maximum population of 3,000 persons - approx. 74% peak users- 100 hours of operation per week

Aerobic Exercise 1,650 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Aerobic Exercising	11.4%	252	x	3 hrs/wk	757 hrs/wk	50 SF/user	33 stas.		
Step Aerobics	3.0%	67	x	3 hrs/wk	201 hrs/wk	50 SF/user	33 stas.		
Calisthenics	5.7%	126	x	3 hrs/wk	378 hrs/wk	50 SF/user	33 stas.		
TOTALS		**445**			**1335 hrs/wk**	**50 SF/user**	**33 stas.**		**3300hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**					**30 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**		**=**	**55 hrs/wk**	**x**	**30 stas.**	**=**	**1634hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**1634hrs/wk**	**minus**	**1335.5 hrs/wk**	**=**	**298hrs/wk**

Non-Structured Exercise 1,000 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Martial Arts	3.0%	66	x	2 hrs/wk	131 hrs/wk	125 SF/user	8 stas.		
Kick Boxing	2.2%	48	x	2 hrs/wk	95 hrs/wk	125 SF/user	8 stas.		
TOTALS		**113**			**226.707 hrs/wk**	**125 SF/user**	**8 stas.**		**800hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**					**7 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**		**=**	**55 hrs/wk**	**x**	**7 stas.**	**=**	**396hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**396hrs/wk**	**minus**	**226.71 hrs/wk**	**=**	**169hrs/wk**

Fitness Module (Weight/Cardio) 4645 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	24.5%	544	x	3 hrs/wk	1632 hrs/wk	56 SF/user	83 stas.		
TOTALS		**544**			**1632 hrs/wk**	**55.96 SF/user**	**83 stas.**		**8300hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**66 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**66 stas.**	**=**	**5976hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**5976hrs/wk**	**minus**	**1632 hrs/wk**	**=**	**4344hrs/wk**

Fitness Module (Weight/Cardio) 4,645 SF	LNS Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	65.0%	1440	x	3 hrs/wk	4321 hrs/wk	56 SF/user	83 stas.		
TOTALS		**1440**			**4321 hrs/wk**	**55.96 SF/user**	**83 stas.**		**8300hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**66 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**66 stas.**	**=**	**5976hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**5976hrs/wk**	**minus**	**4321 hrs/wk**	**=**	**1655hrs/wk**

Gymnasium Module 17,400 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Court Size is 50 x 94 for a total playing area of:						9,400 SF	2 court/s		
Volleyball	6.4%	143	x	3 hrs/wk	428 hrs/wk	392 SF/user	32 players		
Basketball	18.3%	406	x	3 hrs/wk	1219 hrs/wk	470 SF/user	28 players		
TOTALS (Average for SF/Per and Stations)		**549**			**1647 hrs/wk**	**430.8 SF/user**	**30 players**		**3000hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**30 players**		
PEAK UTILIZATION RATE	**60%**	**of Hours of Operation**		**=**	**60 hrs/wk**	**x**	**30 players**	**=**	**1800hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**1800hrs/wk**	**minus**	**1647 hrs/wk**	**=**	**153hrs/wk**

Note: VB assumes 12 players + 4 rotating players for each court. BB assumes 10 players + 4 waiting to rotate in for each court.

Racquetball Court 850 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Racquetball	3.1%	69	x	2 hrs/wk	138 hrs/wk	213 SF/user	4 occup.		
TOTALS		**69**			**138 hrs/wk**	**212.5 SF/user**	**4 occup.**		**400hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**4 occup.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**4 occup.**	**=**	**200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**200hrs/wk**	**minus**	**138 hrs/wk**	**=**	**62hrs/wk**

Jogging Track 4,200 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Running / Jogging	14.6%	325	x	2 hrs/wk	649 hrs/wk		66 occup.		
Exercise Walking	28.8%	638	x	2 hrs/wk	1275 hrs/wk		66 occup.		
TOTALS		**962**			**1924 hrs/wk**		**66 occup.**		**6600hrs/wk**
PEAK ATTENDANCE	**60%**	**of Stations in Use**					**40 occup.**		
PEAK UTILIZATION RATE	**80%**	**of Hours of Operation**		**=**	**80 hrs/wk**	**x**	**40 occup.**	**=**	**3168hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**3168hrs/wk**	**minus**	**1924 hrs/wk**	**=**	**1244hrs/wk**

Medium Facility - maximum population of 6,000 persons - approx. 74% peak users- 100 hours of operation per week

Aerobic Exercise 2,800 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Aerobic Exercising	11.4%	504	x	3 hrs/wk	1513 hrs/wk	50 SF/user	56 stas.		
Step Aerobics	3.0%	134	x	3 hrs/wk	402 hrs/wk	50 SF/user	56 stas.		
Calisthenics	5.7%	252	x	3 hrs/wk	756 hrs/wk	50 SF/user	56 stas.		
TOTALS		**890**			**2671 hrs/wk**	**50 SF/user**	**56 stas.**		**5600hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**					**50 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**		**=**	**55 hrs/wk**	**x**	**50 stas.**	**=**	**2772hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**2772hrs/wk**	**minus**	**2671 hrs/wk**	**=**	**101hrs/wk**

Non-Structured Exercise 2,150 SF	Average Particip.	Projected Participants	Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Martial Arts	3.0%	131	x 2 hrs/wk	262 hrs/wk	125 SF/user	17 stas.		
Kick Boxing	2.2%	95	x 2 hrs/wk	191 hrs/wk	125 SF/user	17 stas.		
TOTALS		**227**		**453.414 hrs/wk**	**125 SF/user**	**17 stas.**		**1720hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**				**15 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**	**=**	**55 hrs/wk**	**x**	**15 stas.**	**=**	**851hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING				**851hrs/wk**	**minus**	**453.41 hrs/wk**	**=**	**398hrs/wk**

Fitness Module (Weight/Cardio) 7,300 SF	Average Particip.	Projected Participants	Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	24.5%	1088	x 3 hrs/wk	3263 hrs/wk	55.7 SF/user	131 stas.		
TOTALS		**1088**		**3263 hrs/wk**	**55.73 SF/user**	**131 stas.**		**13100hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**				**105 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**	**=**	**90 hrs/wk**	**x**	**105 stas.**	**=**	**9432hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING				**9432hrs/wk**	**minus**	**3263 hrs/wk**	**=**	**6169hrs/wk**

Fitness Module (Weight/Cardio) 7,300 SF	LNS Particip.	Projected Participants	Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	65.0%	2881	x 3 hrs/wk	8643 hrs/wk	55.7 SF/user	131 stas.		
TOTALS		**2881**		**8643 hrs/wk**	**55.73 SF/user**	**131 stas.**		**13100hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**				**105 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**	**=**	**90 hrs/wk**	**x**	**105 stas.**	**=**	**9432hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING				**9432hrs/wk**	**minus**	**8643 hrs/wk**	**=**	**789hrs/wk**

Gymnasium Module 24,600 SF	Average Particip.	Projected Participants	Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Court Size is 50 x 94 for a total playing area of:					14,100 SF	3 court/s		
Volleyball	6.4%	286	x 3 hrs/wk	857 hrs/wk	392 SF/user	48 players		
Basketball	18.3%	813	x 3 hrs/wk	2438 hrs/wk	470 SF/user	42 players		
TOTALS (Average for SF/Per and Stations)		**1098**		**3295 hrs/wk**	**430.8 SF/user**	**45 players**		**4500hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**				**45 players**		
PEAK UTILIZATION RATE	**60%**	**of Hours of Operation**	**=**	**60 hrs/wk**	**x**	**45 players**	**=**	**2700hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING				**2700hrs/wk**	**minus**	**3295 hrs/wk**	**=**	**-595hrs/wk**

Note: VB assumes 12 players + 4 rotating players for each court. BB assumes 10 players + 4 waiting to rotate in for each court.

Racquetball Court 850 SF	Average Particip.	Projected Participants	Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Racquetball	3.1%	138	x 2 hrs/wk	276 hrs/wk	213 SF/user	4 occup.		
TOTALS		**138**		**276 hrs/wk**	**212.5 SF/user**	**4 occup.**		**400hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**				**4 occup.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**	**=**	**50 hrs/wk**	**x**	**4 occup.**	**=**	**200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING				**200hrs/wk**	**minus**	**276 hrs/wk**	**=**	**-76hrs/wk**

Jogging Track 5,300 SF	Average Particip.	Projected Participants	Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Running / Jogging	14.6%	649	x 2 hrs/wk	1298 hrs/wk		84 occup.		
Exercise Walking	28.8%	1275	x 2 hrs/wk	2550 hrs/wk		84 occup.		
TOTALS		**1924**		**3849 hrs/wk**		**84 occup.**		**8400hrs/wk**
PEAK ATTENDANCE	**60%**	**of Stations in Use**				**50 occup.**		
PEAK UTILIZATION RATE	**80%**	**of Hours of Operation**	**=**	**80 hrs/wk**	**x**	**50 occup.**	**=**	**4032hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING				**4032hrs/wk**	**minus**	**3849 hrs/wk**	**=**	**183hrs/wk**

Large Facility - maximum population of 10,000 persons - approx. 74% peak users- 100 hours of operation per week

Aerobic Exercise 4,500 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Aerobic Exercising	11.4%	841	x	3 hrs/wk	2522 hrs/wk	50 SF/user	90 stas.		
Step Aerobics	3.0%	223	x	3 hrs/wk	670 hrs/wk	50 SF/user	90 stas.		
Calisthenics	5.7%	420	x	3 hrs/wk	1259 hrs/wk	50 SF/user	90 stas.		
TOTALS		**1484**			**4452 hrs/wk**	**50 SF/user**	**90 stas.**		**9000hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**					**81 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**		**=**	**55 hrs/wk**	**x**	**81 stas.**	**=**	**4455hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**4455hrs/wk**	**minus**	**4451.6 hrs/wk**	**=**	**3hrs/wk**

Non-Structured Exercise 2,500 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Martial Arts	3.0%	219	x	2 hrs/wk	437 hrs/wk	125 SF/user	20 stas.		
Kick Boxing	2.2%	159	x	2 hrs/wk	318 hrs/wk	125 SF/user	20 stas.		
TOTALS		**378**			**755.689 hrs/wk**	**125 SF/user**	**20 stas.**		**2000hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**16 stas.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**16 stas.**	**=**	**800hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**800hrs/wk**	**minus**	**756 hrs/wk**	**=**	**44hrs/wk**

Fitness Module (Weight/Cardio) 11,500 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	24.5%	1813	x	3 hrs/wk	5438 hrs/wk	55.8 SF/user	206 stas.		
TOTALS		**1813**			**5438 hrs/wk**	**55.83 SF/user**	**206 stas.**		**20600hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**165 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**165 stas.**	**=**	**14832hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**14832hrs/wk**	**minus**	**5438 hrs/wk**	**=**	**9394hrs/wk**

Fitness Module (Weight/Cardio) 11,500 SF	LNS Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	65.0%	4801	x	3 hrs/wk	14404 hrs/wk	55.8 SF/user	206 stas.		
TOTALS		**4801**			**14404 hrs/wk**	**55.83 SF/user**	**206 stas.**		**20600hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**165 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**165 stas.**	**=**	**14832hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**14832hrs/wk**	**minus**	**14404 hrs/wk**	**=**	**428hrs/wk**

Gymnasium Module 31,800 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Court Size is 50 x 94 for a total playing area of:						18,800 SF	4 court/s		
Volleyball	6.4%	476	x	3 hrs/wk	1428 hrs/wk	392 SF/user	64 players		
Basketball	18.3%	1354	x	3 hrs/wk	4063 hrs/wk	470 SF/user	56 players		
TOTALS (Average for SF/Per and Stations)		**1830**			**5491 hrs/wk**	**430.8 SF/user**	**60 players**		**6000hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**60 players**		
PEAK UTILIZATION RATE	**60%**	**of Hours of Operation**		**=**	**60 hrs/wk**	**x**	**60 players**	**=**	**3600hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**3600hrs/wk**	**minus**	**5491 hrs/wk**	**=**	**-1891hrs/wk**

Note: VB assumes 12 players + 4 rotating players for each court. BB assumes 10 players + 4 waiting to rotate in for each court.

Racquetball Courts 1,700 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Racquetball	3.1%	230	x	2 hrs/wk	461 hrs/wk	213 SF/user	8 occup.		
TOTALS		**230**			**461 hrs/wk**	**212.5 SF/user**	**8 occup.**		**800hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**8 occup.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**8 occup.**	**=**	**400hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**400hrs/wk**	**minus**	**461 hrs/wk**	**=**	**-61hrs/wk**

Jogging Track 6400 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Running / Jogging	14.6%	1082	x	2 hrs/wk	2164 hrs/wk		102 occup.		
Exercise Walking	28.8%	2125	x	2 hrs/wk	4250 hrs/wk		102 occup.		
TOTALS		**3207**			**6414 hrs/wk**		**102 occup.**		**10200hrs/wk**
PEAK ATTENDANCE	**60%**	**of Stations in Use**					**61 occup.**		
PEAK UTILIZATION RATE	**80%**	**of Hours of Operation**		**=**	**80 hrs/wk**	**x**	**61 occup.**	**=**	**4896hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**4896hrs/wk**	**minus**	**6414 hrs/wk**	**=**	**-1518hrs/wk**

Maximum authorized population of 20,000 - 100 hours of operation per week:

Base Population: (15,001-20,000)

Aerobic Exercise 9,000 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Aerobic Exercising	11.4%	1681	x	3 hrs/wk	5044 hrs/wk	50 SF/user	180 stas.		
Step Aerobics	3.0%	447	x	3 hrs/wk	1340 hrs/wk	50 SF/user	180 stas.		
Calisthenics	5.7%	840	x	3 hrs/wk	2519 hrs/wk	50 SF/user	180 stas.		
TOTALS		**2968**			**8903 hrs/wk**	**50 SF/user**	**180 stas.**		**18000hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**					**162 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**		**=**	**55 hrs/wk**	**x**	**162 stas.**	**=**	**8910hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**8910hrs/wk**	**minus**	**8903.2 hrs/wk**	**=**	**7hrs/wk**

Non-Structured Exercise 5,000 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Martial Arts	3.0%	437	x	2 hrs/wk	875 hrs/wk	125 SF/user	40 stas.		
Kick Boxing	2.2%	318	x	2 hrs/wk	636 hrs/wk	125 SF/user	40 stas.		
TOTALS		**756**			**1511.38 hrs/wk**	**125 SF/user**	**40 stas.**		**4000hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**32 stas.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**32 stas.**	**=**	**1600hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**1600hrs/wk**	**minus**	**1511.4 hrs/wk**	**=**	**89hrs/wk**

Fitness Module (Weight/Cardio) 23,000 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	24.5%	3626	x	3 hrs/wk	10877 hrs/wk	55.8 SF/user	412 stas.		
TOTALS		**3626**			**10877 hrs/wk**	**55.83 SF/user**	**412 stas.**		**41200hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**330 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**330 stas.**	**=**	**29664hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**29664hrs/wk**	**minus**	**10877 hrs/wk**	**=**	**18787hrs/wk**

Fitness Module (Weight/Cardio) 23,000 SF	LNS Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	65.0%	9603	x	3 hrs/wk	28809 hrs/wk	55.8 SF/user	412 stas.		
TOTALS		**9603**			**28809 hrs/wk**	**55.83 SF/user**	**412 stas.**		**41200hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**330 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**330 stas.**	**=**	**29664hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**29664hrs/wk**	**minus**	**28809 hrs/wk**	**=**	**855hrs/wk**

Gymnasium Module 48,600 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Court Size is 50 x 94 for a total playing area of:						28,200 SF	6 court/s		
Volleyball	6.4%	952	x	3 hrs/wk	2856 hrs/wk	392 SF/user	96 players		
Basketball	18.3%	2709	x	3 hrs/wk	8127 hrs/wk	470 SF/user	84 players		
TOTALS (Average for SF/Per and Stations)		**3661**			**10983 hrs/wk**	**430.8 SF/user**	**90 players**		**9000hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**90 players**		
PEAK UTILIZATION RATE	**60%**	**of Hours of Operation**		**=**	**60 hrs/wk**	**x**	**90 players**	**=**	**5400hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**5400hrs/wk**	**minus**	**10983 hrs/wk**	**=**	**-5583hrs/wk**

Note: VB assumes 12 players + 4 rotating players for each court. BB assumes 10 players + 4 waiting to rotate in for each court.

Racquetball Courts 3,400 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Racquetball	3.1%	461	x	2 hrs/wk	921 hrs/wk	213 SF/user	16 occup.		
TOTALS		**461**			**921 hrs/wk**	**212.5 SF/user**	**16 occup.**		**1600hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**16 occup.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**16 occup.**	**=**	**800hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**800hrs/wk**	**minus**	**921 hrs/wk**	**=**	**-121hrs/wk**

Jogging Track 6,400 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Running / Jogging	14.6%	2164	x	2 hrs/wk	4328 hrs/wk		150 occup.		
Exercise Walking	28.8%	4250	x	2 hrs/wk	8501 hrs/wk		150 occup.		
TOTALS		**6414**			**12828 hrs/wk**		**150 occup.**		**15000hrs/wk**
PEAK ATTENDANCE	**60%**	**of Stations in Use**					**90 occup.**		
PEAK UTILIZATION RATE	**80%**	**of Hours of Operation**		**=**	**80 hrs/wk**	**x**	**90 occup.**	**=**	**7200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**7200hrs/wk**	**minus**	**12828 hrs/wk**	**=**	**-5628hrs/wk**

Maximum authorized population of 25,000 - 100 hours of operation per week:

Base Population: (20,001-25,000)

Aerobic Exercise 11,250 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Aerobic Exercising	11.4%	2102	x	3 hrs/wk	6306 hrs/wk	50 SF/user	225 stas.		
Step Aerobics	3.0%	558	x	3 hrs/wk	1675 hrs/wk	50 SF/user	225 stas.		
Calisthenics	5.7%	1049	x	3 hrs/wk	3148 hrs/wk	50 SF/user	225 stas.		
TOTALS		**3710**			**11129 hrs/wk**	**50 SF/user**	**225 stas.**		**22500hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**					**203 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**		**=**	**55 hrs/wk**	**x**	**203 stas.**	**=**	**11138hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**11138hrs/wk**	**minus**	**11129 hrs/wk**	**=**	**8hrs/wk**

Non-Structured Exercise 6,250 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Martial Arts	3.0%	547	x	2 hrs/wk	1094 hrs/wk	125 SF/user	50 stas.		
Kick Boxing	2.2%	398	x	2 hrs/wk	796 hrs/wk	125 SF/user	50 stas.		
TOTALS		**945**			**1889.22 hrs/wk**	**125 SF/user**	**50 stas.**		**5000hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**40 stas.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**40 stas.**	**=**	**2000hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**2000hrs/wk**	**minus**	**1889.2 hrs/wk**	**=**	**111hrs/wk**

Fitness Module (Weight/Cardio) 28,750 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	24.5%	4532	x	3 hrs/wk	13596 hrs/wk	55.8 SF/user	515 stas.		
TOTALS		**4532**			**13596 hrs/wk**	**55.83 SF/user**	**515 stas.**		**51500hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**412 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**412 stas.**	**=**	**37080hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**37080hrs/wk**	**minus**	**13596 hrs/wk**	**=**	**23484hrs/wk**

Fitness Module (Weight/Cardio) 28,750 SF	LNS Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	65.0%	12004	x	3 hrs/wk	36011 hrs/wk	55.8 SF/user	515 stas.		
TOTALS		**12004**			**36011 hrs/wk**	**55.83 SF/user**	**515 stas.**		**51500hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**412 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**412 stas.**	**=**	**37080hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**37080hrs/wk**	**minus**	**36011 hrs/wk**	**=**	**1069hrs/wk**

Gymnasium Module 57,000 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Court Size is 50 x 94 for a total playing area of:						32,900 SF	7 court/s		
Volleyball	6.4%	1190	x	3 hrs/wk	3570 hrs/wk	392 SF/user	112 players		
Basketball	18.3%	3386	x	3 hrs/wk	10158 hrs/wk	470 SF/user	98 players		
TOTALS (Average for SF/Per and Stations)		**4576**			**13728 hrs/wk**	**430.8 SF/user**	**105 players**		**10500hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**105 players**		
PEAK UTILIZATION RATE	**60%**	**of Hours of Operation**		**=**	**60 hrs/wk**	**x**	**105 players**	**=**	**6300hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**6300hrs/wk**	**minus**	**13728 hrs/wk**	**=**	**-7428hrs/wk**

Note: VB assumes 12 players + 4 rotating players for each court. BB assumes 10 players + 4 waiting to rotate in for each court.

Racquetball Courts 4,250 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Racquetball	3.1%	576	x	2 hrs/wk	1152 hrs/wk	213 SF/user	20 occup.		
TOTALS		**576**			**1152 hrs/wk**	**212.5 SF/user**	**20 occup.**		**2000hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**20 occup.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**20 occup.**	**=**	**1000hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**1000hrs/wk**	**minus**	**1152 hrs/wk**	**=**	**-152hrs/wk**

Jogging Track 6,400 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Running / Jogging	14.6%	2705	x	2 hrs/wk	5410 hrs/wk		150 occup.		
Exercise Walking	28.8%	5313	x	2 hrs/wk	10626 hrs/wk		150 occup.		
TOTALS		**8018**			**16036 hrs/wk**		**150 occup.**		**15000hrs/wk**
PEAK ATTENDANCE	**60%**	**of Stations in Use**					**90 occup.**		
PEAK UTILIZATION RATE	**80%**	**of Hours of Operation**		**=**	**80 hrs/wk**	**x**	**90 occup.**	**=**	**7200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**7200hrs/wk**	**minus**	**16036 hrs/wk**	**=**	**-8836hrs/wk**

Maximum authorized population of 30,000 - 100 hours of operation per week:

Base Population: (25,001-30,000)

Aerobic Exercise 13,500 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Aerobic Exercising	11.4%	2522	x	3 hrs/wk	7567 hrs/wk	50 SF/user	270 stas.		
Step Aerobics	3.0%	670	x	3 hrs/wk	2010 hrs/wk	50 SF/user	270 stas.		
Calisthenics	5.7%	1259	x	3 hrs/wk	3778 hrs/wk	50 SF/user	270 stas.		
TOTALS		**4452**			**13355 hrs/wk**	**50 SF/user**	**270 stas.**		**27000hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**					**243 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**		=	**55 hrs/wk**	**x**	**243 stas.**	=	**13365hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**13365hrs/wk**	**minus**	**13355 hrs/wk**	=	**10hrs/wk**

Non-Structured Exercise 7,500 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Martial Arts	3.0%	656	x	2 hrs/wk	1312 hrs/wk	125 SF/user	60 stas.		
Kick Boxing	2.2%	477	x	2 hrs/wk	955 hrs/wk	125 SF/user	60 stas.		
TOTALS		**1134**			**2267.07 hrs/wk**	**125 SF/user**	**60 stas.**		**6000hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**48 stas.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		=	**50 hrs/wk**	**x**	**48 stas.**	=	**2400hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**2400hrs/wk**	**minus**	**2267.1 hrs/wk**	=	**133hrs/wk**

Fitness Module (Weight/Cardio) 34,500 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	24.5%	5438	x	3 hrs/wk	16315 hrs/wk	55.8 SF/user	618 stas.		
TOTALS		**5438**			**16315 hrs/wk**	**55.83 SF/user**	**618 stas.**		**61800hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**494 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		=	**90 hrs/wk**	**x**	**494 stas.**	=	**44496hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**44496hrs/wk**	**minus**	**16315 hrs/wk**	=	**28181hrs/wk**

Fitness Module (Weight/Cardio) 34,500 SF	LNS Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	65.0%	14404	x	3 hrs/wk	43213 hrs/wk	55.8 SF/user	618 stas.		
TOTALS		**14404**			**43213 hrs/wk**	**55.83 SF/user**	**618 stas.**		**61800hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**494 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		=	**90 hrs/wk**	**x**	**494 stas.**	=	**44496hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**44496hrs/wk**	**minus**	**43213 hrs/wk**	=	**1283hrs/wk**

Gymnasium Module 65,400 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Court Size is 50 x 94 for a total playing area of:						37,600 SF	8 court/s		
Volleyball	6.4%	1428	x	3 hrs/wk	4284 hrs/wk	392 SF/user	128 players		
Basketball	18.3%	4063	x	3 hrs/wk	12190 hrs/wk	470 SF/user	112 players		
TOTALS (Average for SF/Per and Stations)		**5491**			**16474 hrs/wk**	**430.8 SF/user**	**120 players**		**12000hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**120 players**		
PEAK UTILIZATION RATE	**60%**	**of Hours of Operation**		=	**60 hrs/wk**	**x**	**120 players**	=	**7200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**7200hrs/wk**	**minus**	**16474 hrs/wk**	=	**-9274hrs/wk**

Note: VB assumes 12 players + 4 rotating players for each court. BB assumes 10 players + 4 waiting to rotate in for each court.

Racquetball Courts 5,100 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Racquetball	3.1%	691	x	2 hrs/wk	1382 hrs/wk	213 SF/user	24 occup.		
TOTALS		**691**			**1382 hrs/wk**	**212.5 SF/user**	**24 occup.**		**2400hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**24 occup.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		=	**50 hrs/wk**	**x**	**24 occup.**	=	**1200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**1200hrs/wk**	**minus**	**1382 hrs/wk**	=	**-182hrs/wk**

Jogging Track 6,400 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Running / Jogging	14.6%	3246	x	2 hrs/wk	6492 hrs/wk		150 occup.		
Exercise Walking	28.8%	6376	x	2 hrs/wk	12751 hrs/wk		150 occup.		
TOTALS		**9621**			**19243 hrs/wk**		**150 occup.**		**15000hrs/wk**
PEAK ATTENDANCE	**60%**	**of Stations in Use**					**90 occup.**		
PEAK UTILIZATION RATE	**80%**	**of Hours of Operation**		=	**80 hrs/wk**	**x**	**90 occup.**	=	**7200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**7200hrs/wk**	**minus**	**19243 hrs/wk**	=	**-12043hrs/wk**

Maximum authorized population of 35,000 - 100 hours of operation per week:

Base Population: (30,001-35,000)

Aerobic Exercise 15,750 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Aerobic Exercising	11.4%	2943	x	3 hrs/wk	8828 hrs/wk	50 SF/user	315 stas.		
Step Aerobics	3.0%	782	x	3 hrs/wk	2346 hrs/wk	50 SF/user	315 stas.		
Calisthenics	5.7%	1469	x	3 hrs/wk	4407 hrs/wk	50 SF/user	315 stas.		
TOTALS		**5194**			**15581 hrs/wk**	**50 SF/user**	**315 stas.**		**31500hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**					**284 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**		**=**	**55 hrs/wk**	**x**	**284 stas.**	**=**	**15593hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**15593hrs/wk**	**minus**	**15581 hrs/wk**	**=**	**12hrs/wk**

Non-Structured Exercise 8,750 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Martial Arts	3.0%	766	x	2 hrs/wk	1531 hrs/wk	125 SF/user	70 stas.		
Kick Boxing	2.2%	557	x	2 hrs/wk	1114 hrs/wk	125 SF/user	70 stas.		
TOTALS		**1322**			**2644.91 hrs/wk**	**125 SF/user**	**70 stas.**		**7000hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**56 stas.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**56 stas.**	**=**	**2800hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**2800hrs/wk**	**minus**	**2644.9 hrs/wk**	**=**	**155hrs/wk**

Fitness Module (Weight/Cardio) 40,250 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	24.5%	6345	x	3 hrs/wk	19034 hrs/wk	56 SF/user	721 stas.		
TOTALS		**6345**			**19034 hrs/wk**	**56 SF/user**	**721 stas.**		**72100hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**577 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**577 stas.**	**=**	**51912hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**51912hrs/wk**	**minus**	**19034 hrs/wk**	**=**	**32878hrs/wk**

Fitness Module (Weight/Cardio) 40,250 SF	LNS Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	65.0%	16805	x	3 hrs/wk	50416 hrs/wk	56 SF/user	721 stas.		
TOTALS		**16805**			**50416 hrs/wk**	**56 SF/user**	**721 stas.**		**72100hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**577 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**577 stas.**	**=**	**51912hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**51912hrs/wk**	**minus**	**50416 hrs/wk**	**=**	**1496hrs/wk**

Gymnasium Module 73,800 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Court Size is 50 x 94 for a total playing area of:						42,300 SF	9 court/s		
Volleyball	6.4%	1666	x	3 hrs/wk	4998 hrs/wk	392 SF/user	144 players		
Basketball	18.3%	4741	x	3 hrs/wk	14222 hrs/wk	470 SF/user	126 players		
TOTALS (Average for SF/Per and Stations)		**6407**			**19220 hrs/wk**	**431 SF/user**	**135 players**		**13500hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**135 players**		
PEAK UTILIZATION RATE	**60%**	**of Hours of Operation**		**=**	**60 hrs/wk**	**x**	**135 players**	**=**	**8100hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**8100hrs/wk**	**minus**	**19220 hrs/wk**	**=**	**-11120hrs/wk**

Note: VB assumes 12 players + 4 rotating players for each court. BB assumes 10 players + 4 waiting to rotate in for each court.

Racquetball Courts 5,950 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Racquetball	3.1%	806	x	2 hrs/wk	1612 hrs/wk	212.5 SF/user	28 occup.		
TOTALS		**806**			**1612 hrs/wk**	**212.5 SF/user**	**28 occup.**		**2800hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**28 occup.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**28 occup.**	**=**	**1400hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**1400hrs/wk**	**minus**	**1612 hrs/wk**	**=**	**-212hrs/wk**

Jogging Track 6,400 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Running / Jogging	14.6%	3787	x	2 hrs/wk	7574 hrs/wk		150 occup.		
Exercise Walking	28.8%	7438	x	2 hrs/wk	14876 hrs/wk		150 occup.		
TOTALS		**11225**			**22450 hrs/wk**		**150 occup.**		**15000hrs/wk**
PEAK ATTENDANCE	**60%**	**of Stations in Use**					**90 occup.**		
PEAK UTILIZATION RATE	**80%**	**of Hours of Operation**		**=**	**80 hrs/wk**	**x**	**90 occup.**	**=**	**7200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**7200hrs/wk**	**minus**	**22450 hrs/wk**	**=**	**-15250hrs/wk**

Maximum authorized population of 40,000 - 100 hours of operation per week:

Base Population: (35,001-40,000)

Aerobic Exercise 18,000 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Aerobic Exercising	11.4%	3363	x	3 hrs/wk	10089 hrs/wk	50 SF/user	360 stas.		
Step Aerobics	3.0%	894	x	3 hrs/wk	2681 hrs/wk	50 SF/user	360 stas.		
Calisthenics	5.7%	1679	x	3 hrs/wk	5037 hrs/wk	50 SF/user	360 stas.		
TOTALS		**5935**			**17806 hrs/wk**	**50 SF/user**	**360 stas.**		**36000hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**					**324 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**		**=**	**55 hrs/wk**	**x**	**324 stas.**	**=**	**17820hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**17820hrs/wk**	**minus**	**17806 hrs/wk**	**=**	**14hrs/wk**

Non-Structured Exercise 10,000 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Martial Arts	3.0%	875	x	2 hrs/wk	1750 hrs/wk	125 SF/user	80 stas.		
Kick Boxing	2.2%	636	x	2 hrs/wk	1273 hrs/wk	125 SF/user	80 stas.		
TOTALS		**1511**			**3022.76 hrs/wk**	**125 SF/user**	**80 stas.**		**8000hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**64 stas.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**64 stas.**	**=**	**3200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**3200hrs/wk**	**minus**	**3022.8 hrs/wk**	**=**	**177hrs/wk**

Fitness Module (Weight/Cardio) 46,000 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	24.5%	7251	x	3 hrs/wk	21753 hrs/wk	56 SF/user	824 stas.		
TOTALS		**7251**			**21753 hrs/wk**	**56 SF/user**	**824 stas.**		**82400hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**659 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**659 stas.**	**=**	**59328hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**59328hrs/wk**	**minus**	**21753 hrs/wk**	**=**	**37575hrs/wk**

Fitness Module (Weight/Cardio) 46,000 SF	LNS Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	65.0%	19206	x	3 hrs/wk	57618 hrs/wk	56 SF/user	824 stas.		
TOTALS		**19206**			**57618 hrs/wk**	**56 SF/user**	**824 stas.**		**82400hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**659 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**659 stas.**	**=**	**59328hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**59328hrs/wk**	**minus**	**57618 hrs/wk**	**=**	**1710hrs/wk**

Gymnasium Module 82,200 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Court Size is 50 x 94 for a total playing area of:						47,000 SF	10 court/s		
Volleyball	6.4%	1904	x	3 hrs/wk	5712 hrs/wk	392 SF/user	160 players		
Basketball	18.3%	5418	x	3 hrs/wk	16253 hrs/wk	470 SF/user	140 players		
TOTALS (Average for SF/Per and Stations)		**7322**			**21966 hrs/wk**	**431 SF/user**	**150 players**		**15000hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**150 players**		
PEAK UTILIZATION RATE	**60%**	**of Hours of Operation**		**=**	**60 hrs/wk**	**x**	**150 players**	**=**	**9000hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**9000hrs/wk**	**minus**	**21966 hrs/wk**	**=**	**-12966hrs/wk**

Note: VB assumes 12 players + 4 rotating players for each court. BB assumes 10 players + 4 waiting to rotate in for each court.

Racquetball Courts 6,800 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Racquetball	3.1%	921	x	2 hrs/wk	1843 hrs/wk	212.5 SF/user	32 occup.		
TOTALS		**921**			**1843 hrs/wk**	**212.5 SF/user**	**32 occup.**		**3200hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**32 occup.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**32 occup.**	**=**	**1600hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**1600hrs/wk**	**minus**	**1843 hrs/wk**	**=**	**-243hrs/wk**

Jogging Track 6,400 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Running / Jogging	14.6%	4328	x	2 hrs/wk	8656 hrs/wk		150 occup.		
Exercise Walking	28.8%	8501	x	2 hrs/wk	17001 hrs/wk		150 occup.		
TOTALS		**12828**			**25657 hrs/wk**		**150 occup.**		**15000hrs/wk**
PEAK ATTENDANCE	**60%**	**of Stations in Use**					**90 occup.**		
PEAK UTILIZATION RATE	**80%**	**of Hours of Operation**		**=**	**80 hrs/wk**	**x**	**90 occup.**	**=**	**7200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**7200hrs/wk**	**minus**	**25657 hrs/wk**	**=**	**-18457hrs/wk**

Maximum authorized population of 45,000 - 100 hours of operation per week:

Base Population: (40,001-45,000)

Aerobic Exercise 20,250 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Aerobic Exercising	11.4%	3783	x	3 hrs/wk	11350 hrs/wk	50 SF/user	405 stas.		
Step Aerobics	3.0%	1005	x	3 hrs/wk	3016 hrs/wk	50 SF/user	405 stas.		
Calisthenics	5.7%	1889	x	3 hrs/wk	5667 hrs/wk	50 SF/user	405 stas.		
TOTALS		**6677**			**20032 hrs/wk**	**50 SF/user**	**405 stas.**		**40500hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**					**365 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**		=	**55 hrs/wk**	**x**	**365 stas.**	=	**20048hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**20048hrs/wk**	**minus**	**20032 hrs/wk**	=	**15hrs/wk**

Non-Structured Exercise 11,250 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Martial Arts	3.0%	984	x	2 hrs/wk	1969 hrs/wk	125 SF/user	90 stas.		
Kick Boxing	2.2%	716	x	2 hrs/wk	1432 hrs/wk	125 SF/user	90 stas.		
TOTALS		**1700**			**3400.6 hrs/wk**	**125 SF/user**	**90 stas.**		**9000hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**72 stas.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		=	**50 hrs/wk**	**x**	**72 stas.**	=	**3600hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**3600hrs/wk**	**minus**	**3400.6 hrs/wk**	=	**199hrs/wk**

Fitness Module (Weight/Cardio) 51,750 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	24.5%	8158	x	3 hrs/wk	24473 hrs/wk	56 SF/user	927 stas.		
TOTALS		**8158**			**24473 hrs/wk**	**56 SF/user**	**927 stas.**		**92700hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**742 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		=	**90 hrs/wk**	**x**	**742 stas.**	=	**66744hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**66744hrs/wk**	**minus**	**24473 hrs/wk**	=	**42271hrs/wk**

Fitness Module (Weight/Cardio) 51,750 SF	LNS Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	65.0%	21607	x	3 hrs/wk	64820 hrs/wk	56 SF/user	927 stas.		
TOTALS		**21607**			**64820 hrs/wk**	**56 SF/user**	**927 stas.**		**92700hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**742 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		=	**90 hrs/wk**	**x**	**742 stas.**	=	**66744hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**66744hrs/wk**	**minus**	**64820 hrs/wk**	=	**1924hrs/wk**

Gymnasium Module 90,600 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Court Size is 50 x 94 for a total playing area of:						51,700 SF	11 court/s		
Volleyball	6.4%	2142	x	3 hrs/wk	6426 hrs/wk	392 SF/user	176 players		
Basketball	18.3%	6095	x	3 hrs/wk	18285 hrs/wk	470 SF/user	154 players		
TOTALS (Average for SF/Per and Stations)		**8237**			**24711 hrs/wk**	**431 SF/user**	**165 players**		**16500hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**165 players**		
PEAK UTILIZATION RATE	**60%**	**of Hours of Operation**		=	**60 hrs/wk**	**x**	**165 players**	=	**9900hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**9900hrs/wk**	**minus**	**24711 hrs/wk**	=	**-14811hrs/wk**

Note: VB assumes 12 players + 4 rotating players for each court. BB assumes 10 players + 4 waiting to rotate in for each court.

Racquetball Courts 7,650 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Racquetball	3.1%	1036	x	2 hrs/wk	2073 hrs/wk	212.5 SF/user	36 occup.		
TOTALS		**1036**			**2073 hrs/wk**	**212.5 SF/user**	**36 occup.**		**3600hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**36 occup.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		=	**50 hrs/wk**	**x**	**36 occup.**	=	**1800hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**1800hrs/wk**	**minus**	**2073 hrs/wk**	=	**-273hrs/wk**

Jogging Track 6,400 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Running / Jogging	14.6%	4869	x	2 hrs/wk	9737 hrs/wk		150 occup.		
Exercise Walking	28.8%	9563	x	2 hrs/wk	19127 hrs/wk		150 occup.		
TOTALS		**14432**			**28864 hrs/wk**		**150 occup.**		**15000hrs/wk**
PEAK ATTENDANCE	**60%**	**of Stations in Use**					**90 occup.**		
PEAK UTILIZATION RATE	**80%**	**of Hours of Operation**		=	**80 hrs/wk**	**x**	**90 occup.**	=	**7200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**7200hrs/wk**	**minus**	**28864 hrs/wk**	=	**-21664hrs/wk**

Maximum authorized population of 50,000 - 100 hours of operation per week:

Base Population: (45,001-50,000)

Aerobic Exercise 22,500 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Aerobic Exercising	11.4%	4204	x	3 hrs/wk	12611 hrs/wk	50 SF/user	450 stas.		
Step Aerobics	3.0%	1117	x	3 hrs/wk	3351 hrs/wk	50 SF/user	450 stas.		
Calisthenics	5.7%	2099	x	3 hrs/wk	6296 hrs/wk	50 SF/user	450 stas.		
TOTALS		**7419**			**22258 hrs/wk**	**50 SF/user**	**450 stas.**		**45000hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**					**405 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**		**=**	**55 hrs/wk**	**x**	**405 stas.**	**=**	**22275hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**22275hrs/wk**	**minus**	**22258 hrs/wk**	**=**	**17hrs/wk**

Non-Structured Exercise 12500 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Martial Arts	3.0%	1094	x	2 hrs/wk	2187 hrs/wk	125 SF/user	100 stas.		
Kick Boxing	2.2%	796	x	2 hrs/wk	1591 hrs/wk	125 SF/user	100 stas.		
TOTALS		**1889**			**3778.45 hrs/wk**	**125 SF/user**	**100 stas.**		**10000hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**80 stas.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**80 stas.**	**=**	**4000hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**4000hrs/wk**	**minus**	**3778.4 hrs/wk**	**=**	**222hrs/wk**

Fitness Module (Weight/Cardio) 57,500 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	24.5%	9064	x	3 hrs/wk	27192 hrs/wk	56 SF/user	1030 stas.		
TOTALS		**9064**			**27192 hrs/wk**	**56 SF/user**	**1030 stas.**		**103000hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**824 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**824 stas.**	**=**	**74160hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**74160hrs/wk**	**minus**	**27192 hrs/wk**	**=**	**46968hrs/wk**

Fitness Module (Weight/Cardio) 57,500 SF	LNS Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	65.0%	24007	x	3 hrs/wk	72022 hrs/wk	56 SF/user	1030 stas.		
TOTALS		**24007**			**72022 hrs/wk**	**56 SF/user**	**1030 stas.**		**103000hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**824 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**824 stas.**	**=**	**74160hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**74160hrs/wk**	**minus**	**72022 hrs/wk**	**=**	**2138hrs/wk**

Gymnasium Module 99,000 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Court Size is 50 x 94 for a total playing area of:						56,400 SF	12 court/s		
Volleyball	6.4%	2380	x	3 hrs/wk	7140 hrs/wk	392 SF/user	192 players		
Basketball	18.3%	6772	x	3 hrs/wk	20317 hrs/wk	470 SF/user	168 players		
TOTALS (Average for SF/Per and Stations)		**9152**			**27457 hrs/wk**	**431 SF/user**	**180 players**		**18000hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**180 players**		
PEAK UTILIZATION RATE	**60%**	**of Hours of Operation**		**=**	**60 hrs/wk**	**x**	**180 players**	**=**	**10800hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**10800hrs/wk**	**minus**	**27457 hrs/wk**	**=**	**-16657hrs/wk**

Note: VB assumes 12 players + 4 rotating players for each court. BB assumes 10 players + 4 waiting to rotate in for each court.

Racquetball Courts 8,500 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Racquetball	3.1%	1152	x	2 hrs/wk	2303 hrs/wk	212.5 SF/user	40 occup.		
TOTALS		**1152**			**2303 hrs/wk**	**212.5 SF/user**	**40 occup.**		**4000hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**40 occup.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**40 occup.**	**=**	**2000hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**2000hrs/wk**	**minus**	**2303 hrs/wk**	**=**	**-303hrs/wk**

Jogging Track 6,400 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Running / Jogging	14.6%	5410	x	2 hrs/wk	10819 hrs/wk		150 occup.		
Exercise Walking	28.8%	10626	x	2 hrs/wk	21252 hrs/wk		150 occup.		
TOTALS		**16036**			**32071 hrs/wk**		**150 occup.**		**15000hrs/wk**
PEAK ATTENDANCE	**60%**	**of Stations in Use**					**90 occup.**		
PEAK UTILIZATION RATE	**80%**	**of Hours of Operation**		**=**	**80 hrs/wk**	**x**	**90 occup.**	**=**	**7200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**7200hrs/wk**	**minus**	**32071 hrs/wk**	**=**	**-24871hrs/wk**

Maximum authorized population of 55,000 - 100 hours of operation per week:

Base Population: (50,001-55,000)

Aerobic Exercise 24,750 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Aerobic Exercising	11.4%	4624	x	3 hrs/wk	13872 hrs/wk	50 SF/user	495 stas.		
Step Aerobics	3.0%	1229	x	3 hrs/wk	3686 hrs/wk	50 SF/user	495 stas.		
Calisthenics	5.7%	2309	x	3 hrs/wk	6926 hrs/wk	50 SF/user	495 stas.		
TOTALS		**8161**			**24484 hrs/wk**	**50 SF/user**	**495 stas.**		**49500hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**					**446 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**		**=**	**55 hrs/wk**	**x**	**446 stas.**	**=**	**24503hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**24503hrs/wk**	**minus**	**24484 hrs/wk**	**=**	**19hrs/wk**

Non-Structured Exercise 13,750 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Martial Arts	3.0%	1203	x	2 hrs/wk	2406 hrs/wk	125 SF/user	110 stas.		
Kick Boxing	2.2%	875	x	2 hrs/wk	1750 hrs/wk	125 SF/user	110 stas.		
TOTALS		**2078**			**4156.29 hrs/wk**	**125 SF/user**	**110 stas.**		**11000hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**88 stas.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**88 stas.**	**=**	**4400hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**4400hrs/wk**	**minus**	**4156.3 hrs/wk**	**=**	**244hrs/wk**

Fitness Module (Weight/Cardio) 63,250 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	24.5%	9970	x	3 hrs/wk	29911 hrs/wk	56 SF/user	1133 stas.		
TOTALS		**9970**			**29911 hrs/wk**	**56 SF/user**	**1133 stas.**		**113300hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**906 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**906 stas.**	**=**	**81576hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**81576hrs/wk**	**minus**	**29911 hrs/wk**	**=**	**51665hrs/wk**

Fitness Module (Weight/Cardio) 63,250 SF	LNS Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	65.0%	26408	x	3 hrs/wk	79224 hrs/wk	56 SF/user	1133 stas.		
TOTALS		**26408**			**79224 hrs/wk**	**56 SF/user**	**1133 stas.**		**113300hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**906 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**906 stas.**	**=**	**81576hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**81576hrs/wk**	**minus**	**79224 hrs/wk**	**=**	**2352hrs/wk**

Gymnasium Module 107,400 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Court Size is 50 x 94 for a total playing area of:						61,100 SF	13 court/s		
Volleyball	6.4%	2618	x	3 hrs/wk	7854 hrs/wk	392 SF/user	208 players		
Basketball	18.3%	7449	x	3 hrs/wk	22348 hrs/wk	470 SF/user	182 players		
TOTALS (Average for SF/Per and Stations)		**10068**			**30203 hrs/wk**	**431 SF/user**	**195 players**		**19500hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**195 players**		
PEAK UTILIZATION RATE	**60%**	**of Hours of Operation**		**=**	**60 hrs/wk**	**x**	**195 players**	**=**	**11700hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**11700hrs/wk**	**minus**	**30203 hrs/wk**	**=**	**-18503hrs/wk**

Note: VB assumes 12 players + 4 rotating players for each court. BB assumes 10 players + 4 waiting to rotate in for each court.

Racquetball Courts 9,350 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Racquetball	3.1%	1267	x	2 hrs/wk	2534 hrs/wk	212.5 SF/user	44 occup.		
TOTALS		**1267**			**2534 hrs/wk**	**212.5 SF/user**	**44 occup.**		**4400hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**44 occup.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**44 occup.**	**=**	**2200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**2200hrs/wk**	**minus**	**2534 hrs/wk**	**=**	**-334hrs/wk**

Jogging Track 6,400 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Running / Jogging	14.6%	5951	x	2 hrs/wk	11901 hrs/wk		150 occup.		
Exercise Walking	28.8%	11689	x	2 hrs/wk	23377 hrs/wk		150 occup.		
TOTALS		**17639**			**35278 hrs/wk**		**150 occup.**		**15000hrs/wk**
PEAK ATTENDANCE	**60%**	**of Stations in Use**					**90 occup.**		
PEAK UTILIZATION RATE	**80%**	**of Hours of Operation**		**=**	**80 hrs/wk**	**x**	**90 occup.**	**=**	**7200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**7200hrs/wk**	**minus**	**35278 hrs/wk**	**=**	**-28078hrs/wk**

Maximum authorized population of 60,000 - 100 hours of operation per week:

Base Population: (55,001-60,000)

Aerobic Exercise 27,000 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Aerobic Exercising	11.4%	5044	x	3 hrs/wk	15133 hrs/wk	50 SF/user	540 stas.		
Step Aerobics	3.0%	1340	x	3 hrs/wk	4021 hrs/wk	50 SF/user	540 stas.		
Calisthenics	5.7%	2519	x	3 hrs/wk	7556 hrs/wk	50 SF/user	540 stas.		
TOTALS		**8903**			**26710 hrs/wk**	**50 SF/user**	**540 stas.**		**54000hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**					**486 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**		**=**	**55 hrs/wk**	**x**	**486 stas.**	**=**	**26730hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**26730hrs/wk**	**minus**	**26709.74 hrs/wk**	**=**	**20hrs/wk**

Non-Structured Exercise 15,000 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Martial Arts	3.0%	1312	x	2 hrs/wk	2625 hrs/wk	125 SF/user	120 stas.		
Kick Boxing	2.2%	955	x	2 hrs/wk	1909 hrs/wk	125 SF/user	120 stas.		
TOTALS		**2267**			**4534.135 hrs/wk**	**125 SF/user**	**120 stas.**		**12000hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**96 stas.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**96 stas.**	**=**	**4800hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**4800hrs/wk**	**minus**	**4534.135 hrs/wk**	**=**	**266hrs/wk**

Fitness Module (Weight/Cardio) 69,000 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	24.5%	10877	x	3 hrs/wk	32630 hrs/wk	56 SF/user	1236 stas.		
TOTALS		**10877**			**32630 hrs/wk**	**56 SF/user**	**1236 stas.**		**123600hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**989 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**989 stas.**	**=**	**88992hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**88992hrs/wk**	**minus**	**32630 hrs/wk**	**=**	**56362hrs/wk**

Fitness Module (Weight/Cardio) 69,000 SF	LNS Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	65.0%	28809	x	3 hrs/wk	86427 hrs/wk	56 SF/user	1236 stas.		
TOTALS		**28809**			**86427 hrs/wk**	**56 SF/user**	**1236 stas.**		**123600hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**989 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**989 stas.**	**=**	**88992hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**88992hrs/wk**	**minus**	**86427 hrs/wk**	**=**	**2565hrs/wk**

Gymnasium Module 115,800 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Court Size is 50 x 94 for a total playing area of:						65,800 SF	14 court/s		
Volleyball	6.4%	2856	x	3 hrs/wk	8568 hrs/wk	392 SF/user	224 players		
Basketball	18.3%	8127	x	3 hrs/wk	24380 hrs/wk	470 SF/user	196 players		
TOTALS (Average for SF/Per and Stations)		**10983**			**32948 hrs/wk**	**431 SF/user**	**210 players**		**21000hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**210 players**		
PEAK UTILIZATION RATE	**60%**	**of Hours of Operation**		**=**	**60 hrs/wk**	**x**	**210 players**	**=**	**12600hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**12600hrs/wk**	**minus**	**32948 hrs/wk**	**=**	**-20348hrs/wk**

Note: VB assumes 12 players + 4 rotating players for each court. BB assumes 10 players + 4 waiting to rotate in for each court.

Racquetball Courts 10,200 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Racquetball	3.1%	1382	x	2 hrs/wk	2764 hrs/wk	212.5 SF/user	48 occup.		
TOTALS		**1382**			**2764 hrs/wk**	**212.5 SF/user**	**48 occup.**		**4800hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**48 occup.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**48 occup.**	**=**	**2400hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**2400hrs/wk**	**minus**	**2764 hrs/wk**	**=**	**-364hrs/wk**

Jogging Track 6,400 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Running / Jogging	14.6%	6492	x	2 hrs/wk	12983 hrs/wk		150 occup.		
Exercise Walking	28.8%	12751	x	2 hrs/wk	25502 hrs/wk		150 occup.		
TOTALS		**19243**			**38485 hrs/wk**		**150 occup.**		**15000hrs/wk**
PEAK ATTENDANCE	**60%**	**of Stations in Use**					**90 occup.**		
PEAK UTILIZATION RATE	**80%**	**of Hours of Operation**		**=**	**80 hrs/wk**	**x**	**90 occup.**	**=**	**7200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**7200hrs/wk**	**minus**	**38485 hrs/wk**	**=**	**-31285hrs/wk**

Maximum authorized population of 65,000 - 100 hours of operation per week:

Base Population: (60,001-65,000)

Aerobic Exercise 29,250 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Aerobic Exercising	11.4%	5465	x	3 hrs/wk	16394 hrs/wk	50 SF/user	585 stas.		
Step Aerobics	3.0%	1452	x	3 hrs/wk	4356 hrs/wk	50 SF/user	585 stas.		
Calisthenics	5.7%	2728	x	3 hrs/wk	8185 hrs/wk	50 SF/user	585 stas.		
TOTALS		**9645**			**28936 hrs/wk**	**50 SF/user**	**585 stas.**		**58500hrs/wk**
PEAK ATTENDANCE	**90%**	**of Stations in Use**					**527 stas.**		
PEAK UTILIZATION RATE	**55%**	**of Hours of Operation**		**=**	**55 hrs/wk**	**x**	**527 stas.**	**=**	**28958hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**28958hrs/wk**	**minus**	**28935.5 hrs/wk**	**=**	**22hrs/wk**

Non-Structured Exercise 16,250 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Martial Arts	3.0%	1422	x	2 hrs/wk	2843 hrs/wk	125 SF/user	130 stas.		
Kick Boxing	2.2%	1034	x	2 hrs/wk	2068 hrs/wk	125 SF/user	130 stas.		
TOTALS		**2456**			**4911.98 hrs/wk**	**125 SF/user**	**130 stas.**		**13000hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**104 stas.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**104 stas.**	**=**	**5200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**5200hrs/wk**	**minus**	**4911.98 hrs/wk**	**=**	**288hrs/wk**

Fitness Module (Weight/Cardio) 74,750 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	24.5%	11783	x	3 hrs/wk	35349 hrs/wk	56 SF/user	1339 stas.		
TOTALS		**11783**			**35349 hrs/wk**	**56 SF/user**	**1339 stas.**		**133900hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**1071 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**1071 stas.**	**=**	**96408hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**96408hrs/wk**	**minus**	**35349 hrs/wk**	**=**	**61059hrs/wk**

Fitness Module (Weight/Cardio) 74,750 SF	LNS Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Exercising with Equipment	65.0%	31210	x	3 hrs/wk	93629 hrs/wk	56 SF/user	1339 stas.		
TOTALS		**31210**			**93629 hrs/wk**	**56 SF/user**	**1339 stas.**		**133900hrs/wk**
PEAK ATTENDANCE	**80%**	**of Stations in Use**					**1071 stas.**		
PEAK UTILIZATION RATE	**90%**	**of Hours of Operation**		**=**	**90 hrs/wk**	**x**	**1071 stas.**	**=**	**96408hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**96408hrs/wk**	**minus**	**93629 hrs/wk**	**=**	**2779hrs/wk**

Gymnasium Module 124,200 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Court Size is 50 x 94 for a total playing area of:						70,500 SF	15 court/s		
Volleyball	6.4%	3094	x	3 hrs/wk	9282 hrs/wk	392 SF/user	240 players		
Basketball	18.3%	8804	x	3 hrs/wk	26412 hrs/wk	470 SF/user	210 players		
TOTALS (Average for SF/Per and Stations)		**11898**			**35694 hrs/wk**	**431 SF/user**	**225 players**		**22500hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**225 players**		
PEAK UTILIZATION RATE	**60%**	**of Hours of Operation**		**=**	**60 hrs/wk**	**x**	**225 players**	**=**	**13500hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**13500hrs/wk**	**minus**	**35694 hrs/wk**	**=**	**-22194hrs/wk**

Note: VB assumes 12 players + 4 rotating players for each court. BB assumes 10 players + 4 waiting to rotate in for each court.

Racquetball Courts 11,050 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Racquetball	3.1%	1497	x	2 hrs/wk	2994 hrs/wk	212.5 SF/user	52 occup.		
TOTALS		**1497**			**2994 hrs/wk**	**212.5 SF/user**	**52 occup.**		**5200hrs/wk**
PEAK ATTENDANCE	**100%**	**of Stations in Use**					**52 occup.**		
PEAK UTILIZATION RATE	**50%**	**of Hours of Operation**		**=**	**50 hrs/wk**	**x**	**52 occup.**	**=**	**2600hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**2600hrs/wk**	**minus**	**2994 hrs/wk**	**=**	**-394hrs/wk**

Jogging Track 6,400 SF	Average Particip.	Projected Participants		Desired Times / Wk.	Desired Contact Hrs.	Max. SF/Person	Stations in Module		Available Contact Hrs.
Running / Jogging	14.6%	7033	x	2 hrs/wk	14065 hrs/wk		150 occup.		
Exercise Walking	28.8%	13814	x	2 hrs/wk	27627 hrs/wk		150 occup.		
TOTALS		**20846**			**41693 hrs/wk**		**150 occup.**		**15000hrs/wk**
PEAK ATTENDANCE	**60%**	**of Stations in Use**					**90 occup.**		
PEAK UTILIZATION RATE	**80%**	**of Hours of Operation**		**=**	**80 hrs/wk**	**x**	**90 occup.**	**=**	**7200hrs/wk**
AVAILABLE PEAK CONTACT HOURS FOR PROGRAMMING					**7200hrs/wk**	**minus**	**41693 hrs/wk**	**=**	**-34493hrs/wk**

4.0 APPLICABLE CRITERIA

Unless a specific document version or date is indicated, use criteria from the most current references, including any applicable addenda, unless otherwise stated in the contract or task order, as of the date of the Contractor's latest accepted proposal or date of issue of the contract or task order solicitation, whichever is later. In the event of conflict between References and/or Applicable Military Criteria, apply the most stringent requirement, unless otherwise specifically noted in the contract or task order.

4.1. INDUSTRY CRITERIA

Applicable design and construction criteria references are listed in Table 1 below. This list is not intended to include all criteria that may apply or to restrict design and construction to only those references listed. See also Paragraph 3 for additional facility-specific applicable criteria.

Table 1: Industry Criteria

Air Conditioning and Refrigeration Institute (ARI)	
ARI 310/380	Packaged Terminal Air-Conditioners and Heat Pumps
ARI 440	Room Fan-Coil and Unit Ventilator
ANSI/ARI 430-99	Central Station Air Handling Units
ARI 445	Room Air-Induction Units
ARI 880	Air Terminals
Air Movement and Control Association (AMCA)	
AMCA 210	Laboratory Methods of Testing Fans for Rating
American Architectural Manufacturers Association (AAMA)	
AAMA 605	Voluntary Specification Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
AAMA 607.1	Voluntary Guide Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum
AAMA 1503	Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections
American Association of State Highway and Transportation Officials (AASHTO)	

	Roadside Design Guide [guardrails, roadside safety devices]
	Standard Specifications for Transportation Materials and Methods of Sampling and Testing [Road Construction Materials]
	Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals
	Guide for Design of Pavement Structures, Volumes 1 and 2 [pavement design guide]
	A Policy of Geometric Design of Highways and Streets
American Bearing Manufacturers Association (AFBMA)	
AFBMA Std. 9	Load Ratings and Fatigue Life for Ball Bearings
AFBMA Std. 11	Load Ratings and Fatigue Life for Roller Bearings
American Boiler Manufacturers Association (ABMA)	
ABMA ISEI	Industry Standards and Engineering Information
American Concrete Institute	
ACI 302.2R	Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials
ACI 318	Building Code Requirements for Structural Concrete
ACI SP-66	ACI Detailing Manual
ACI 530	Building Code Requirements for Masonry Structures
ADA Standards for Accessible Design	
See US Access Board	ADA and ABA Accessibility Guidelines for Buildings and Facilities, Chapters 3-10.
American Institute of Steel Construction (AISC)	
	Manual of Steel Construction – 13th Edition (or latest version)

American Iron and Steel Institute	
AISI S100	North American Specification for the Design of Cold-Formed Steel Structural Members
American National Standards Institute 11 (ANSI)	
ANSI Z21.10.1	Gas Water Heaters Vol. 1, Storage water Heaters with Input Ratings of 75,000 Btu per Hour or less
ANSI Z124.3	American National Standard for Plastic Lavatories
ANSI Z124.6	Plastic Sinks
ANSI Z21.45	Flexible Connectors of Other Than All-Metal Construction for Gas Appliances
ANSI/IEEE C2	National Electrical Safety Code
ANSI/AF&PA NDS	National Design Specification for Wood Construction
American Society of Civil Engineers (ASCE)	
ASCE 7	Minimum Design Loads for Buildings and Other Structures
ASCE 37	Design and Construction of Sanitary and Storm Sewers, Manuals and Reports on Engineering Practice [sanitary sewer and storm drain design criteria]
ASCE/SEI 31-03	Seismic Evaluation of Existing Buildings [Existing Building Alteration/Renovation]
ASCE/SEI 41-06	Seismic Rehabilitation of Existing Buildings [Existing Building Alteration/Renovation]
American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)	
ASHRAE 90.1	ANSI/ASHRAE/IESNA 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE Guideline 0	The Commissioning Process
ASHRAE Guideline 1.1	The HVAC Commissioning Process

ASHRAE Handbooks	Fundamentals, HVAC Applications, Systems and Equipment, Refrigeration (Applicable, except as otherwise specified)
ASHRAE Standard 15	Safety Standard for Refrigeration Systems
ASHRAE Standard 62.1	Ventilation for Acceptable Indoor Air Quality
ASHRAE Standard 55	Thermal Environmental Conditions for Human Occupancy (Design portion is applicable, except where precluded by other project requirements.)
ASHRAE Standard 189.1	Standard for the Design of High-Performance Green Buildings (ANSI Approved; USGBC and IES Co-sponsored), - (APPLICABLE TO THE EXTENT SPECIFICALLY CALLED OUT IN THE CONTRACT)
American Society of Mechanical Engineers International (ASME)	
ASME BPVC SEC VII	Boiler and Pressure Vessel Code: Section VII Recommended Guidelines for the Care of Power Boilers
ASME A17.1	Safety Code for Elevators and Escalators
ASME B 31 (Series)	Piping Codes
American Water Works Association (AWWA)	
	Standards [standards for water line materials and construction]
American Welding Society	
	Welding Handbook
	Welding Codes and Specifications (as applicable to application, see International Building Code for example)
Architectural Woodwork Institute (AWI)	
Latest Version	AWI Quality Standards
Associated Air Balance Council (AABC)	
AABC MN-1	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems

	AABC Associated Air Balance Council Testing and Balance Procedures
ASTM International	
ASTM C1060-90(	Standard Practice for Thermographic Inspection of Insulation Installations in Envelope Cavities of Frame Buildings
ASTM E 779	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
ASTM E1827-96	Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
Builders Hardware Manufacturers Association (BHMA)	
ANSI/BHMA	The Various BHMA American National Standards
Building Industry Consulting Service International	
	Telecommunications Distribution Methods Manual (TDMM)
	Customer-Owned Outside Plant Design Manual (CO-OSP)
Code of Federal Regulations (CFR)	
49 CFR 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
10 CFR 430	Energy Conservation Program for Consumer Products
Consumer Electronics Association	
CEA 709.1B	Control Network Protocol Specification
CEA 709.3	Free-Topology Twisted-Pair Channel Specification
CEA 852	Tunneling Component Network Protocols Over Internet Protocol Channels
Electronic Industries Association (EIA)	
ANSI/EIA/TIA 568	Structured Cabling Series

ANSI/EIA/TIA 569	Commercial Building Standard for Telecommunications Pathways and Spaces (includes ADDENDA)
ANSI/TIA/EIA-606	Administrative Standard for the Telecommunications Infrastructure of Commercial Buildings
J-STD EIA/TIA 607	Commercial Building Grounding and Bonding Requirements for Telecommunications
Federal Highway Administration (FHWA)	
	Manual on Uniform Traffic Control Devices for Streets and Highways [signage and pavement markings for streets and highways]
FHWA-NHI-01-021	Hydraulic Engineering Circular No. 22, Second Edition, URBAN DRAINAGE DESIGN MANUAL
Illuminating Engineering Society of North America (IESNA)	
IESNA RP-1	Office Lighting
IESNA RP-8	Roadway Lighting
IESNA Lighting Handbook	Reference and Application
Institute of Electrical and Electronics Engineers Inc. (IEEE)	
	Standard for Use of the International System of Units (SI): the Modern Metric System
Standard 1100	Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
International Code Council (ICC)	
IBC	International Building Code Note: All references in the International Building Code to the International Electrical Code shall be considered to be references to NFPA 70. All references in the International Building Code to the International Fuel Gas Code shall be considered to be references to NFPA 54 and NFPA 58. All references in the International Building Code to the International Fire

	Code and Chapter 9 shall be considered to be references to Unified Facilities Criteria (UFC) 3-600-01.
IMC	International Mechanical Code – Note: For all references to “HEATING AND COOLING LOAD CALCULATIONS”, follow ASHRAE 90.1 Note: For all references to “VENTILATION”, follow ASHRAE 62.1
IRC	International Residential Code
IPC	International Plumbing Code
IEC	Energy Conservation Code (IEC) –Applicable only to the extent specifically referenced herein. Refer to Paragraph 5, ENERGY CONSERVATION requirements.
IGC	International Gas Code - not applicable. Follow NFPA 54, National Fuel Gas Code and NFPA 58, Liquified Petroleum Gas Code.
International Organization for Standardization (ISO)	
ISO 6781:1983	Qualitative detection of thermal irregularities in building envelopes – infrared method
LonMark International (LonMark)	
LonMark Interoperability Guidelines	(available at www.lonmark.org), including: Application Layer Guidelines, Layer 1-6 Guidelines, and External Interface File (XIF) Reference Guide
LonMark Resource Files	(available at www.lonmark.org), including Standard Network Variable Type (SNVT) definitions
Metal Building Manufacturers Association (MBMA)	
	Metal Building Systems Manual
Midwest Insulation Contractors Association (MICA)	
	National Commercial and Industrial Insulation Standards Manual
National Association of Corrosion Engineers International (NACE)	

NACE RP0169	Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE RP0185	Extruded, Polyolefin Resin Coating Systems with Adhesives for Underground or Submerged Pipe
NACE RP0285	Corrosion Control of Underground Storage Tank Systems by Cathodic Protection
NACE RP0286	Electrical Isolation of Cathodically Protected Pipelines
National Electrical Manufacturers Association (NEMA)	
National Environmental Balancing Bureau (NEBB)	
	Procedural Standards Procedural Standards for Testing Adjusting Balancing of Environmental Systems
National Fire Protection Association (NFPA)	
NFPA 10	Standard for Portable Fire Extinguishers
NFPA 13	Installation of Sprinkler Systems
NFPA 13R	Residential Occupancies up to and Including Four Stories in Height Sprinkler Systems
NFPA 14	Standard for the Installation of Standpipes and Hose Systems
NFPA 20	Installation of Centrifugal Fire Pumps
NFPA 24 NFPA 25	Standard for the Installation of Private Fire Service Mains and Their Appurtenances [underground fire protection system design] Inspection, Testing And Maintenance Of Water-Based Fire Protection Systems
NFPA 30	Flammable and Combustible Liquids Code
NFPA 30A	Motor Fuel Dispensing Facilities and Repair Garages
NFPA 31	Installation of Oil Burning Equipment
NFPA 54	National Fuel Gas Code

NFPA 58	Liquefied Petroleum Gas Code
NFPA 70	National Electrical Code
NFPA 70E	Standard for Electrical Safety in the Workplace
NFPA 72	National Fire Alarm Code
NFPA 76	Fire Protection of Telecommunications Facilities
NFPA 80	Standard for Fire Doors and Fire Windows
NFPA 90a	Installation of Air Conditioning and Ventilating Systems
NFPA 96	Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
NFPA 101	Life Safety Code
NFPA 780	Standard for the Installation of Lightning Protection Systems
National Roofing Contractor's Association (NRCA)	
	Roofing and Waterproofing Manual
National Sanitation Foundation, International	
NSF/ANSI Std. 2, 3, 4, 5, 6, 7, 8, 12, 13, 18, 20, 21, 25, 29, 35, 36, 37, 51, 52, 59, 169	Food Equipment Standards
ANSI/UL Std. 73, 197, 471, 621, 763	Food Equipment Standards
CSA Std. C22.2 No. 109, 120, 195	Food Equipment Standards
Occupational Safety and Health Administration (OSHA)	
Title 29, Part 1926	OSHA Construction Industry Standards, Title 29, Code of Federal Regulations, Part 1926, Safety and Health Regulations for Construction

Plumbing and Drainage Institute (PDI)	
PDI G 101	Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data
PDI WH201	Water Hammer Arrestors
Precast Concrete Institute	
PCI Design Handbook	Precast and Prestressed Concrete
Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)	
SMACNA HVAC Duct Construction Standards	HVAC Duct Construction Standards - Metal and Flexible
SMACNA Architectural Manual	Architectural Sheet Metal Manual
SMACNA HVAC TAB	HVAC Systems - Testing, Adjusting and Balancing
State/Local Regulations	
	State Department of Transportation Standard Specifications for Highway and Bridge Construction
	Sedimentation and Erosion Control Design Requirements
	Environmental Control Requirements
	Storm Water Management Requirements
Steel Door Institute (SDI)	
ANSI A250.8/SDI 100	Standard Steel Doors and Frames
Steel Deck Institute	
	SDI Diaphragm Design Manual
Steel Joist Institute	
	Catalog of Standard Specifications and Load Tables for Steel Joists and

	Joist Girders
Underwriters Laboratories (UL)	
UL 96A	Installation Requirements for Lightning Protection Systems
UL 300	Standard for Safety for Fire Testing of Fire Extinguishing Systems for Protection of Restaurant Cooking Areas
UNITED STATES ACCESS BOARD: U.S. ARCHITECTURAL AND TRANSPORTATION BARRIERS COMPLIANCE BOARD	
ADA and ABA Accessibility Guidelines for Buildings and Facilities	ABA Accessibility Standard for DoD Facilities Derived from the ADA and ABA Accessibility Guidelines: Specifically includes: ABA Chapters 1 and 2 and Chapters 3 through 10. Use this reference in lieu of IBC Chapter 11. Excluded are: (a) Facilities, or portions of facilities, on a military installation that are designed and constructed for use exclusively by able-bodied military personnel (See Paragraph 3 for any reference to this exclusion). (b) Reserve and National Guard facilities, or portions of such facilities, owned by or under the control of the Department of Defense, that are designed and constructed for use exclusively by able-bodied military personnel. (See paragraph 3 for any reference to this exclusion).
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES	
	FDA National Food Code
U.S. GREEN BUILDING COUNCIL (USGBC)	
LEED-NC	Green Building Rating System for New Construction & Major Renovations
	Application Guide for Multiple Buildings and On-Campus Building Projects

4.2. MILITARY CRITERIA

The project shall conform to the following criteria. Certain design impacts and features due to these criteria are noted for the benefit of the offeror. However, all requirements of the referenced criteria will be applicable, whether noted or not, unless otherwise specified herein.

4.2.1. Energy Policy Act of 2005 (Public Law 109-58) (applies only to the extent specifically implemented in the contract, which may or may not directly cite or reference EPACT)

4.2.2. Executive Order 12770: Metric Usage In Federal Government

(a) Metric design and construction is required except when it increases construction cost. Offeror to determine most cost efficient system of measurement to be used for the project.

4.2.3. TB MED 530: Occupational and Environmental Health Food Sanitation

4.2.4. Unified Facilities Criteria (UFC) 3-410-01FA: Heating, Ventilating, and Air Conditioning - applicable only to the extent specified in paragraph 5, herein.

4.2.5. Deleted.

4.2.6. UFC 3-600-01 Design: Fire Protection Engineering for Facilities. Use the latest edition of the IBC in coordination with this UFC. Use Chapters 3, 6, 7, 33 and UFC 3-600-01. If any conflict occurs between these Chapters and UFC 3-600-01, the requirements of UFC 3-600-01 take precedence. Use UFC 3-600-01 in lieu of IBC Chapters 4, 8,9,10.

4.2.7. UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings

4.2.8. UFC 4-023-03 Design of Buildings to Resist Progressive Collapse (Use most recent version, regardless of references thereto in other publications)

(a) Note the option to use tie force method or alternate path design for Occupancy Category II.

4.2.9. UFC 4-021-01 Design and O&M: Mass Notification Systems

4.2.10. Technical Criteria for Installation Information Infrastructure Architecture (I3A)

(a) Email: DetrickISECI3Aguide@conus.army.mil

4.2.11. U.S. Army Information Systems Engineering Command (USAISEC) SECRET Internet Protocol (IP) Router Network (SIPRNET) Technical Implementation Criteria (STIC).. See Paragraph 3 for applicability to specific facility type. May not apply to every facility. This is mandatory criteria for those facilities with SIPRNET.

4.2.11.1. Draft Guide Specification for Section 27 05 28 PROTECTIVE DISTRIBUTION SYSTEM (PDS) FOR SIPRNET COMMUNICATIONS SYSTEMS, found at http://mrsi.usace.army.mil/rfp/Shared%20Documents/SECTION_270528-v3.pdf

5.0 GENERAL TECHNICAL REQUIREMENTS

This paragraph contains technical requirements with general applicability to Army facilities. See also Paragraph 3 for facility type-specific operational, functional and technical requirements. Residential or similar grade finishes and materials are not acceptable for inclusion in these buildings, unless otherwise specifically allowed.

5.1. SITE PLANNING AND DESIGN

5.1.1. STANDARDS AND CODES: The site planning and design shall conform to APPLICABLE CRITERIA and to paragraph 6, PROJECT SPECIFIC REQUIREMENTS.

5.1.2. SITE PLANNING OBJECTIVES: Group buildings in configurations that create a sense of community and promote pedestrian use. See paragraph 3 for additional site planning requirements relating to building functions.

5.1.2.1. Provide enclosures and or visual screening devices for Outdoor Utility such as dumpsters, emergency generators, transformers, heating, ventilation, and air conditioning units from streetscape and courtyard views to limit visual impact. Enclosures shall be compatible with the building they serve and accessible by vehicle. The location of dumpsters can have a significant visual impact and should be addressed as part of an overall building design and incorporated in site planning.

5.1.2.2. Where included in the project, dumpster pads shall be concrete (minimum of 8 inches thick on 4 inch base course, unless site conditions dictate more conservative requirements) and directly accessible by way of a paved service drive or parking lot with adequate overhead clearance for collection vehicles. Provide space at dumpster areas for recycling receptacles. Coordinate with Installation on recycling receptacle types, sizes and access requirements and provide space at dumpster areas to accommodate them.

5.1.2.3. Vehicular Circulation. Apply design vehicle templates provided by the American Association of State Highway and Transportation Officials (AASHTO) to the site design. The passenger car class includes passenger cars and light trucks, such as vans and pick-ups. The passenger car template is equivalent to the non-organizational – privately owned vehicle (POV). The truck class template includes single-unit trucks, recreation vehicles, buses, truck tractor-semi-trailer combinations, and trucks or truck tractors with semi-trailers in combination with full trailers. Provide vehicle clearances required to meet traffic safety for emergency vehicles, service vehicles, and moving vans. Provide required traffic control signage Site entrances and site drive aisles shall maximize spacing between drives, incorporate right-angle turns, and limit points of conflict between traffic. Design Services Drives to restrict access to unauthorized vehicles by removable bollards, gates, or other barriers to meet Anti-Terrorism/Force Protection (ATFP) requirements. Orient service drives to building entrances other than the primary pedestrian entry at the front of the building.

5.1.2.4. Provide Emergency Vehicle Access around the facility and shall be in accordance with AT/FP requirements. Maintain a 33-foot clear zone buffer for emergency vehicles, designed to prevent other vehicles from entering the AT/FP standoff to the building.

5.1.2.5. Clear and grub all trees and vegetation necessary for construction; but, save as many trees as possible. Protect trees to be saved during the construction process from equipment.

5.1.2.6. Stormwater Management. Employ design and construction strategies (Best Management Practices) that reduce stormwater runoff, reduce discharges of polluted water offsite and maintain or restore predevelopment hydrology with respect to temperature, rate, volume and duration of flow to the maximum extent practicable. See paragraph 6, PROJECT SPECIFIC requirements for additional information.

5.1.3. EXTERIOR SIGNAGE: Provide exterior signage in accordance with Appendix H, Exterior Signage. Provide exterior NO SMOKING signage that conveys building and grounds smoking policy.

5.1.4. EXISTING UTILITIES: Base utilities maps and capacities for this site are included as part of this RFP. See paragraph 6 for more detailed information.

5.2. SITE ENGINEERING

5.2.1. STANDARDS AND CODES: The site engineering shall conform to APPLICABLE CRITERIA.

5.2.2. SOILS:

5.2.2.1. A report has been prepared to characterize the subsurface conditions at the project site and is **appended to these specifications.** The report provides a general overview of the soil and geologic conditions with detailed descriptions at discrete boring locations. The Contractor's team shall include a licensed geotechnical engineer to interpret the report and develop earthwork and foundation recommendations and design parameters in which to base the contractor's design. If any additional subsurface investigation or laboratory analysis is required to better characterize the site or develop the final design, the Contractor shall perform it under the direction of a licensed geotechnical engineer. There will be no separate payment for the cost of additional tests. If differences between the Contractor's additional subsurface investigation and the government provided soils report or the reasonably expected conditions require material revisions in the design, an equitable adjustment may be made, in accordance with the provisions of the Differing Site Conditions clause. The basis for the adjustment would be the design and construction appropriate for the conditions described in the Government furnished report or the reasonably expected conditions, in comparison with any changes required by material differences in the actual conditions encountered, in accordance with the terms of contract clause Differing Site Conditions.

5.2.2.2. The contractor's licensed geotechnical engineer shall prepare a final geotechnical evaluation report, to be submitted along with the first foundation design submittal, as described in Section 01 33 16, *Design After Award*.

5.2.3. VEHICLE PAVEMENTS: (as applicable to the project)

5.2.3.1. Design procedures and materials shall conform to one of the following: 1) the USACE Pavement Transportation Computer Assisted Structural Engineering (PCASE) program, 2) American Association of State Highway and Transportation Officials (AASHTO) or, 3) the applicable state Department of Transportation standards in which the project is located. See paragraph 5.2.2.2 and Section 01 33 16 for required information for the Contractor's geotechnical evaluation report. Provide underdrain systems for pavement designs over cohesive soil subgrades. The minimum flexible pavement section shall consist of 2 inches of asphalt and 6 inches of base or as required by the pavement design, whichever is greater, unless specifically identified by the Government to be a gravel road. Design roads and parking areas for a life expectance of 25 years with normal maintenance. Parking area for tactical vehicles (as applicable to the project) shall be Portland Cement Concrete (PCC) rigid pavement design. For concrete pavements, submit joint layout plan for review and concurrence. Design pavements for military tracked vehicles (as applicable to the project) IAW USACE PCASE. Traffic estimates for each roadway area will be as shown on the drawings or listed in Section 01 10 00 Paragraph 6.4.4. Pavement markings and traffic signage shall comply with the Installation requirements and with the Manual on Uniform Traffic Control Devices.

5.2.3.2. Parking Requirements.

(a) All handicap POV parking lots (where applicable in the facility specific requirements) shall meet the ADA and ABA Accessibility Guidelines for accessible parking spaces.

(b) Design POV parking spaces for the type of vehicles anticipated, but shall be a minimum of 9 ft by 18 ft for POVs, except for two wheel vehicles.

5.2.3.3. Sidewalks. Design the network of walks throughout the complex (where applicable) to facilitate pedestrian traffic among facilities, and minimize the need to use vehicles. Incorporate sidewalks to enhance the appearance of the site development, while creating a sense of entry at the primary patron entrances to the buildings. Minimum sidewalk requirements are in Paragraph 3, where applicable and/or paragraph 6 and/or site plans, where applicable..

5.2.4. CATHODIC PROTECTION: Provide cathodic protection systems for all underground metallic systems and metallic fittings/portions of non-metallic, underground systems, both inside and outside the building 5 foot line that are subject to corrosion. Coordinate final solutions with the installation to insure an approach that is consistent with installation cathodic protection programs.

5.2.5. UTILITIES: See paragraph 6.4.6 for specific information on ownership of utilities and utility requirements. Meter all utilities (gas, water, and electric, as applicable) to each facility. For Government owned utilities, install meters that are wireless data transmission capable as well as have a continuous manual reading option. All meters will be capable of at least hourly data logging and transmission and provide consumption data for gas, water, and electricity. Gas and electric meters will also provide demand readings based on consumption over a maximum of any 15 minute period. Configure all meters to transmit at least daily even if no receiver for the data is currently available at the time of project acceptance. For privatized utilities, coordinate with the privatization utility(ies) for the proper meter base and meter installation.

5.2.6. PERMITS: The CONTRACTOR shall be responsible for obtaining all permits (local, state and federal) required for design and construction of all site features and utilities.

5.2.7. IRRIGATION. Landscape irrigation systems, if provided, shall comply with the following:

5.2.7.1. Irrigation Potable Water Use Reduction. Reduce irrigation potable water use by 100 percent using LEED credit WE1.1 baseline (no potable water used for irrigation), except where precluded by other project requirements.

5.2.8. EPA WATERSENSE PRODUCTS AND CONTRACTORS. Except where precluded by other project requirements, use EPA WaterSense labeled products and irrigation contractors that are certified through a WaterSense labeled program where available.

5.3. ARCHITECTURE AND INTERIOR DESIGN:

This element will be evaluated per APPLICABLE CRITERIA under the quality focus.

5.3.1. STANDARDS AND CODES: The architecture and interior design shall conform to APPLICABLE CRITERIA.

5.3.2. GENERAL: Overall architectural goal is to provide a functional, quality, visually appealing facility that is a source of pride for the installation and delivered within the available budget and schedule.

5.3.3. COMPUTATION OF AREAS: See APPENDIX Q for how to compute gross and net areas of the facility(ies).

5.3.4. BUILDING EXTERIOR: Design buildings to enhance or compliment the visual environment of the Installation. Where appropriate, reflect a human scale to the facility. Building entrance should be architecturally defined and easily seen. When practical, exterior materials, roof forms, and detailing shall be compatible with the surrounding development and adjacent buildings on the Installation and follow

locally established architectural themes. Use durable materials that are easy to maintain. Exterior colors shall conform to the Installation requirements. See paragraph 6.

5.3.4.1. Building Numbers: Permanently attach exterior signage on two faces of each building indicating the assigned building number or address. Building number signage details and locations shall conform to Appendix H, Exterior Signage.

5.3.5. BUILDING INTERIOR

5.3.5.1. Space Configuration: Arrange spaces in an efficient and functional manner in accordance with area adjacency matrices.

5.3.5.2. Surfaces: Appearance retention is the top priority for building and furniture related finishes. Provide low maintenance, easily cleaned room finishes that are commercially standard for the facility occupancy specified, unless noted otherwise.

5.3.5.3. Color: The color, texture and pattern selections for the finishes of the building shall provide an aesthetically pleasing, comfortable, easily maintainable and functional environment for the occupants. Coordinate the building colors and finishes for a cohesive design. Select colors appropriate for the building type. Use color, texture and pattern to path or way find through the building. Trendy colors that will become dated shall be limited to non-permanent finishes such as carpet and paint. Select finisheswith regards to aesthetics, maintenance, durability, life safety and image. Limit the number of similar colors for each material. Use medium range colors for ceramic and porcelain tile groutto help hide soiling. Plastic laminate and solid surface materials shall have patterns that are mottled, flecked or speckled. Coordinate finish colors of fire extinguisher cabinets, receptacle bodies and plates, fire alarms / warning lights, emergency lighting, and other miscellaneous items with the building interior. Match color of equipment items on ceilings (speakers, smoke detectors, grills, etc.) the ceiling color.

5.3.5.4. Circulation: Circulation schemes must support easy way finding within the building.

5.3.5.5. Signage: Provide interior signage for overall way finding and life safety requirements. A comprehensive interior plan shall be from one manufacturer. Include the following sign types: (1) Lobby Directory, (2) Directional Signs; (3) Room Identification Signs; (4) Building Service Signs; (5) Regulatory Signs; (6) Official and Unofficial Signs (7) Visual Communication Boards (8) NO SMOKING signage that conveys building smoking policy. Use of emblems or logos may also be incorporated into the signage plan.

5.3.5.6. Window Treatment: Provide interior window treatments with adjustable control in all exterior window locations for control of day light coming in windows or privacy at night. Maintain uniformity of treatment color and material to the maximum extent possible within a building.

5.3.5.7. Casework: Unless, otherwise specified, all casework for Cabinetry and cases shall be “custom grade”, as described in the AWI Quality Standards.

5.3.6. COMPREHENSIVE INTERIOR DESIGN

5.3.6.1. Comprehensive Interior Design includes the integration of a Structural Interior Design (SID) and a Furniture, Fixtures and Equipment (FF&E) design and package. SID requires the design, selection and coordination of interior finish materials that are integral to or attached to the building structure. Completion of a SID involves the selection and specification of applied finishes for the building’s interior features including, but not limited to, walls, floors, ceilings, trims, doors, windows, window treatments, built-in furnishings and installed equipment, lighting, and signage. The SID package includes finish schedules, finish samples and any supporting interior elevations, details or plans necessary to communicate the building finish design and build out. The SID also provides basic space planning for the anticipated FF&E requirements in conjunction with the functional layout of the building and design issues

such as life safety, privacy, acoustics, lighting, ventilation, and accessibility. See Section 01 33 16 for SID design procedures.

5.3.6.2. The FF&E design and package includes the design, selection, color coordination and of the required furnishing items necessary to meet the functional, operational, sustainability, and aesthetic needs of the facility coordinated with the interior finish materials in the SID. The FF&E package includes the specification, procurement documentation, placement plans, ordering and finish information on all freestanding furnishings and accessories, and a cost estimate. Coordinate the selection of furniture style, function and configuration with the defined requirements. Examples of FF&E items include, but are not limited to workstations, seating, files, tables, beds, wardrobes, draperies and accessories as well as marker boards, tack boards, and presentation screens. Criteria for furniture selection include function and ergonomics, maintenance, durability, sustainability, comfort and cost. See Section 01 33 16 for FFE design procedures.

5.4. STRUCTURAL DESIGN

5.4.1. STANDARDS AND CODES: The structural design shall conform to APPLICABLE CRITERIA.

5.4.2. GENERAL: The structural system must be compatible with the intended functions and components that allows for future flexibility and reconfigurations of the interior space. Do not locate columns, for instance, in rooms requiring visibility, circulation or open space, including, but not limited to entries, hallways, common areas, classrooms, etc. Select an economical structural system based upon facility size, projected load requirements and local availability of materials and labor. Base the structural design on accurate, site specific geotechnical information and anticipated loads for the building types and geographical location. Consider climate conditions, high humidity, industrial atmosphere, saltwater exposure, or other adverse conditions when selecting the type of cement and admixtures used in concrete, the concrete cover on reinforcing steel, the coatings on structural members, expansion joints, the level of corrosion protection, and the structural systems. Analyze, design and detail each building as a complete structural system. Design structural elements to preclude damage to finishes, partitions and other frangible, non-structural elements to prevent impaired operability of moveable components; and to prevent cladding leakage and roof ponding. Limit deflections of structural members to the allowable of the applicable material standard, e.g., ACI, AISC, Brick Industry Association, etc. When modular units or other pre-fabricated construction is used or combined with stick-built construction, fully coordinate and integrate the overall structural design between the two different or interfacing construction types. If the state that the project is located in requires separate, specific licensing for structural engineers (for instance, such as in Florida, California and others), then the structural engineer designer of record must be registered in that state.

5.4.3. LOADS: See paragraph 3 for facility specific (if applicable) and paragraph 6 for site and project specific structural loading criteria. Unless otherwise specified in paragraph 6, use Exposure Category C for wind. If not specified, use Category C unless the Designer of Record can satisfactorily justify another Exposure Category in its design analysis based on the facility Master Plan. Submit such exceptions for approval as early as possible and prior to the Interim Design Submittal in Section “Design After Award”. Design the ancillary building items, e.g. doors, window jambs and connections, overhead architectural features, systems and equipment bracing, ducting, piping, etc. for gravity, seismic, lateral loads and for the requirements of UFC 4-010-01, DOD Minimum Antiterrorism Standards for Buildings. Ensure and document that the design of glazed items includes, but is not limited to, the following items under the design loads prescribed in UFC 4-010-01:

(a) Supporting members of glazed elements, e.g. window jamb, sill, header

(b) Connections of glazed element to supporting members, e.g. window to header

(c) Connections of supporting members to each other, e.g. header to jamb

(d) Connections of supporting members to structural system, e.g. jamb to foundation.

5.4.4. TERMITE TREATMENT: (Except Alaska) Provide termite prevention treatment in accordance with Installation and local building code requirements, using licensed chemicals and licensed applicator firm.

5.5. THERMAL PERFORMANCE

5.5.1. STANDARDS AND CODES: Building construction and thermal insulation for mechanical systems shall conform to APPLICABLE CRITERIA.

5.5.2. BUILDING ENVELOPE SEALING PERFORMANCE REQUIREMENT. Design and construct the building envelope for office buildings, office portions of mixed office and open space (e.g., company operations facilities), dining, barracks and instructional/training facilities with a continuous air barrier to control air leakage into, or out of, the conditioned space. Clearly identify all air barrier components of each envelope assembly on construction documents and detail the joints, interconnections and penetrations of the air barrier components. Clearly identify the boundary limits of the building air barriers, and of the zone or zones to be tested for building air tightness on the drawings. The use of painted interior walls is not an acceptable air barrier method.

5.5.2.1. Trace a continuous plane of air-tightness throughout the building envelope and make flexible and seal all moving joints.

5.5.2.2. The air barrier material(s) must have an air permeance not to exceed 0.004 cfm / sf at 0.3” wg (0.02 L/s.m2 @ 75 Pa) when tested in accordance with ASTM E 2178

5.5.2.3. Join and seal the air barrier material of each assembly in a flexible manner to the air barrier material of adjacent assemblies, allowing for the relative movement of these assemblies and components.

5.5.2.4. Support the air barrier so as to withstand the maximum positive and negative air pressure to be placed on the building without displacement, or damage, and transfer the load to the structure.

5.5.2.5. Seal all penetrations of the air barrier. If any unavoidable penetrations of the air barrier by electrical boxes, plumbing fixture boxes, and other assemblies are not airtight, make them airtight by sealing the assembly and the interface between the assembly and the air barrier or by extending the air barrier over the assembly.

5.5.2.6. The air barrier must be durable to last the anticipated service life of the assembly.

5.5.2.7. Do not install lighting fixtures with ventilation holes through the air barrier

5.5.2.8. Provide a motorized damper in the closed position and connected to the fire alarm system to open on call and fail in the open position for any fixed open louvers at elevator shafts. Coordinate the motorized elevator hoistway vent damper(s) with the Fire Protection System design in paragraph 5.10. Ensure that the damper(s) is accessible to facilitate regular inspection and maintenance.

5.5.2.9. Damper and control to close all ventilation or make-up air intakes and exhausts, , etc., when leakage can occur during inactive periods. Atrium smoke exhaust and intakes shall only open when activated per IBC and other applicable Fire Code requirements.

5.5.2.10. Compartmentalize garages under buildings by providing air-tight vestibules at building access points.

5.5.2.11. Compartmentalize spaces under negative pressure such as boiler rooms and provide make-up air for combustion.

5.5.2.12. Performance Criteria and Substantiation: Submit the qualifications and experience of the testing entity for approval. Demonstrate performance of the continuous air barrier for the opaque building envelope by the following tests:

(a) Develop an Air Barrier Quality Control plan to assure that a competent air barrier inspector/specialist inspects the critical components prior to them being concealed. At a minimum, three onsite inspections are required during construction to assure the completeness of the construction and design.

(b) Test the completed building and demonstrate that the air leakage rate of the building envelope does not exceed 0.25cfm/ft2 at a pressure differential of 0.3" w.g.(75 Pa) in accordance with ASTM's E 779 (2003) or E-1827-96 (2002). Accomplish tests using both pressurization and depressurization.. Divide the volume of air leakage in cfm @ 0.3" w.g. (L/s @ 75 Pa) by the area of the pressure boundary of the building, including roof or ceiling, walls and floor to produce the air leakage rate in cfm/ft2 @ 0.3" w.g. (L/s.m2 @ 75 Pa). Do not test the building until verifying that the continuous air barrier is in place and installed without failures in accordance with installation instructions so that repairs to the continuous air barrier, if needed to comply with the required air leakage rate, can be done in a timely manner.

(c) Test the completed building using Infrared Thermography testing. Use infrared cameras with a resolution of 0.1deg C or better. Perform testing on the building envelope in accordance with ISO 6781:1983 and ASTM C1060-90(1997). Determine air leakage pathways using ASTM E 1186-03 Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems, and perform corrective work as necessary to achieve the whole building air leakage rate specified in (a) above.

(d) Notify the Government at least three working days prior to the tests to provide the Government the opportunity to witness the tests. Provide the Government written test results confirming the results of all tests.

5.6. PLUMBING

5.6.1. STANDARDS AND CODES: The plumbing system shall conform to APPLICABLE CRITERIA.

5.6.2. PRECAUTIONS FOR EXPANSIVE SOILS: Where expansive soils are present, include design features for underslab piping systems and underground piping serving chillers, cooling towers, etc, to control forces resulting from soil heave. Some possible solutions include, but are not necessarily limited to, features such as flexible expansion joints, slip joints, horizontal offsets with ball joints, or multiple bell and spigot gasketed fittings. For structurally supported slabs, suspend piping from the structure with adequate space provided below the pipe for the anticipated soil movement.

5.6.3. HOT WATER SYSTEMS: For Hot Water heating and supply, provide a minimum temp of 140 Deg F in the storage tank and a maximum of 110 Deg F at the fixture, unless specific appliances or equipment specifically require higher temperature water supply.

5.6.4. SIZING HOT WATER SYSTEMS: Unless otherwise specified or directed in paragraph 3, design in accordance with ASHRAE Handbook Series (appropriate Chapters), ASHRAE Standard 90.1, and the energy conservation requirements of the contract. Size and place equipment so that it is easily accessible and removable for repair or replacement.

5.6.5. JANITOR CLOSETS: In janitor spaces/room/closets, provide at minimum, a service sink with heavy duty shelf and wall hung mop and broom rack(s).

5.6.6. FLOOR DRAINS: As a minimum, provide floor drains in mechanical rooms and areas, janitor spaces/rooms/closets and any other area that requires drainage from fixtures or equipment, drain downs, condensate, as necessary.

5.6.7. URINALS: Urinals shall be water-use type, conforming to ASHRAE Standard 189.1 (0.5 gpf/1.9 lpf).

5.6.8. BUILDING WATER USE REDUCTION. Reduce building potable water use in each building 30 percent from the Baseline, using the Manufacturing Performance Requirements for .Plumbing Fixtures from the Energy Policy Act of 1992 (Public Law 102-486), except as modified by LEED. See Appendix S. Public lavatory faucets shall deliver a maximum flow rate of 0.5 gallons per minute, when tested in accordance with ASME A 112.18/CSA B125 and use that flowrate as the Baseline figure for calculating the 30 percent reduction requirement from the Baseline.

5.6.9. Do not use engineered vent or Sovent® type drainage systems.

5.6.10. Where the seasonal design temperature of the cold water entering a building is below the seasonal design dew point of the indoor ambient air, and where condensate drip will cause damage or create a hazard, insulate plumbing piping with a vapor barrier type of insulation to prevent condensation. Do not locate water or drainage piping over electrical wiring or equipment unless adequate protection against water (including condensation) damage is provided. Insulation alone is not adequate protection against condensation. Follow ASHRAE Fundamentals Chapter 23, Insulation for Mechanical Systems, IMC paragraph 1107 and International Energy Conservation Code for pipe insulation requirements.

5.6.11. Cover all drain, waste and vent piping to prevent mortar or other debris from being flushed down and blocking pipes during such construction activities.

5.7. ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

5.7.1. STANDARDS AND CODES: The electrical systems for all facilities shall conform to APPLICABLE CRITERIA.

5.7.2. MATERIALS AND EQUIPMENT: Materials, equipment and devices shall, as a minimum, meet the requirements of Underwriters Laboratories (UL) where UL standards are established for those items. Wiring for branch circuits shall be copper. Motors larger than one-half horsepower shall be three phase. All electrical systems shall be pre-wired and fully operational unless otherwise indicated. Wall mounted electrical devices (power receptacles, communication outlets and CATV outlets) shall have matching colors, mounting heights and faceplates.

5.7.3. POWER SERVICE: Primary service from the base electrical distribution system to the pad-mounted transformer and secondary service from the transformer to the building service electrical equipment room shall be underground. See paragraph 6 for additional site electrical requirements.

5.7.3.1. Spare Capacity: Provide 10% space for future circuit breakers in all panelboards serving residential areas of buildings and 15% spaces in all other panelboards.

5.7.4. TELECOMMUNICATION SERVICE: Connect the project's facilities to the Installation telecommunications (voice and data) system through the outside plant (OSP) telecommunications underground infrastructure cabling system per the I3A Criteria. Connect to the OSP cabling system from each facility main cross connect located in the telecommunications room.

5.7.5. LIGHTING: Comply with the recommendations of the Illumination Engineering Society of North America (IESNA), the National Energy Policy Act and Energy Star requirements for lighting products..

5.7.5.1. Interior Lighting:

(a) Reflective Surfaces: Coordinate interior architectural space surfaces and colors with the lighting systems to provide the most energy-efficient workable combinations.

(b) High Efficiency Fluorescent Lighting: Utilize NEMA premium electronic ballasts and energy efficient fluorescent lamps with a Correlated Color Temperature (CCT) of 4100K. Linear fluorescent and compact fluorescent fixtures shall have a Color Rendering Index of (CRI) of 87 or higher. Fluorescent lamps shall be the low mercury type qualifying as non-hazardous waste upon disposal. Do not use surface mounted fixtures on acoustical tile ceilings. Provide an un-switched fixture with emergency ballast at each entrance to the building.

(c) Solid State Lighting: Fixtures shall provide lighting with a minimum Correlated Color Temperature (CCT) of 4100K and shall have a Color Rendering Index of (CRI) of 75 or higher. Verify performance of the light producing solid state components by a test report in compliance with the requirements of IESNA LM 80. Verify performance of the solid state light fixtures by a test report in compliance with the requirements of IESNA LM 79. Provide lab results by a NVLAP certified laboratory. The light producing solid state components and drivers shall have a life expectancy of 50,000 operating hours while maintaining at least 70% of original illumination level. Provide a complete five year warranty for fixtures.

(d) Metal Halide Lighting (where applicable): Metal Halide lamp fixtures in the range of 150-500 Watts shall be pulse start type and have a minimum efficiency rating of 88%.

(e) Lighting Controls: ANSI/ASHRAE/IESNA 90.1 has specific lighting controls requirements. See Also Appendix T, ***Functional Area Lighting Control Strategy.***

(f) Exterior Lighting: See paragraph 6.9 for site specific information, if any, on exterior lighting systems. Minimize light pollution and light trespass by not over lighting and use cut-off type exterior luminaries.

5.7.6. TELECOMMUNICATION SYSTEM: Building telecommunications cabling systems (BCS) and OSP telecommunications cabling system shall conform to APPLICABLE CRITERIA, including but not limited to I3A Technical Criteria. An acceptable BCS encompasses, but is not limited to, copper and fiber optic (FO) entrance cable, termination equipment, copper and fiber backbone cable, copper and fiber horizontal distribution cable, workstation outlets, racks, cable management, patch panels, cable tray, cable ladder, conduits, grounding, and labeling.. Items included under OSP infrastructure encompass, but are not limited to, manhole and duct infrastructure, copper cable, fiber optic cable, cross connects, terminations, cable vaults, and copper and FO entrance cable.

5.7.6.1. Design, install, label and test all telecommunications systems in accordance with the I3A Criteria and ANSI/TIA/EIA 568, 569, and 606 standards. A Building Industry Consulting Services International (BICSI) Registered Communications Distribution Designer (RCDD) with at least 2 yrs related experience shall develop and stamp telecommunications design, and prepare the test plan. See paragraph 5.8.2.5 for design of environmental systems for Telecommunications Rooms.

5.7.6.2. The installers assigned to the installation of the telecommunications system or any of its components shall be regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. Key personnel; i.e., supervisors and lead installers assigned to the installation of this system or any of its components shall be BICSI Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel. In lieu of BICSI certification, supervisors and installers shall have a minimum of 5 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products.

5.7.6.3. Perform a comprehensive end to end test of all circuits to include all copper and fiber optic cables upon completion of the BCS and prior to acceptance of the facility. Provide adequate advanced notification to the COR to allow COR and Installation personnel attendance The BCS circuits include but are not limited to all copper and fiber optic(FO) entrance cables, termination equipment, copper and fiber backbone cable, copper and fiber horizontal distribution cable, and workstation outlets. Test in accordance with ANSI/EIA/TIA 568 standards. Use test instrumentation that meets or exceeds the standard. Submit the official test report to include test procedures, parameters tested, values, discrepancies and corrective actions in electronic format. Test and accomplish all necessary corrective

actions to ensure that the government receives a fully operational, standards based, code compliant telecommunications system.

5.7.7. LIGHTNING PROTECTION SYSTEM: Provide a lightning protection system where recommended by the Lightning Risk Assessment of NFPA 780, Annex L.

5.8. HEATING, VENTILATING, AND AIR CONDITIONING

5.8.1. STANDARDS AND CODES: The HVAC system shall conform to APPLICABLE CRITERIA.

5.8.2. DESIGN CONDITIONS.

5.8.2.1. Outdoor and indoor design conditions shall be in accordance with UFC 3-410-01FA. Outdoor air and exhaust ventilation requirements for indoor air quality shall be in accordance with ASHRAE 62.1. All Buildings with minimum LEED Silver requirement (or better) will earn LEED Credit EQ 7.1, Thermal Comfort-Design., except where precluded by other project requirements. Where the contract specifies indoor design temperature , airflow, humidity conditions, etc., use those parameters.

5.8.2.2. High Humidity Areas: Design HVAC systems in geographical areas meeting the definition for high humidity in UFC 3-410-01FA to comply with the special criteria therein for humid areas.

5.8.2.3. Cooling equipment may be oversized by up to 15 percent to account for recovery from night setforward. Heating equipment may be oversized by up to 30 percent to account for recovery from night setback. Design single zone systems and multi-zone systems to maintain an indoor design condition of 50% relative humidity for cooling only. For heating only where the indoor relative humidity is expected to fall below 20% for extended periods, add humidification to increase the indoor relative humidity to 30%. Provide ventilation air from a separate dedicated air handling unit (DOAU) for facilities using multiple single zone fan-coil type HVAC systems. Do not condition outside air through fan coil units. In Air handlers that handle outdoor air and have fans that run continuously during the occupied mode, direct expansion cooling coils may be used only if the controls and compressor technology is provided that allows the compressor to operate down to 10% of full load without utilizing hot gas bypass to minimize the potential of delivering unconditioned outdoor air to the space.

5.8.2.4. Locate all equipment so that service, adjustment and replacement of controls or internal components are readily accessible for easy maintenance.

5.8.2.5. Environmental Requirements for Telecommunications Rooms and Telecommunications Equipment Rooms, (including SIPRNET ROOMS, where applicable for specific facility type). Comply with ANSI/EIA/TIA 569 (including applicable Addenda**)**. Maintain environmental conditions at the Class 1 and 2 Recommended Operating Environment. Before being introduced into the room, filter and pre-condition outside air to remove particles with the minimum MERV filtration quality shown in the ASHRAE HVAC Applications, Chapter 17. Maintain rooms under positive pressure relative to surrounding spaces. Design computer room air conditioning units specifically for telecommunications room applications. Build and test units in accordance with the requirements of ANSI/ASHRAE Standard 127. A complete air handling system shall provide ventilation, air filtration, cooling and dehumidification, humidification (as determined during the design phase), and heating. The system shall be independent of other facility HVAC systems and shall be required year round.

5.8.2.6. Fire dampers: dynamic type with a dynamic rating suitable for the maximum air velocity and pressure differential to which the damper is subjected. Test each fire damper with the air handling and distribution system running.

5.8.3. BUILDING AUTOMATION SYSTEM. Provide a Building Automation System (BAS), consisting of a building control network , and integrate the building control network into the UMCS as specified.

The building control networkshall be a single complete non-proprietary Direct Digital Control (DDC) system for control of all the heating, ventilating and air conditioning (HVAC) systems and for control of other building systems. The building control network shall be an Open implementation of LONWORKS® technology using ANSI/EIA 709.1B as the only communications protocol and use only LonMark Standard Network Variable Types (SNVTs), as defined in the LonMark® Resource Files, for communication between DDC Hardware devices to allow multi-vendor interoperability.

5.8.3.1. The building automation system shall be open in that it is designed and installed such that the Government or its agents are able to perform repair, replacement, upgrades, and expansions of the system without further dependence on the original Contractor. This includes, but is not limited to the following:

(a) Install hardware such that individual control equipment can be replaced by similar control equipment from other equipment manufacturers with no loss of system functionality.

(b) Necessary documentation (including rights to documentation and data), configuration information, configuration tools, programs, drivers, and other software shall be licensed to and otherwise remain with the Government such that the Government or its agents are able to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the Contractor.

5.8.3.2. All DDC Hardware shall:

(a) Be connected to a TP/FT-10 ANSI/EIA 709.3 control network.

(b) Communicate over the control network via ANSI/EIA 709.1B exclusively.

(c) Communicate with other DDC hardware using only SNVTs

(d) Conform to the LonMark® Interoperability Guidelines.

(e) Be locally powered; link power (over the control network) is not acceptable.

(f) Be fully configurable via standard or user-defined configuration parameter types (SCPT or UCPT), standard network variable type (SNVT) network configuration inputs (*nci*), or hardware settings on the controller itself to support the application. All settings and parameters used by the application shall be configurable via standard or user-defined configuration parameter types (SCPT or UCPT), standard network variable type (SNVT) network configuration inputs (*nci*), or hardware settings on the controller itself

(g) Provide input and output SNVTs required to support monitoring and control (including but not limited to scheduling, alarming, trending and overrides) of the application. Required SNVTs include but are not limited to: SNVT outputs for all hardware I/O, SNVT outputs for all setpoints and SNVT inputs for override of setpoints.

(h) To the greatest extent practical, not rely on the control network to perform the application.

(i) Provide on board nonvolatile memory for devices accumulating energy consumption.

5.8.3.3. Controllers shall be Application Specific Controllers whenever an ASC suitable for the application exists. When an ASC suitable for the application does not exist use programmable controllers or multiple application specific controllers.

5.8.3.4. Application Specific Controllers shall be LonMark Certified whenever a LonMark Certified ASC suitable for the application exists. For example, VAV controllers must be LonMark certified.

5.8.3.5. Application Specific Controllers (ASCs) shall be configurable via an LNS plug-in whenever t an ASC with an LNS plug-in suitable for the application exists.

5.8.3.6. Each scheduled system shall accept a network variable of type SNVT_occupancy and shall use this network variable to determine the occupancy mode. If the system has not received a value to this network variable for more than 60 minutes it shall default to a configured occupancy schedule.

5.8.3.7. Gateways may be used provided that each gateway communicates with and performs protocol translation for control hardware controlling one and only one package unit.

5.8.3.8. Not Used

5.8.3.9. Perform all necessary actions needed to fully integrate the building control system. These actions include but are not limited to:

- Configure M&C Software functionality including: graphical pages for System Graphic Displays including overrides, alarm handling, scheduling, trends for critical values needing long-term or permanent monitoring via trends, and demand limiting.
- Install IP routers or ANSI/CEA-852 routers as needed to connect the building control network to the UMCS IP network. Routers shall be capable of configuration via DHCP and use of an ANSI/CEA-852 configuration server but shall not rely on these services for configuration. All communication between the UMCS and building networks shall be via the ANSI/CEA-709.1B protocol over the IP network in accordance with ANSI/CEA-852.

5.8.3.10. Provide the following to the Government for review prior to acceptance of the system:

- The latest version of all software and user manuals required to program, configure and operate the system.
- Points Schedule drawing that shows every DDC Hardware device. The Points Schedule shall contain the following information as a minimum:
    - Device address and NodeID.
    - Input and Output SNVTs including SNVT Name, Type and Description.
    - Hardware I/O, including Type (AI, AO, BI, BO) and Description.
    - Alarm information including alarm limits and SNVT information.
    - Supervisory control information including SNVTs for trending and overrides.
    - Configuration parameters (for devices without LNS plug-ins) Example Points Schedules are available at https://eko.usace.army.mil/fa/besc/
- Riser diagram of the network showing all network cabling and hardware. Label hardware with ANSI.CEA-709.1 addresses, IP addresses, and network names.
- Control System Schematic diagram and Sequence of Operation for each HVAC system.
- Operation and Maintenance Instructions including procedures for system start-up, operation and shut-down, a routine maintenance checklist, and a qualified service organization list.
- LONWORKS® Network Services (LNS®) database for the completed system.
- Quality Control (QC) checklist (below) completed by the Contractor's Chief Quality Control (QC) Representative

Table 5-1: QC Checklist

Instructions: Initial each item, sign and date verifying that the requirements have been met.		
#	Description	Initials
1	All DDC Hardware is installed on a TP/FT-10 local control bus.	
2	Communication between DDC Hardware is only via EIA 709.1B using SNVTs. Other protocols and network variables other than SNVTs have not been used.	
3	All sequences are performed using DDC Hardware.	
4	LNS Database is up-to-date and accurately represents the final installed system	
5	All software has been licensed to the Government	
6	M&C software monitoring displays have been created for all building systems, including all override and display points indicated on Points Schedule drawings.	
7	Final As-built Drawings accurately represent the final installed system.	
8	O&M Instructions have been completed and submitted.	
9	Connections between the UMCS IP network and ANSI/CEA-709.1B building networks are through ANSI/CEA-852 Routers.	
By signing below I verify that all requirements of the contract, including but not limited to the above, been met.		
Signature:_____ Date:_____		

5.8.3.11. Perform a Performance Verification Test (PVT) under Government supervision prior to system acceptance. During the PVT demonstrate that the system performs as specified, including but not limited to demonstrating that the system is Open and correctly performs the Sequences of Operation.

5.8.3.12. Provide a 1 year unconditional warranty on the installed system and on all service call work. The warranty shall include labor and material necessary to restore the equipment involved in the initial service call to a fully operable condition.

5.8.3.13. Provide training at the project site on the installed building system Upon completion of this training each student, using appropriate documentation, should be able to start the system, operate the system, recover the system after a failure, perform routine maintenance and describe the specific hardware, architecture and operation of the system.

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5.8.4. TESTING, ADJUSTING AND BALANCING. Test and balance air and hydronic systems, using a firm certified for testing and balancing by the Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB), or the Testing Adjusting, and Balancing Bureau (TABB). The prime contractor shall hire the TAB firm directly, not through a subcontractor. Perform TAB in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB TABES, or SMACNA HVACTAB unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard shall be considered mandatory. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practicable to satisfy the Contract requirements. Use the TAB Standard for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, adhere to the manufacturer's recommendations. All quality assurance provisions of the TAB Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the TAB Standard, the TAB Specialist shall develop TAB procedures. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements are mandatory.

5.8.5. COMMISSIONING: Commission all HVAC systems and equipment, including controls, and all systems requiring commissioning for LEED Enhanced commissioning, in accordance with ASHRAE Guideline 1.1, ASHRAE Guideline 0 and LEED. Do not use the sampling techniques discussed in ASHRAE Guideline 1.1 and in ASHRAE Guideline 0. Commission 100% of the HVAC controls and equipment. Hire the Commissioning Authority (CxA), certified as a CxA by AABC, NEBB, or TABB, as described in Guideline 1.1. The CxA will be an independent subcontractor and not an employee of the Contractor nor an employee or subcontractor of any other subcontractor on this project, including the design professionals (i.e., the DOR or their firm(s)). The CxA will communicate and report directly to the Government in execution of commissioning activities. The Contracting Officer's Representative will act as the Owner's representative in performance of duties spelled out under OWNER in Annex F of ASHRAE Guideline 0. Because required CxA contractual relationship may not be acceptable to GBCI for LEED certification, the project cannot earn LEED Credit EA3 Enhanced Commissioning. However, still complete, maintain and provide copies of all necessary LEED documentation for Credit EA 3. This LEED Credit cannot be included to meet the required LEED rating for this project. Contractor may attempt this as an additional credit for GBCI certification but the Government will not accept it until GBCI accepts it.

5.9. ENERGY CONSERVATION

5.9.1. The building including the building envelope, HVAC systems, service water heating, power, and lighting systems shall meet the Mandatory Provisions and the Prescriptive Path requirements of ASHRAE 90.1. Substantiation requirements are defined in Section 01 33 16, Design After Award.

5.9.2. Design all building systems and elements to meet the minimum requirements of ANSI/ASHRAE/IESNA 90.1. Design the buildings, including the building envelope, HVAC systems, service water heating, power, and lighting systems to achieve an energy consumption that is at least 40% below the consumption of a baseline building meeting the minimum requirements of ANSI/ASHRAE/IESNA Standard 90.1. Energy calculation methodologies and substantiation requirements are defined in Section 01 33 16, Design After Award.

5.9.3. Purchase Energy Star products, except use FEMP designated products where FEMP is applicable to the type product. The term "Energy Star product" means a product that is rated for energy efficiency under an Energy Star program. The term "FEMP designated product" means a product that is designated under the Federal Energy Management Program of the Department of Energy as being among the highest 25 percent of equivalent products for energy efficiency. When selecting integral sized electric motors, choose NEMA PREMIUM type motors that conform to NEMA MG 1, minimum Class F insulation system. Motors with efficiencies lower than the NEMA PREMIUM standard may only be used in unique applications that require a high constant torque speed ratio (e.g., inverter duty or vector duty type motors that conform to NEMA MG 1, Part 30 or Part 31).

5.9.4. Solar Hot Water Heating. Provide at least 30% of the domestic hot water requirements through solar heating methodologies, unless the results of a Life Cycle Cost Analysis (LCCA) developed utilizing the Building Life Cycle Cost Program (BLCC) which demonstrates that the solar hot water system is not life cycle cost effective in comparison with other hot water heating systems. The type of system will be established during the contract or task order competition and award phase, including submission of an LCCA for government evaluation to justify non-selection of solar hot water heating. The LCCA uses a study period of 25 years and the Appendix K utility cost information. The LCCA shall include life cycle cost comparisons to a baseline system to provide domestic hot water without solar components, analyzing at least two different methodologies for providing solar hot water to compare against the baseline system.

5.9.5. Process Water Conservation. When potable water is used to improve a building's energy efficiency, employ lifecycle cost effective water conservation measures, except where precluded by other project requirements.

5.9.6. Renewable Energy Features. The Government's goal is to implement on-site renewable energy generation for Government use when lifecycle cost effective. See Paragraph 6, PROJECT SPECIFIC REQUIREMENTS for renewable energy requirements for this project.

5.10. FIRE PROTECTION

5.10.1. STANDARDS AND CODES Provide the fire protection system conforming to APPLICABLE CRITERIA.

5.10.2. Inspect and test all fire suppression equipment and systems, fire pumps, fire alarm and detection systems and mass notification systems in accordance with the applicable NFPA standards. The fire protection engineer of record shall witness final tests. The fire protection engineer of record shall certify that the equipment and systems are fully operational and meet the contract requirements. Two weeks prior to each final test, the contractor shall notify, in writing, the installation fire department and the installation public work representative of the test and invite them to witness the test.

5.10.3. Fire Extinguisher Cabinets: Provide fire extinguisher cabinets and locations for hanging portable fire extinguishers in accordance with NFPA 10 Standard for Portable Fire Extinguishers. The Government will furnish and install portable fire extinguishers, which are personal property, not real property installed equipment.

5.10.4. Fire alarm and detection system: Required fire alarm and detection systems shall be the addressable type. Fire alarm initiating devices, such as smoke detectors, heat detectors and manual pull stations shall be addressable. When the system is in alarm condition, the system shall annunciate the type and location of each alarm initiating device. Sprinkler water flow alarms shall be zoned by building and by floor. Supervisory alarm initiating devices, such as valve supervisory switches, fire pump running alarm, low-air pressure on dry sprinkler system, etc. shall be zoned by type and by room location.

5.10.5. Roof Access: Paragraph 2-9 of UFC 3-600-01 Fire Protection for Facilities will be modified in the next update to that UFC. Pending revision, comply with roof access and stairway requirements in accordance with the International Building Code. Where roof access is required by the IBC or other criteria, comply with UFC 4-010-01, Anti-Terrorist Force Protection, Standard 14. "Roof Access".

5.10.6. Fire Protection Engineer Qualifications: In accordance with UFC 3-600-01, FIRE PROTECTION ENGINEERING FOR FACILITIES**,** the fire protection engineer of record shall be a registered professional engineer (P.E.) who has passed the fire protection engineering written examination administered by the National Council of Examiners for Engineering and Surveys (NCEES), or a registered P.E. in a related engineering discipline with a minimum of 5 years experience, dedicated to fire protection engineering that can be verified with documentation.

5.11. SUSTAINABLE DESIGN

5.11.1. STANDARDS AND CODES: Sustainable design shall conform to APPLICABLE CRITERIA. See paragraph 6, PROJECT-SPECIFIC REQUIREMENTS for which version of LEED applies to this project. The LEED-NC Application Guide for Multiple Buildings and On-Campus Building Projects (AGMBC) applies to all projects. Averaging may be used for LEED compliance as permitted by the AGMBC but is restricted to only those buildings included in this project. Each building must individually comply with the requirements of paragraphs ENERGY CONSERVATION and BUILDING WATER USE REDUCTION.

5.11.2. LEED RATING, REGISTRATION, VALIDATION AND CERTIFICATION: See Paragraph PROJECT-SPECIFIC REQUIREMENTS for project minimum LEED rating/achievement level, for facilities that are exempt from the minimum LEED rating, for LEED registration and LEED certification requirements and for other project-specific information and requirements.

5.11.2.1. Innovation and Design Credits. LEED Innovation and Design (ID) credits are acceptable only if they are supported by formal written approval by GBCI (either published in USGBC Innovation and Design Credit Catalog or accompanied by a formal ruling from GBCI). LEED ID credits that require any Owner actions or commitments are acceptable only when Owner commitment is indicated in paragraph PROJECT-SPECIFIC REQUIREMENTS or Appendix LEED Project Credit Guidance

5.11.3. OPTIMIZE ENERGY PERFORMANCE. : Project must earn, as a minimum, the points associated with compliance with paragraph ENERGY CONSERVATION. LEED documentation differs from documentation requirements for paragraph ENERGY CONSERVATION and both must be provided. For LEED-NC v2.2 projects you may substitute ASHRAE 90.1 2007 Appendix G in its entirety for ASHRAE 90.1 2004 in accordance with USGBC Credit Interpretation Ruling dated 4/23/2008.

5.11.4. COMMISSIONING. See paragraph 5.8.5 COMMISSIONING for commissioning requirements. USACE templates for the required Basis of Design document and Commissioning Plan documents are available at http://en.sas.usace.army.mil (click on USACE LEED Commissioning Plan Template) and may be used at Contractor's option.

5.11.5. DAYLIGHTING. Except where precluded by other project requirements, do the following in at least 75 percent of all spaces occupied for critical visual tasks: achieve a 2 percent glazing factor (calculated in accordance with LEED credit EQ8.1) OR earn LEED Daylighting credit, provide appropriate glare control and provide either automatic dimming controls or occupant-accessible manual lighting controls.

5.11.6. LOW-EMITTING MATERIALS. Except where precluded by other project requirements, use materials with low pollutant emissions, including but not limited to composite wood products, adhesives, sealants, interior paints and finishes, carpet systems and furnishings,

5.11.7. CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT. Except where precluded by other project requirements, earn LEED credit EQ 3.1 Construction IAQ Management Plan, During Construction and credit EQ 3.2 Construction IAQ Management Plan, Before Occupancy.

5.11.8. RECYCLED CONTENT. In addition to complying with section RECYCLED/RECOVERED MATERIALS, earn LEED credit MR4.1, Recycled Content, 10 percent except where precluded by other project requirements.

5.11.9. BIOBASED AND ENVIRONMENTALLY PREFERABLE PRODUCTS. Except where precluded by other project requirements, use materials with biobased content, materials with rapidly renewable content, FSC certified wood products and products that have a lesser or reduced effect on human health and the environment over their lifecycle to the maximum extent practicable.

5.11.10. FEDERAL BIOBASED PRODUCTS PREFERRED PROCUREMENT PROGRAM (FB4P). The Farm Security and Rural Investment Act (FSRIA) of 2002 required the U.S. Department of Agriculture (USDA) to create procurement preferences for biobased products that are applicable to all federal procurement (to designate products for biobased content). For all designated products that are used in this project, meet USDA biobased content rules for them except use of a designated product with USDA biobased content is not required if the biobased product (a) is not available within a reasonable time, (b) fails to meet performance standard or (c) is available only at an unreasonable price. For biobased content product designations, see http://www.biopreferred.gov/ProposedAndFinalItemDesignations.aspx.

5.12. CONSTRUCTION AND DEMOLITION (C&D) WASTE MANAGEMENT: Achievement of 50% diversion, by weight, of all non-hazardous C&D waste debris is required. Reuse of excess soils, recycling of vegetation, alternative daily cover, and wood to energy are not considered diversion in this context, however the Contractor must tracked and report it. A waste management plan and waste diversion reports are required, as detailed in Section 01 57 20.00 10, ENVIRONMENTAL PROTECTION.

5.13. SECURITY (ANTI-TERRORISM STANDARDS): Unless otherwise specified in Project Specific Requirements, only the minimum protective measures as specified by the current Department of Defense Minimum Antiterrorism Standards for Buildings, UFC 4-010-01, are required for this project. The element of those standards that has the most significant impact on project planning is providing protection against explosives effects. That protection can either be achieved using conventional construction (including specific window requirements) in conjunction with establishing relatively large standoff distances to parking, roadways, and installation perimeters or through building hardening, which will allow lesser standoff distances. Even with the latter, the minimum standoff distances cannot be encroached upon. These setbacks will establish the maximum buildable area. All standards in Appendix B of UFC 4-010-01 must be followed and as many of the recommendations in Appendix C that can reasonably be accommodated should be included. The facility requirements listed in these specifications assume that the minimum standoff distances can be met, permitting conventional construction. Lesser standoff distances (with specific minimums) are not desired, however can be provided, but will require structural hardening for the building. See Project Specific Requirements for project specific siting constraints. The following list highlights the major points but the detailed requirements as presented in Appendix B of UFC 4-010-01 must be followed.

(a) Standoff distance from roads, parking and installation perimeter; and/or structural blast mitigation

(b) Blast resistant windows and skylights, including glazing, frames, anchors, and supports

(c) Progressive collapse resistance for all facilities 3 stories or higher. Unless determined otherwise by the Installation and noted in paragraphs 3 or 6, the building shall be considered to have areas of uncontrolled public access when designing for progressive collapse.

(d) Mass notification system (shall also conform to UFC 4-021-01, Mass Notification Systems)

(e) For facilities with mailrooms (see paragraph 3 for applicability) – mailrooms have separate HVAC systems and are sealed from rest of building

6.0 PROJECT SPECIFIC REQUIREMENTS FORT CAMPBELL, KY

6.1. GENERAL

The requirements of this paragraph augment the requirements indicated in Paragraphs 3 through 5.

6.2. APPROVED DEVIATIONS

6.2.1 The following are approved deviations from the requirements stated in Paragraphs 3 through 5 that only apply to this project.

6.2.1.1. DELETED

6.2.2 Building Automation System

Perform all necessary actions needed to fully integrate the building control system to the FMCS. The following requirements supersede paragraphs 5.8.3.7 and 5.8.3.9.

6.2.2.1 Meter all utilities and include the cost in the contract price.

(a) Provide and install water meter(s). Coordinate meter purchase, location, and installation with the Privatized Utility, CH2MHill.

(b) Provide and install gas meter(s). Coordinate meter purchase and installation from Clarksville Gas and Water. CG&W shall install and program the wireless transmitter on each meter (Also include this cost in the contract price.)

(c) Provide and install wireless electric meter(s) compatible with existing Aclara Data Collection Units. Meters shall be the Aclara Star Network MTU wireless electric meters or an approved equal that functions with the existing system. Provide a working meter including programming of the unit for operation with dedicated server.

6.2.2.2 The building automation system (BAS) controls in the facilities under this contract will be integrated to and become part of the Facility Management and Control System (FMCS). Provide Java Application Control Engines (JACE), version R2, within each building or facility. The JACE (version R2) shall connect the BAS in the building or buildings to the FMCS via Fort Campbell's wide area network.

6.2.2.3 Access to the BAS shall be available locally in each building, and remotely from personal computers residing on the Fort Campbell network. Accomplish access through standard Web browsers, via the Internet and the Fort Campbell network.

6.2.2.4 Each JACE shall communicate with the BAS including the LonMark/LonTalk controllers and other open systems and devices provided in the building. The FMCS is based on the Niagara Framework, a Java-based framework developed by Tridium. Niagara provides an open automation infrastructure that integrates diverse systems and devices regardless of manufacturer into a unified platform that can be easily managed in real time over the Internet using a standard Web browser.

6.2.2.5 The JACE shall serve as the interface between the BAS and the FMCS. The JACE may perform BAS data manager functions such as time schedules for equipment, trend logging, and alarm processing and alarm handling functions. However, the JACE shall not perform process control. Process control shall be handled by the Application Specific Controllers and Programmable Controllers included in the BAS.

6.2.2.6 Provide graphics for each piece of controlled HVAC equipment and other equipment. The graphics shall include the building floor plan with links to mechanical rooms and all controlled equipment. As a minimum, the graphics shall show the equipment modes, commonly adjusted setpoints, sensed

variables, output commands, and actuator positions for each piece of controlled equipment. The graphics shall be available locally using a laptop service tool, or remotely as described above. Demonstrate the graphic interface and show that all sensed values are accurate, that dynamic screen links work properly, that set points can be changed remotely, and that any input or output variable can be trend logged and graphed. Additionally, perform a JACE failure test using an out-of-the-box test JACE furnished by Fort Campbell. The test JACE will be void of any programming. Demonstrate that the program and database required to make the test JACE operate can be successfully loaded from a service lap top tool, and that the test JACE then operates and functions correctly as a replacement JACE.

6.2.2.7 Provide non-expiring licenses for all controllers and software and which require licensing to Fort Campbell.

6.2.2.8 The graphics shall be similar to the existing graphics used on the Fort Campbell Facility Management and Control System. Sample FMCS graphic screens are included in the applicable Appendix. The first graphic resides on the server in building 865. Modify this graphic to add the newly connected building or buildings to the graphic.

6.2.2.8 Green light means no building alarms.

6.2.2.10 Red means building alarms exist.

6.2.2.11 Yellow means the building is not communicating.

6.3. SITE PLANNING AND DESIGN

6.3.1. General:

6.3.1.1. Base Bid

The project site is located at the south end of the installation cantonment area close to Gate 10 at the former Clarksville Base site where a new large Brigade Complex is under construction to the west of 101st Airborne Road. In the vicinity, a new family housing complex and a new school are also currently under construction. The proposed facility is located at the northeast corner of the new Strike Boulevard and relocated California Road. ***The project site is constrained by this intersection to the south and west and to the east by an existing landfill (designated as Solid Waste Management Unit (SWMU) #11 on the conceptual site plans). No digging can occur within the state-approved SWMU boundary. This includes all electrical systems and work, (i.e., light poles, cabling/conduit, and/or grounding.) Construction may encroach on the existing landfill as long as the soil cap is not penetrated or reduced in depth and must be coordinated with the Fort Campbell Environmental Division Restoration Program (270-798-9768) before any work is done within the SWMU boundary. Soil erosion of the cap will not be permitted***. To the north of the site, topography slopes down quickly to a wooded creek and dirt access road that serves as the site boundary. A high voltage power line exists along the north side of Strike Boulevard and along the east side of California Road, further constraining the site. Additionally, a buried utility corridor runs along the south side of Strike Boulevard and the east side of California Road.

California Road may expand to four lanes in the future. The project site layout should accommodate one additional lane and associated roadside drainage on the east side of California Road which will be constructed in the future.

6.3.1.2. Options

The project includes options to construct two softball fields (Option - Item No. 0007) and a multipurpose athletic field field (Option - Item No. 0006). For the requirements associated with these outdoor recreation facilities, see Paragraph 6.18. ADDITIONAL FACILITIES

6.3.2. Site Structures and Amenities

6.3.2.1 Refer to Appendix J, Site Plan for dumpster location.

6.3.2.2 Provide visual screens for dumpster and mechanical equipment in accordance with ATFP requirements. Enclosures shall match the building's architectural theme and finish material.

(a) Dumpsters Enclosures. Dumpster Enclosures shall be 3-sided and sized to accommodate two dumpsters, each measuring 6 ½-feet x 6 ½-feet.(reference Paragraph 5.1.2.1. for additional information). Provide a concrete loading apron for the first 15-feet in front of the dumpster pad to accommodate loading of dumpsters and avoid rutting on the pavement. Enclosures shall be at least 18-feet wide with the swinging doors mounted on the front of the enclosure, not the inside of the enclosure. If the doors are mounted on the inside wall they will need to be at least 19-feet wide. Swinging doors, gate posts, and bollards shall not reduce the clear opening width.

(b) Exterior Mechanical Equipment. Enclosures for chillers and cooling towers shall not be more than ten feet high.

6.3.3. Site Functional Requirements:

6.3.3.1. Stormwater Management (SWM) Systems.

(a) Design and construct the stormwater drainage system in accordance with Federal Aviation Administration Advisory Circular FAA AC 150-5320-5C, Surface Drainage Design; Federal Highway Administration Publication No. FHWA-NHI-01-021, Hydraulic Engineering Circular No. 22, Second Edition, URBA DRAINAGE DESIGN MANUAL. Base design of drainage structures on a 10-year storm frequency. Design of the storm drainage system shall incorporate the principles of Low Impact Development (LID), as detailed in UFC 3-210-10 DESIGN: LOW IMPACT DEVELOPMENT MANUAL. The design shall maintain or restore to the maximum extent technically feasible, the predevelopment hydrology of the site with regard to temperature, rate, volume, and duration of flow in accordance with Section 438 of the Energy Independence and Security Act of 2007 (EISA 2007). Design the stormwater management facilities in accordance with DoD Policy Memorandum, Office of the Secretary of Defense, DoD Implementation of Storm Water Requirements under Section 438 of the Energy Independence and Security Act (EISA), 19 Jan 10.

(b) For volume control, an on-site storm water retention/detention system shall be required. Design criteria for storage facilities shall follow the "Fort Campbell Policy for Storm Water Erosion and Sediment Control at Construction Sites" developed by Fort Campbell DPW, as posted on the Fort Campbell

Environmental web site (http://www.campbell.army.mil/envdiv/). Take special note of the Precipitation Frequency Estimates and the required Pre-developed curve number included in the policy.

(c) Development projects over 5000 square feet are required by the 2007 Energy Independence and Security Act, Section 438, to implement strategies to “maintain or restore, to the maximum extent feasible, the predevelopment hydrology of the property with regard to temperature, rate, volume, and or duration of flow.” See the USEPA technical guidance at http://www.epa.gov/oaintrnt/documents/epa_swm_guidance.pdf. In addition, Fort Campbell has a water quality treatment standard for the first flush of 1.1 inches of rainfall.

6.3.3.2. Erosion and Sediment Control

(a) Fort Campbell Environmental Division of Public Works oversees the Stormwater Sediment and Erosion Control Management Plan for the Post. The point of contact for Fort Campbell Environmental Divisions is Dan Etson, (270) 798-8794, dan.etson@us.army.mil.

(b) Fort Campbell is currently implementing compliance with new five year Phass II MS4 general permits issued by Kentucky and Tennessee in 2010. In order to comply with the provisions of the state and EPA NPDES permits, all construction projects, including those located in the Clarksville Base Development, must comply with the provisions of the "Fort Campbell Policy for Storm Water Erosion and Sediment Control at Construction Sites" developed by Fort Campbell DPW, as posted on the Fort Campbell Environmental web site (http://www.campbell.army.mil/envdiv/). These provisions include the Contractor’s preparation of a project specific Storm Water Pollution Prevention Plan (SWPPP), the Contractor signing onto Fort Campbell’s general permit Notice to Intent, and enforcement of the plan components. Projects located in the Clarksville Base Development are covered under an Individual NPDES Permit for Construction Activities. The Contractor will be signing onto Fort Campbell’s permit. Aggressive EPSC measures are critical. Fort Campbell samples project storm water outfalls using a third party EPSC inspector. See 6.15.2 for additional information.

(c) Be aware of any Wetlands, Sinkholes, or Class V Injection Well that may be associated with this project. Do not discharge any storm water off the installation on to private land owners. Install and maintain all erosion and sediment control devices in accordance with the Fort Campbell Policy for Storm Water Erosion and Sediment Control at Construction Sites.

6.3.3.3. Vehicular Circulation.

(a) Emergency Vehicle Access. The ground access surface shall accommodate all Fort Campbell Fire Department Trucks and Emergency Vehicles in accordance with all applicable criteria. Provide drive through circulation that minimizes the need for turning trucks around within the site boundary to the maximum extent possible.

(b) Provide ladder vehicle access as a minimum to two sides of each facility and a minimum of three sides of all sleeping quarters to accommodate the Fire Department’s trucks and emergency vehicles.

(c) Design for the Fort Campbell Fire Department's heaviest vehicle, 84,000 lbs. The ladder truck turning radius is 46’-0”. Fire lanes shall have a minimum 20’-0” clear width. Grass paver type products may be used for emergency vehicle access if soils engineering studies indicate ground can support such structures. Verify requirements with FTC Fire Department and ensure that the base is prepared to completely support the required loads.

(d) Provide access to the Physical Fitness Complex from both Strike Boulevard and California Road. The single Strike Boulevard entrance to the facility should be kept a minimum of 650 feet from the intersection of Strike and California as to avoid complicating the expected turning/stacking movements. A left turn auxilliary lane shall be provided in the Strike Boulevard median to accommodate left turning

movements. Locate entrances on California Road at least 200 feet from the intersection of Strike and California. Service access shall be provided to the facility for equipment installation and removal.

(e) Personal vehicle (POV) parking shall be provided on the site. The parking shall be outside the 82-foot antiterrorism force protection (ATFP) setback from the building. Parking may be constructed on Solid Waste Managament Unit #11. The pavement shall be constructed above the existing cap. Pervious pavement materials are not permitted. Parking lot lighting pole foundations will not be permitted to penetrate the cap.

(f) Base Bid:

Provide a minimum of 225 spaces.

(g) Bid Option:

Option - Item No. 0009 - Additional Parking. Provide an additional 140 parking spaces. Additional parking may be located adjacent to the main parking lot (Base Bid) and/or an additional parking lot may be constructed near the ballfields. The option includes all necessary earthwork, paving, associated stormwater management, pavement markings and signage.

6.4. SITE ENGINEERING

6.4.1. Existing Topographical Conditions

The Government has provided a three dimensional digital topographic and utility survey. Bring any discrepancies which are found in the Government furnished survey to the immediate attention of the Government for clarification. The survey provides control points based on state plane coordinates and identifies horizontal and vertical datums.

The site topographic survey can be found in Appendix J. Any discrepencies which are found in the Government furnished survey shall be brought to the immediate attention of the Government for clarification. The existing utility burial depths shall be determined by the Contractor. Pipe inverts have been provided for those utilities that are known. The expansion of Strike Boulevard will be under construction at the same time this project is under construction. The new entrances shall be designed and coordinated with the Strike Boulevard construction.

6.4.2. Existing Geotechnical conditions: See Appendix A for a preliminary geotechnical report.

6.4.2.1. Geotechnical Engineer. A qualified independent testing agency shall observe and test subgrade suitability (by proof rolling operations), fill placement and compaction operations on a full time basis as directed by the Contractor's project Geotechnical Engineer.

6.4.3. Fire Flow Tests See Appendix D for historical fire flow test results. Use test results for proposal purposes and estimating the basis of design for fire flow and domestic water supply and for preparing the proposal cost estimate. After award, verify test results. Coordinate with Contracting Officer and CH2MHill to perform flow test on the water system at the anticipated points of connection in order to provide up- to -date flow information during the design phase. Point of contact for CH2M Hill is Chris Semler, (931) 431-2015. If test results indicates that the available flow or pressure has deteriorated from the data provided in Appendix D, bring this to the attention of the Government.

6.4.4. Pavement Engineering and Traffic Estimates:

6.4.4.1 Pavement Design. Minimum flexible pavement sections shall consist of 3.5 inches of asphalt (1.5 inches of surface course and 2 inches of base course) and 8 inches of aggregate subbase and/or base. Minimum rigid pavement section shall consist of 6 inches of concrete and 8 inches of aggregate subbase and/or base. The minimum subbase/base can be neglected if the subgrade has a CBR greater than 30.

(a) Do not use Reclaimed Asphalt Pavement (RAP) in the asphalt surface wearing course.

(b) Pavement designs shall be based on the anticipated loading frequency and vehicle types for a design life of 25 years.

(c) The geotechnical report submitted by the Designer of Record shall contain flexible and rigid pavement designs including design California Bearing Ratio (CBR), subgrade modulus, and requirements for compaction of subgrades. Concrete or bituminous pavements may be designed and constructed; sidewalks and dumpster pads shall be concrete. Pavement materials shall meet the AASHTO requirements as adopted and modified by the Tennessee Department of Transportation (TDOT) specifications. Pavement designs over cohesive soil subgrades shall require underdrain systems.

(d) Plans and specifications shall detail all of the specific aggregates proposed in the pavement design per TDOT designations and gradations including the aggregate used to choke off drainage layer aggregates to accommodate paving equipment. Refer to the Fort Campbell traffic analysis prepared by Gannett Fleming in 2008 entitled "Fort Campbell, KY, Revised Transportation Study" for more information regarding vehicular traffic. For the specific site, the Contractor shall assume that a dumpster truck will be accessing the site once a week. Also, the Contractor shall assume that an AASHTO standard WB-50 vehicle will access the site once a month delivering and removing equipment.

6.4.5. Traffic Signage and Pavement Markings

Signage shall be provided to restrict tactical vehicles from POV pavements. Signage and pavement markings shall conform with the latest edition of the Manual On Uniform Traffic Control Devices (MUTCD), with the exception that all parking lot markings shall be white. Blue handicapped markings shall not be provided.

Ft. Campbell is required to keep an inventory of all signs installed. All signs shall be located with a GPS coordinate. The sign wording, size, and location shall be categorized and provided to the Contracting Officer's Representative.

6.4.6. Base Utility Information

6.4.6.1. Utilities

(a) The Installation's DPW supervises infrastructure and utilities and in some cases they are owned and operated by private entities. Obtain and verify actual utility locations by calling Tennessee One-Call (1-800-351-1111) prior to start of any excavation work. General location of existing utility services such as potable water, sanitary sewer, electric, natural gas, and communications are located:

All required utilities with adequate capacity are located in the vicinity of the project site. A 12-inch water main and six-inch steel gas main both run along the south side of Strike Boulevard and are available for connection. The 12-inch water main shall be used for both water supply and fire protection, with a seperate tap for each line. A 16-inch sanitary sewer force main runs along the east side of California Road. The force main shall not be disturbed. Sanitary service for the new facility shall be routed to the existing manhole indicated in the Appendix J Overall Conceptual Utility Plan. Electrical and communications connections shall also be made along California Road, see section 6.9 SITE ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS for additional information.

Water and sanitary sewer permits from the State of TN and CH2MHill shall be required. The State of TN permits take approximately 4 to 6 weeks to obtain. Information pertaining to the pemit application process have been provided in Appendix C.

(b) Install all utility lines underground. Avoid installing utility lines under pavement to the maximum extent possible. Utility lines that must cross under roadways shall be jack and bore or directional drill and sleeve including water, natural gas, electric, communications and cable TV lines.

(c) Do not construct buildings over or within 10 feet of any new or existing utility lines, to include Water and Wastewater, Storm Sewer, Sanitary Sewerage, Gas, and COMM. Coordinate with respective provider to determine final routing of lines, and locations of connections points.

6.4.6.2. Water Distribution and Sanitary Sewerage System:

(a) CH2M Hill is the owner and operator of the Fort Campbell water distribution sanitary sewerage system. Design and construct the new distribution system and new sewer lines, required building service and sewer lines, and any modifications to the existing distribution lines and main sewers in accordance with the latest edition of CH2M Hill's "Fort Campbell Water and Wastewater Design Guide and Construction Standards". Coordinate with CH2M Hill to determine the locations of connections to the existing water distribution system and final routing of the water distribution lines and service lines including the locations of the distribution mains, and the locations of fire hydrants and post indicator valves. In addition coordinate the routing of the new or relocated main sanitary sewer lines, the routing and locations of the new building sewer lines, the locations of connection points to the main sewer system, the locations of existing sewer lines to be removed, the locations of new and existing manholes, the locations of lift stations and the location of force mains. Submit to CH2M Hill a completed "Application for Water and Wastewater Connection" form and the associated application fee. Include adequate time in the proposal for the design of the water system, the acquisition of State permits, and the construction of the water lines. Point of contact for CH2M Hill at Fort Campbell is Chris Semler, (931) 431-2015. Alternate contact for CH2M HILL is Robert Neath (314) 421-0313.

(b) Contact CH2M HILL representative in a timely manner to coordinate water and sewer service to the facilities being constructed or renovated under this contract. No water and wastewater design or construction may begin without the execution of a permit issued by CH2M HILL. All new construction

must satisfy the terms of the permitting process before water or wastewater services will be activated. Comply with all policies, procedures, standards, specifications and details required by CH2M HILL governing the design, construction and supply of water and sewer services required under this contract.

(c) After award and during the design phase of the project, coordinate with CH2M Hill and submit preliminary drawings to CH2M Hill for review. The drawings shall show all new distribution lines, fire hydrants, new service lines, and any modifications to existing distribution system. In addition, show all new main and building sewer lines, manholes, pumping stations, force mains, and any modifications to existing sewer lines, tie-in points, and projected sewer flowrate from each building and at each manhole.

(d) Base the design of the water distribution system on the static and residual water pressure conditions as shown in Paragraph 6.4.3 Fire Flow Tests.

(e) Determine the following for each building in the project and provide this information to CH2M Hill:

- the required capacity of domestic water supply
- the domestic water service line size
- the required capacity of the fire water service line
- the fire water service line size and
- the location of the entrances to the building of the domestic water and fire water service lines.

(f) Coordinate the sequence and timing of all water line tie-ins to existing water lines with CH2M Hill. No work associated with the water system shall begin until all required permits and approvals for the water system are obtained. Existing water service lines and mains serving buildings on the site which remain occupied during construction shall remain in service, uninterrupted, until those buildings are abandoned or until the new water distribution line has been accepted by the Government.

(g) Coordinate the sequence and timing of all tie-ins to existing sewer lines with CH2M Hill. Do not begin construction of the sanitary sewer system until all required permits and approvals for the sanitary sewer system are obtained. Existing sanitary lines serving buildings on the site which remain occupied during construction shall remain in service, uninterrupted, until those buildings are abandoned.

(h) Submit the final design drawings and specifications for review and comment. Include any changes as a result of the comments in the drawings and specifications prior to the start of construction.

(i) Connect the water meter to the building Direct Digital Control in accordance with Paragraph 6.2.2.1.

(j) CH2M Hill will inspect all construction of water distribution piping and sanitary sewer piping. Point of contact for CH2M HILL at Fort Campbell is Chris Semler, (931) 431-2015. Alternate contact for CH2M HILL is Robert Neath (314) 421-0313.

(k) Field Quality Control for Sanitary Sewer Distribution System. The contracting officer and CH2M Hill will conduct field inspections and witness field tests specified. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing including means for water transport when water is needed. CH2M Hill will furnish water needed for field tests.

6.4.6.3. Gas Distribution System:

(a) Clarksville Gas and Water Department (CG&W) is the owner of the Fort Campbell gas distribution system. CG&W is responsible for the adequacy of design and construction of the required building service lines and modifications to any existing distribution lines. Coordinate with CG&W to determine the routing of any new or relocated gas distribution lines, the routing and locations of new and existing service lines, the locations of connection points to the main gas distribution system, the locations of existing gas distribution lines to be removed, and the locations of new valves. Coordinate directly with CG&W to obtain the cost of the design, permits, and construction of the required building service lines to the five foot line up to and including meters and regulators and any necessary modifications to the distribution lines. Include this cost in the appropriate line item in the CLIN schedule. CG&W may require the following information to determine the cost of the gas system changes: the capacity of gas required for each building; the low pressure gas service line size for the building; the location of the entrances to the buildings of the gas service lines, and locations of the gas regulators and meters. Include adequate

time in the proposal for the design of the gas system and the acquisition of permits and approvals. Point of contact for CG&W at Fort Campbell is Randall Lewis, (931) 542-9600. Point of contact for CG&W pertaining to gas service line capacity, size, routing, and points of connection to the gas distribution system is Mike Young, (931) 645-7422.

(b) After award, during the design phase of the project, provide information to CG&W about the expected building gas consumption and shall coordinate with CG&W to complete the gas distribution system design.

(c) Design and installation of the gas distribution system must be in accordance with all policies, procedures, standards, specifications and details required by CG&W. Determine the following for each building in the project:

- the required capacity of gas service,
- the low pressure gas service line size, and
- the preferred location of the service entrance including the gas regulators and meters.

(d) C&W will furnish and install meters and regulators on all buildings. The Contractor shall connect the meters to the building Direct Digital Control system in accordance with paragraph 6.2.2.1. The Contractor shall be responsible for all costs incurred for the gas system installation, including meters and regulators.

(e) Do not abandon in place any gas lines.

(f) Include the following in the design plans and specifications:

- the routing of gas distribution and gas service lines outside the buildings
- the location of gas meters and regulators
- existing gas distribution and service lines to be removed

(g) Coordinate the sequence and timing of all gas line construction activities with CG&W. No work associated with the gas system shall begin until all required permits and approvals for the gas system are obtained. Include adequate time in the proposal for the design of the natural gas system and the acquisition of permits and approvals.

(h) Submit the final design drawings and specifications for review and comment, and include any changes as a result of the comments in the drawings and specifications prior to the start of construction.

6.4.6.4. Electrical:

(a) Furnish and install a meter on electric service to each building. Equip the electric meter with a pulse initiator. Connect the pulse initiator on the electric meter to the building Direct Digital Control system. Coordinate all new electrical work with Fort Campbell DPW. The points of contact are Mihir Chaudhuri at (270) 798-9725 or email mihir.chaudhuri@us.army.mil, or Robert Galbraith at (270) 798-2232 or email robert.t.galbraith@us.army.mil.

6.4.6.5. Telecommunications:

(a) Government Telephones and Data Connectivity. Furnish and construct all outside plant manholes, duct, conduit, and the required distribution cables, between underground terminal boxes and the building central communications closet for Government telephones and data connectivity. Install 3”x4” duct from the closet manhole to the facility telecommunications room. Install 4”x4” duct back along roadways were no duct exists. Toneable trace wire will be installed in at least one of the ducts in the ductbank. Install manholes at a maximum of every 500 feet of duct. Install 4-cell fiber mesh in the duct to accommodate fiber optic cable. Duct shall be concrete encased and protected in all areas, under road surfaces, and in storm drainage area that are subject to washout, in accordance with I3A. Install duct prior to road surfacing. Coordinate with Network Enterprise Center (NEC) during the design process. The Points of contact for NEC are Greg Lantz at (270) 798-6238 or email gregory.lantz@us.army.mil.

6.4.6.6. Cable Television:

(a) Provide cable television outlets in areas as required by I3A. Design, furnish, and install all conduit, wiring and outlet boxes within the facilities. Comcast will be responsible for all the interior jacks and faceplates. Coordinate with Comcast during the design process. The Point of contact for Comcast during design and construction is Bill Goodwin at (615) 244-7462 ext. 1115646 (office) or (615) 405-5589 (cell) or email billy_goodwin@cable.comcast.com Field verify the locations of the point of service (tie point) and facility demarcation point with Comcast prior to start of work.

(b) Provide two inch conduit installed from telecommunication room to point of accessible connectivity at nearest pole with existing CATV.

6.4.7. Cut and Fill

6.4.7.1. Grading.

(a) All Fort Campbell projects should generally maintain existing topography and slopes while recognizing standard minimum and maximum gradients. There should be a balance of the quantity of cut and fill which would create a smooth transition of graded areas into the existing natural terrain. The plan should reflect selective site clearing that preserves groups of trees. Grading should manage site runoff to maintain the rate and quantity of flow to pre-development levels, or reduce site runoff where possible. Apply the principles of positive drainage to control the conditions that remove rainfall away from facilities and functions. Lawn sheet flow shall not flow over sidewalks or paved areas. Do not drain new parking areas onto existing streets and do not drain existing streets into new parking areas. Site designs should seek to minimize the disturbance of land, utilize natural drainage paths where possible, and take into account future construction in the area. Site design should also minimize the impact of construction activities on drainage and prevent loss of soils by water and wind erosion. Designs that improve on existing water quality by incorporating sustainable design principles are encouraged, and consistent with budget constraints and activity requirements. Incorporate sustainable design principles to improve existing water quality.

(b) The finished grades adjacent to the new building will be a minimum of 6 inch below finished floor except where grades are required on walk ways and entrances to buildings that are handicap accessible. Slope finish grades away from the building at 5% for the first 10 feet and then at a minim of 1% to existing or new storm drainage. Use a preferred minimum gradient or 1% in all parking areas. The maximum gradient used parallel from front to rear of a space shall be 5% and from side to side (width of the space) shall be 1-1/2%.

6.4.7.2. Historically, the potential for sinkholes does exist at Fort Campbell. The preliminary site characteristics for this particular site are located in Appendix A. Geotechnical Information.

6.4.8. Borrow Material

(a) Use only the approved borrow pit. Provide a written list of all personnel and equipment that will be located at the site during borrow operations. Immediately report to the site operational authority any evidence of unauthorized personnel or activities at the site , including unauthorized dumping of wastes, littering, and any other activities that present a potential risk to human health or the environment. Immediately report any problems with runoff and erosion controls. Maintain a daily haul record, including truck counts and estimated volume per truck load. Submit the haul record to the COR on a weekly basis.

(b) The Ft. Campbell Borrow/Spoil area location is shown on Appendix J, sheet G-002 Borrow/Disposal Area Plan. Trucks hauling to and from the borrow/spoil area may use Mabry Raod.

6.4.9. Haul Routes and Staging Areas

(a) Use Gate 7 as the Haul Route to the construction work area. Refer to Appendix J, Borrow/Disposal Area Plan for Haul Route.

6.4.10. Clearing and Grubbing:

(a) The site is mostly wooded with mixed hardwood and evergreen woodlands. Within 30 days after Notice to Proceed, the Contractor shall submit a certified check in the amount of One thousand two hundred fity-seven dollars and 10/100 ($1,257.10) payable to "USAED, Louisville District" for the fair market value of the timber designated for removal on the site. The check shall be mailed/delivered to Barry Tucker, US Army Corps of Engineers, PO Box 100, Fort Knox, KY 40121-0100. The Contractor shall have one year from the Notice to Proceed to remove said timber. Ownership of timber transfers upon cutting. Title to the timber sold hereunder shall vest in the Purchaser as and when the Purchaser cuts the timber. The risk of loss shall pass to the Purchaser upon vesting of title. All trees not cut will remain property of the Government.

6.4.11. Landscaping:

(a) Provide landscaping in accordance with UFC 4-010-01 and the Standard Appendix I, Acceptable Plants List. Use the services of a qualified Landscape Architect, experienced in site planning and planting design. Provide a complete, integrated landscape-planting plan consisting of trees only for the overall project. The design shall reflect appropriate groupings and street tree plantings to define the open spaces. Choose tree materials on the basis of plant hardiness, climate, soil conditions, low maintenance, and quality. All selected tree and plant materials shall be easily maintained and tolerant of the specific site conditions. Incorporate sustainable design principles into the selection of plants. Plant only during periods when beneficial results can be obtained. Planting for site development within the 5-foot line shall consist of establishing groundcover (turf or other materials) consistent with adjacent landscaped areas. Additional landscaping such as ornamental planting at building entrances may be provided as a project betterment.

(b) Passive Barriers may be installed as a landscape component and consist of any combination of berms, steep banks, ditches, fences, walls, bollards, trees, and other plant materials that is located between the vehicular circulation areas and the building(s). Trees may be used as long as the spacing between branch structures and size at the time of installation would prevent vehicle intrusion. Some species will require a double row with close proximity to achieve this functionality.

(c) Maintenance during Planting Operation.

Maintain installed plants in a healthy growing condition. Begin maintenance operations immediately after each plant is installed and continue until the plant establishment period commences.

(d) Plant Establishment Period.

On completion of the last day of the planting operation, the plant establishment period for maintaining installed plants in a healthy growing condition shall commence and shall be in effect for the remaining contract time period not to exceed 12 months. When the planting operation extends over more than one season or there is a variance to the planting times, the plant establishment periods shall be established for the work completed.

(e) Maintenance during Establishment Period.

The maintenance of plants shall include straightening plants, tightening stakes and guying material, repairing tree wrap, protecting plant areas from erosion, maintaining erosion material, supplementing mulch, accomplishing wound dressing, removing dead or broken tip growth by pruning, maintaining edging of beds, checking for girdling of plants and maintaining plant labels, watering, weeding, removing and replacing unhealthy plants. If used, irrigation systems shall be for plant establishment only. Remove at the end of this period. Ft Campbell will not furnish potable water for irrigation.

(f) Unhealthy Tree.

A tree shall be considered unhealthy or dead when the main leader has died back, or 25 percent of the crown is dead. Determine the cause for an unhealthy plant. Unhealthy or dead plants shall be removed immediately and shall be replaced as soon as seasonal conditions permit in accordance with the following warranty paragraph.

(g) Warranty.

Furnished plants shall be guaranteed for a period of 12 months beginning on the date of inspection by the Contracting Office to commence the plant establishment period, against defects including death and unsatisfactory growth, lack of adequate maintenance, neglect, or by weather conditions unusual for the warranty period.

6.4.12. Turf:

(a) Seed.

State approved seed of the latest season's crop shall be provided in the original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with applicable State seed laws. Seed mixtures shall be proportioned by weight. Weed seed shall not exceed one percent by weight of the total mixture.

(b) Sod.

State approved sod shall be provided as classified by applicable State laws. Each individual sod section shall be of a size to permit rolling and lifting without breaking. The sod shall be relatively free of thatch, diseases, nematodes, soil-borne insects, weeds or undesirable plants, stones larger than one (1) inches in any dimension, woody plant roots, and other material detrimental to a healthy stand of turf. Sod that has become dry, moldy, or yellow from heating, or has irregular shaped pieces of sod and torn or uneven ends shall be rejected. Sod shall be machine cut to a uniform thickness of 1-1/4 inches within a tolerance of 1/4 inch excluding top growth and thatch. The limitation of time between harvesting and placing sod shall be 36 hours.

(c) Sprig Quality.

The cultivar shall be provided as healthy living stems, stolons, or rhizomes with attached roots, including two (2) or three (3) nodes, and shall be from four (4) to (6) inches long, without adhering soil. Sprigs shall be provided which have been grown under climatic conditions similar to those in the locality of the project. Sprigs shall be obtained from heavy and dense sod, free from weeds or other material detrimental to a healthy stand of turf. Sprigs that have been exposed to heat or excessive drying shall be rejected. The time limitation between harvesting and placing sprigs shall be 24 hours.

(d) Temporary Turf Cover.

When there are contract delays in the turfing operation or a quick cover is required to prevent erosion, the areas designated for turf shall be seeded with a temporary seed. When no other turfing materials have been applied, the quantity of one-half of the required soil amendments shall be applied and the area tilled.

(e) Final Turf.

The turf shall be installed during appropriate planting times and conditions recommended by the trade for the type and variety of turf specified. The turf operations shall be performed only during periods when beneficial results can be obtained. Drainage patterns shall be maintained. The turf shall be installed by using the methods as recommended by the trade for the type and variety of turf specified. Immediately after turfing, the area shall be protected against traffic or other use by erecting barricades and providing signage as required. The turf establishment period for establishing a healthy stand of turf shall begin on the first day of work under the turfing contract and shall end three (3) months after the last day of the turfing operation. An unsatisfactory stand of turf shall be repaired as soon as turfing conditions permit.

6.4.12.1. Satisfactory Stand of Turf:

(a) Seeded Lawn & Field Area.

A satisfactory stand of turf from the seeding operation is defined as a minimum of 150 grass plants per square foot. The total bare spots shall not exceed 2 percent of the total seeded area.

(b) Sodded Area.

A satisfactory stand of turf from the sodding operation is defined as living sod uniform in color and texture. Bare spots shall be no larger than two (2) inches square. Sod shall be placed in all ditch flow lines and slopes, around each building, and a 10 foot strip adjacent to all structures such as curbs, sidewalks, roads, catch basins, etc.

(c) Sprigged Area.

A satisfactory stand of turf from the sprigging operation is defined as a minimum of 20 sprigs per square meter (2 sprigs per square foot). Bare spots shall be no larger than 9 inches square. The total bare spots shall not exceed two (2) percent of the total sprigged area.

6.4.12.2. Maintenance During Establishment Period:

(a) The maintenance of the turfed areas shall include eradicating weeds, eradicating insects and diseases, protecting embankments and ditches from erosion, maintaining erosion control materials and mulch, protecting turf areas from traffic, mowing, watering, post-fertilization, and replacing unsatisfactory turf areas. If used, irrigation systems shall be for plant establishment only. Remove at the end of this period. Ft Campbell will not furnish potable water for irrigation.

6.5. ARCHITECTURE

6.5.1. General: To the maximum extent possible within the contract cost limitation, the buildings shall conform to the look and feel of the architectural style and shall use the same colors as adjacent facilities as expressed herein and shall conform with the Fort's Campbell Real Property Master Plan. The Government will evaluate the extent to which the proposal is compatible with the architectural theme expressed in the RFP during the contract or task order competition. The first priority in order of importance is that the design provides comparable building mass, size, height, and configuration compared to the architectural theme expressed herein. The second priority is that design is providing compatible exterior skin appearance based upon façade, architectural character (period or style), exterior detailing, matching nearby and installation material/color pallets, as described herein.

6.5.2. **Design**

6.5.2.1. Appendix F is provided "For Information Only", to establish the desired site and architectural themes for the area. Appendix F identifies the desired project look and feel based on **Fort Campbell's** Installation Architectural Theme from existing and proposed adjacent building forms; i.e. building exterior skin, roof lines, delineation of entrances, proportions of fenestration in relation to elevations, shade and shadow effects, materials, textures, exterior color schemes, and organizational layout.

6.5.2.2. The design should address Fort Campbell's identified preferences. Implement these preferences considering the following:

(a) Achievable within the Construction Contract Cost Limitation (CCL)

(b) Meets Milestones within Maximum Performance Duration.

(c) Achieves Full Scope indentified in this Solicitation

(d) Best Life-Cycle Cost Design

(e) Meets the Specified Sustainable Design and LEED requirements.

(f) Complies with Energy Conservation Requirements Specified in this RFP.

6.5.2.3. Priority #1. Visual Compatibility: Facility Massing (Size, Height, Spacing, Architectural Theme, etc.) Exterior Aesthetic Considerations: The buildings massing, exterior functional aesthetics, and character shall create a comprehensive and harmonious blend of design features that are sympathetic to the style and context of the Installation. The Installation's intent for this area is:

Create buildings that utilize visually appealing materials and colors that express the architectural theme and characteristics of the installation. The organization of the building elevations shall reflect the size and spacing of other buildings near the site while acknowledging the unique functional requirements of the interior of this facility. Emphasis shall be given to the main entrance of the facility. The main entrance shall be eaily recognizable and create a strong sense of place.

See Appendix F Conceptual Aesthetic Considerations for additional information on the area's architectural theme.

See Appendix LL for Exterior and Interior Finishes.

6.5.2.4. Priority #2. Architectural Compatibility: Exterior Design Elements (Materials, Style, Construction Details, etc.) Roofs, Exterior Skin, and Windows & Door Fenestrations should promote a visually appealing compatibility with the desired character while not sacrificing the integrity and technical competency of building systems.

6.5.2.5. See Appendix F for exterior colors that apply to Architectural character at Fort Campbell. The manufacturers and materials referenced are intended to establish color only, and are not intended to limit manufacturers and material selections.

6.5.2.6. Additional architectural requirements:

(a) Install fall protection anchor points on all roofs with a slope greater than 2:12

(b) Exterior Skin. If the Offerors proposal consists of brick, split faced or scored CMU, which will be exposed to weathering, provide efflorescence testing and prevention measures. Schedule tests far enough in advance of starting masonry work to permit retesting. Apply water repellant primer and stain to all exterior architectural CMU walls after completion of exterior work and when the masonry is not subject to damage by construction activities.

(c) Hardware. Provide a removable Small Format Interchangeable Core (SFIC) "*I/C - 7 pin Insta-Key"* integrated master keying system for all doors. SFIC's shall be compatible with the existing "*I/C - 7 pin Insta- Key*" system used at Fort Campbell. Combination locks used in secured areas shall be Mass Hamilton X09 type or LKM 7000 by Lockmasters Inc with an S&G 2740-100; Do not use the CDX-09. Electric locks shall be stand alone Best BASIS "G" system with encoders and Kiosk. Coordinate installation with the DPW Locksmith Shop. Point of contact is Bob Ayers, (270) 798-3581 (office).

(d) Telecommunication Room and Electrical Room locks shall be *Insta-Key* cored and compatible with the Mortise lock - Schlage Model CL5594-MGK-SFS-626-ATR or Cylindrical Lock - Schlage Model CL5196-MGK-SFS-626-ELB-ATR.

(e) Mechanical Rooms shall have an exterior building access only for maintenance personnel and accessible to maintenance vehicles. Provide a hasp and DPW approved padlock in addition to standard *Insta-Key* core.

(f) Telecommunications Rooms shall have an interior access point unless otherwise specified or indicated. In the case of exterior access, install equipment cabinet(s) instead of racks in the Telecommunications Rooms. Cabinet(s) shall be dust rated with glass front door and accessible rear panel.

(g) Functional floor plans and conceptual site plans are provided for this facility in the applicable appendices. Adjacencies in the conceptual layout represent the users' preferred adjacencies of the

programmed functional space. However, the plans may be modified to accomodate local , regulatory, engineering, architectural, life safety , and/or construction requirements at the time of proposal. Additional consideration will be given for innovative, creative, cost-saving proposals, which meet or exceed the minimum requirements as established in herein; however, there shall be no loss in durability due to the use of the proposed systems s compared to the typical construction sytems and finishes indicated herein.

(h) The floor plan shall be created to be flexible and open as possible. The space types should provide a comprehensive, varied program of physical activities to meet the individual training regimens, as well as the training needs of the Garrison

6.5.3. Programmable Electronic Key Card Access Systems:

N/A

6.5.4. INTERIOR DESIGN

6.5.4.1. Interior building signage requirements:

(a) Utilize "wayfinding" numbering.

(b) Construction drawing numbers shall match interior signage numbering for fire and maintenance purposes.

(c) See Appendix GG for additional interior signage requirements.

6.5.4.2. Interior Design Considerations:

(a) Interior Partitions and Walls.

The use of wall coverings that do not breathe such as vinyl wall coverings is not permitted on the interior face of exterior walls due to the tendency for mold to develop.

(b) Interior Glass and Glazing: Coordinate the arrangement of fenestrations with the proposed furniture layout.

6.5.4.3. Furniture, Fixtures and Equipment Design Development:

(a) During design development, coordinate the location of furniture so that it does not interfere with other building systems (i.e. electrical and communication outlets, thermostats, etc.).

(b) Coordinate with USACE and DPW during design development. Point of contact for DPW, Master Plans is Sharon (Davis) Presley at (270) 956-2926 or email sharron.davis@us.army.mil.

6.6. STRUCTURAL DESIGN

6.6.1. Site Specific Loading Requirements

6.6.1.1 Structural Loading. Design building structures for the following types of minimum site specific loads per most recent versions of ASCE-7 and IBC.
6.6.1.1. Roof Live Load – 20 psf
6.6.1.2. Snow Load – 15 psf (pg, ground snow load)
6.6.1.3. Wind Load – 90 mph, 3-second gust
6.6.1.4. Seismic Criteria - As determined from a site specific geotechnical investigation, but not less than the following values:

Ss = 0.59g
S1 = 0.19g

And not more than the following values:

Ss= 0.74g
S1= 0.22g

6.6.2 The structural design shall meet all of the seismic requirements of the Applicable Codes and Standards including a continuous load path and interconnection, consideration of plan irregularities and effects due to inherent and accidental torsion, and consideration of building expansion joints. Seismic design also includes the bracing of various systems, piping, hangars, etc.
6.6.3. Note that areas of Fort Campbell contain Karst geology and are subject to potential sinkholes.
6.6.4. The structural system shall be compatible with building use. For example, do not locate columns in rooms requiring visibility or open space, such as entries, common areas, etc.
6.6.5. Extend bearing portions of substructure to levels below the frost line. Frost penetration is 22 inches below grade.
6.6.6. Treat subgrades under all facility foundations to resist subterranean and other wood destroying insects known to exist in the vicinity of the site. Treat in accordance with the environmental criteria referenced in this document.
6.6.7. Radon Mitigation: Ensure that the building prevents/mitigates the accumulation of radon gas. Fort Campbell requires the installation of radon mitigation features be included in all new construction as shown in the applicable Appendix of this document. The design and construction of foundation walls, slabs, and crawl spaces shall include provisions for the reduction of radon entry and facilitate its removal. Radon exhaust vents shall extend through the roof. Test exhaust vents prior to occupany. If radon is realized in amounts past the acceptable levels, exhaust fans will be required. An equitable adjustment (credit or increase, as appropriate) will be provided pursuant the contract Changes clause. For additional information, contact the TSCA Program Manager of the Fort Campbell Environmental Division at (270) 798-9604.
6.6.8. Water Barrier: A capillary water barrier is required under all interior slabs-on-grade. The capillary water barrier shall, as a minimum, prevent the mitigation of termites, radon, and moisture.
6.6.9. Equipment Pads: Elevate interior floor or slab-on-grade mounted equipment on minimum 4 inch thick concrete pads to prevent accumulation of water and metal corrosion. Elevate exterior on-grade mounted equipment on minimum 6 inch thick concrete pads. Turn down perimeter of exterior pads to a level below the frost line.

6.7. THERMAL PERFORMANCE

There are no additional requirements other than those previously stated/referenced.

6.8. PLUMBING

There are no additional requirements other than those previously stated/referenced.

6.9. SITE ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

6.9.1. Primary Electrical Distribution.

The point of connection for the primary feed to the site shall be

coordinated with Fort Campbell DPW, Electrical Utility Section.

Provide facility with an individual transformer.

Provide primary ductbank with one spare conduit. Ductbank shall be concrete encased.

Primary conductors shall be copper. Aluminum is not permitted.

Provide load-break cutouts and arrestors at riser point of connection for underground primary services. For overhead distribution tap lines, provide load break cutouts.

Manholes, handholes, and pullboxes shall be the same dimensions and of equivalent, or better, quality as existing manholes, handholes, and pullboxes located at and/or closest to the site. Strength of manholes, handholes, and pullboxes and their frames and covers shall be in accordance with the requirements of IEEE C2.

6.9.1.1. Base Bid:

The point of connection for utility power to the site and an existing electric manhole adjacent to the site, along California Blvd, as indicated on the utility drawing, UT101.

Existing dual 12.47/7.2KV utility power circuits run along California Blvd, adjacent to the site, as indicated on the utility drawing, UT101.

Connect the 12.4/7.2KV feeds for the facility and site power at the existing electric manhole. Refer to the utility drawing, UT1 01, for approximate location of the existing electric handhole/point of connection, and existing 12.47 KV underground power lines.

Provide two (2) sectionalizing/isolating switches with fused switching compartments near the existing electric manhole for looped primary power feeds to the new Contractor-provided pad mounted facility transformer to provide redundant power service to the facility.

Connect the existing two (2) 12.47 KV circuits in the existing manhole to each of the new sectionalizing/isolating switches.

Underground Secondary Distribution System shall consist of direct buried conduit and copper conductors. Secondary power systems shall provide manholes and/or handholes as required for the application but not less than every two hundred feet (200').

6.9.1.2. Bid Options:

See paragraph 6.18.1. for Site Electrical Distribution primary and secondary requirements for Option - Item No. 0006: Multipurpose Athletic Field.

See paragraph 6.18.2. for Site Electrical Distribution primary and secondary requirements for Option - Item No. 0007: Two Softball Fields.

See paragraph 6.18.3. for Site Electrical Distribution primary and secondary requirements for Option - Item No. 0009: Additional Parking.

6.9.1.3. Additional Primary Electrical Distribution requirements:

(a) Provide primary ductbank with one spare conduit. Ductbank shall be concrete encased.

(b) Primary conductors shall be copper. Aluminum is not permitted.

(c) Provide load-break cutouts and arrestors at point of connections for underground primary services. For overhead distribution tap lines, provide load break cutouts.

(d) Coordinate connections with Fort Campbell DPW, Electrical Utility Section.

6.9.2. Underground Secondary Distribution System.

The system shall consist of direct buried conduit and copper conductors.

6.9.3. Transformers.

Transformers shall be pad-mounted type, 12.47 kV delta primary and secondary voltage as appropriate for load(s) to be served. Service transformers, for all 15kV and below, 3-phase underground fed installations, shall be of the pad-mounted type. Transfomers shall contain FR3 dielectic fluid. The high-voltage compartment shall be dead-front construction. Primary switching and protective devices shall include loadbreak switching, fuse protection, medium-voltage separable load-break connectors, universal bushing wells and inserts or integral one piece bushings and surge arresters. The nameplate rating for the transformer shall not be less than 110 percent of the KVA demand load calculated for the transformer. Provide copper windings, not aluminum. The enclosure shall include a hasp and pad lock.

6.9.4. Street and Area Lighting.

6.9.4.1 Provide lighting for the project site, at existing and new roadway intersections, and at intervals not exceeding 60.9 m (200 ft) between intersections. Provide area lighting at intervals not exceeding 60.9 m (200 ft) along area walkways not otherwise illuminated; and at all steps. Exterior lighting (parking lot, street, building, etc) shall be LED, Induction, LEP (Light Emitting Plasma), or energy saving technology. "Dark Sky" Lighting is a mandatory requirement for the numerous flight paths over the installation to insure the safety of the flight crews and equipment. Parking lot and security lighting will be provided at a maintained level of 0.5 to 1.0 footcandles and shall have a uniformity ratio, maximum to minimum, of 20:1 or less. All building entrances will be illuminated to 10 footcandles. Parking lot and walkway lighting shall be individually fused and mounted on aluminum poles. Install fuses for the pole-mounted fixtures in the pole base.Control shall be by photocell. This control shall be by means of one photocell per pole. Install a programmable timer with manual switch override in the Mechanical Room.

(a) Coordinate lighting control requirements for all exterior lighting systems with the Customer,subject to the Contracting Officer's approval, to include the sequencing of the programmable timer.

(b) Light poles installed in the parking lot shall be installed on raised concrete foundations for protection of vehicles. Light poles provided along the roadways shall be breakaway. The pole locations shall be in accordance with the Applicable Criteria.

(c) Direct burial conduit is required for street light and area light circuits. All exterior lighting (parking lot, street, building, etc.) shall be either 120, 208, or 277 Volt. 480-Volt lighting is not permitted.

6.9.4.2 Select and locate lighting fixtures to maintain the minimum foot-candle requirements for safety and security purposes. Beyond that, aesthetic considerations should take precedence. Light poles should be consistent and provide uniformity throughout the installation. Determine the pole height by their intended function. Size light fixtures proportionally to the intended pole height. Coordinate final fixture selection with the Contracting Officer for approval.

6.9.5. Telecommunications:

6.9.5.1. General. All communications equipment, materials, and work shall be in accordance with I3A requirements and are subject to approval by the NEC office and the Contracting Officer.

6.9.5.2. The NEC will remark cables upon justifiable request by the Contractor. Contractor is not responsible to maintain locates, except to use reasonable care. For NEC contact information, refer to paragraph 6.4.6.5.

6.9.5.3. Entrance conduits in all buildings shall be a minimum of three-way, 4 inch ducts.

6.9.5.4. Do not implement Free Space Optic (FSO) systems unless approved by the NEC Plans and Architecture Branch..

6.9.5.5. Coordinate with the NEC for a list of areas where 48” of cover is required above the top of the duct. Duct bank encasements shall be in accordance with I3A requirements.

6.9.5.6. Rotary trenchers or plowing are not allowed during trenching or excavation, except in undeveloped range and training areas. NEC prefers the method of open trenching, using bucket type equipment, i.e., backhoe and track hoe. The maximum width of the trench is in accordance with the type of equipment used to dig.

6.9.5.7. Splice cable either in manholes or pedestals. Do not make buried splices or use quasite boxes unless NEC approves in writing.

6.9.5.8. Do no use aerial cable.

6.9.5.9. Provide stainless steel splice cases for all copper cable splices, or an equivalent which shall be approved by the lead planner or the Service Management Division Chief. NEC requires submittals for splice cases and splice modules prior to work beginning. Specify splice cases for the particular environment in which they shall be placed and size to accommodate the cable count spliced. Design end plates for the number and size of the cables served by the splice and design to seal around each cable individually. All splice cases shall be re-enterable and shall contain all necessary equipment to be installed properly, adhering to all appropriate electrical codes.

6.9.5.10. Install warning signs in accordance with the following:

- Sign mounted to steel PSP stake; orange in color
- 4’ below ground in concrete; rising 5’ above ground
- No closer than 2 feet from the center of the ditch
- If there is a change in direction, position a sign immediately at the turn showing the line
- Although I3A states every 250’ for those areas that end up being less than 250’ provide sign(s) accordingly, even if an additional sign is necessary.

6.9.5.11. Provide a minimum copper cable size 25 pair.

6.10. FACILITY ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

Coordinate with Fort Campbell NEC during the design process. Submit all requested deviations from the mandatory design criteria in writing for approval at the discretion of the Government.

6.10.1. Provide dual jacks in lieu of single jacks. Dual jacks shall be two CAT 6 RJ45 type with green inserts.

6.10.2. Provide Copper Voice and Data jacks in new facilities or in facilities with no existing building cabling system in accordance with the I3A Criteria Section 2.4.1.1 (TIA/EIA T568A configuration). If the existing building cabling is of type TIA/EIA T568B, then install TIA/EIA T568B.

6.10.3. Voice and Data drops shall conform to the following wire color scheme:

- Green – Voice and NIPRnet data
- Red – SIPRnet (Secret) data
- Orange – JWICS (Top Secret) data
- All faceplates shall be neutral in color. Inserts shall be the same color as the wiring used for that particular jack.

6.10.4. Install Fiber Optic patch panels in cabinets or racks that house the LAN equipment. Do not install fiber optic patch panels on backboards.

6.10.5. Terminate copper distribution on 110 type rack mounted patch panels only. Do not install 110 type patch panels on backboards.

6.10.6. Make all new fiber optic terminations using LC connectors. Terminate any connectors already in place in renovated buildings or additional fiber connections in existing buildings with the identical type of existing fiber optic connectors.

6.10.7 Key telecommunication Room doors separate from other locks in the building IAW DPW standards. Provide two copies of the key to the NEC Logisitics Branch. Reference section 6.5.2.6, (b) for additional lock requirements.

6.10.8 Provide lightning protection, based on NFPA 780 (2004) Annex L Lightning Risk Assessment of the facility. Provide grounding, bonding, shielding for all facilities. Provide grounding straps and connect to the building grounding system. Provide grounding points in vehicle and equipment parking areas on 20 foot centers (maximum) and coordinated with the power and data board units. Provide ground strap on walls, and two (2) grounding points on each functional bay floor. Provide a bonding grounding in oil storage room. If lighting protection is required, install with mechanical fasteners on standing seam metal roofs.

6.11. HEATING, VENTILATING, AND AIR CONDITIONING

6.11.1 Integrate the control system to the installation's existing UMCS. The existing UMCS is FMCS at Fort Campbell, and shall be as described in Paragraph 6.2.1. Coordinate with Installation Energy Manager during the design process. Point of contact for Fort Campbell FMCS's is John Register at (270)-484-2741 or email John.W.Register@us.army.mil .

6.11.1. Outdoor design conditions include the following.

Winter Dry-Bulb:	Design Dry Bulb Day,14°F (99%)	
Summer Dry-Bulb: (MCDB)	Design Dry Bulb Day, 92°F (1%)	Design Wet Bulb Day, 88°F
Summer Wet-Buld:	Design Dry Bulb Day, 76°F (MCWB)	Design Wet Bulb Day, 78°F (1%)

6.12. ENERGY CONSERVATION

6.12.1. Inclusion of Renewable Energy Features. The following renewable energy features have been determined lifecycle cost effective, are included in the project budget and shall be provided:

None specified.

6.12.2. Recommended Energy Enhancement Strategies:

The list below contains brief descriptions representing strategies and design criteria that enhance the energy performance or sustainability of facilities. The following enhancements may be considered if found viable for the project.

6.12.2.1 Tight construction with Infiltration less than .15 cfm per square foot of exterior envelope area at 75 PA. Recommend the use of Insulated Concrete Form (ICF) for the exterior building envelope.

6.12.2.2. Added insulation to high performance ‘Passivhaus’ levels (See the Building Envelope section of the Energy and Water Conservation Design Guide referred to above for minimum R/U values per climatic zone).

6.12.2.3. Design detailing to avoid thermal bridges that allow heat to bypass insulation.

6.12.2.4. Windows: Triple-pane, Energy Star, with low-E coatings appropriate to climatic zone.

6.12.2.5. Lighting: lower lighting consumption to average 0.75W/ft2 or less. To achieve this performance, consider the following:

a. Low maintenance, low wattage-per-lumen technologies, e.g. SSL/LED fixtures.

b. Occupancy, Vacancy, and Daylighting sensors for active ambient light control.

c. Increase vertical glazing by 50% over standard designs.

d. Increase Skylight to Floor Area (SFA) fraction to 3% over corridors, admin areas and office areas.

e. Use digital multi-zone lighting controls with individually addressable fixtures.

6.12.2.6. ‘Cool Roof’ finishes where cooling load exceeds heating (e.g. Climate Zones 1-5).

6.12.2.7. Top Tier Energy Star or FEMP rated appliances and equipment.

6.12.2.8. Demand/user controlled High Efficiency HVAC equipment per ASHRAE 189.1.

6.12.2.9. Optimize HVAC zones with respect to user schedules and occupancy.

6.12.2.10. Include Energy Recovery Ventilation (ERV) systems with >75% efficiency.

6.12.2.11. Dedicated Outside Air System (DOAS) for ventilation with heat recovery for assembly and heat/fume generating activities.

6.12.2.12. Indirect Evaporative Pre-Cooling (IEPC or IDEC) for Dry Climates (Climate Zones xB).

6.12.2.13. HVAC equipment efficiency ratings (e.g. COP) that exceed ASHRAE 189.1 (C) requirements.

6.12.2.14. High Efficiency condensing boilers with >90% efficiency and/or incorporate Ground-Source Heat Pump technology.

6.12.2.15. NEMA MG1 Premium Efficiency/ Electronically Commutated Motors (ECM) motors.

6.12.2.16. Variable Air Volume (VAV) or hydronic distribution; consider “Radiant” cooling systems in ceilings.

6.12.2.17. Measurement and Verification (M&V) systems.

6.12.2.18. On-site Renewable Energy elements:

a. Transpired Solar Collectors.

b. SSL/LED parking and street lighting; site-specific light distribution patterns.

c. Prepackaged pole-mounted solar site lighting solutions.

d. Include 30% demand solar water heating in areas where the average sun exposure is equal or greater than 4.0 kWh/m2 per day according to the National Renewable Energy Lab (HYPERLINK "http://www.nrel.gov/gis/solar.html"http://www.nrel.gov/gis/solar.html) in accordance with the SDD policy (Reference d).

19. Maximum flow rates for plumbing fixtures per ASHRAE 189.1;

a. Dual-flush toilets.

6.12.2.20. Stormwater management: Meet local codes and Low Impact Development (LID) best practices (e.g. pervious pavement, rainwater harvesting, swales, bioretention ponds).

6.13. FIRE PROTECTION

6.13.1. The Fire Alarm Control Panel shall be fully compatible with the existing King-Fisher Industrial Radio Alarm Control System (IRACS) presently in use at Fort Campbell. The fire alarm AM transmitter shall be Government furnished, contractor installed. Mass Notification: The required mass notification system shall be in a separate cabinet from the fire alarm system.

6.13.1.1. The fire alarm system shall be an open protocol type in that it is designed and installed such that the Government or its agents are able to perform: repair, replacement, upgrades, and expansions of the system without further dependence on the original contractor or system manufacturer.

6.13.1.2. Fire Lite, Notifier, Mirtone, and EST are approved Fire Alarm and Mass Notification systems authorized for installation in Fort Campbell facilities based on demonstrated ability to meet UFC 4-021-01 and Fort Campbell criteria and in order to reduce training, maintenance, and reserve parts cost. The proposed fire alarm system particular model must meet all requirements as stated above.

6.13.1.3. There shall be no requirement for software locks, special tools and any other proprietary equipment to maintain, add devices to or delete devices from the system, or test the Fire Alarm system. Fire detection and alarm systems shall be able to be programmed from the control panel and the Government's laptop. Provide any software, cables / interface devices required to manipulate the system , coordinated with Government personnel and jointly installed on the DPW laptop computer without any licensing agreements, signed documents or any requirements upon the Government to rely on any contractor or manufacturer for maintenance or manipulation of the system.

6.13.1.4. Provide space within exterior mechanical and within electrical rooms to accommodate the fire alarm and mass notification panels as well as the Government supplied Contractor installed Kingfisher transmitter. Provide exterior access to the Mechanical Room and where possible to the Electrical Room to allow Fire Dept access. Install remote fire alarm annunciators only when required.

6.13.1.5. Fire alarm system shall be addressable type, Class A, looped.

6.13.1.6. Install a weather proof exterior fire alarm strobe on the outside of the building on the street side to signal responding Fire Dept.

6.13.1.7. Provide a bronze, Series 3200 Knox-Box located within 10 feet of front entrance to the building at a mounting height of five feet.

6.13.2. Mass Notification/PA System:

6.13.2.1. The Mass Notification System shall be capable of connecting to a future facility wide system using dry contacts and 600 Ohm audio inputs

6.13.2.2. Provide LOC (local operating console) without locking door next to staff duty or receptionist station (where applicable to the facility type). Provide additional LOC's as required by applicable criteria.

6.13.2.3. The Mass Notification system shall be pre-programmed MNS (male voice). Audible announcement messages shall be as follows: and include the NFPA 72 (2010) Para 24.4.2.17 "this is a test" requirement:

(a) WEATHER (100 KHZ Steady tone, 5 Seconds); THE NATIONAL WEATHER SERVICE HAS ISSUED A SEVERE WEATHER ALERT FOR THIS AREA. TUNE TO LOCAL RADIO AND TELEVISION STATIONS FOR FURTHER GUIDANCE.

(b) SUSPICIOUS ACTIVITY (Fast whoop, 5 Seconds); MAY I HAVE YOUR ATTENTION PLEASE! A POSSIBLE BREACH IN SECURITY HAS BEEN REPORTED. PLEASE REMAIN CALM. YOU ARE INSTRUCTED TO TAKE APPROPRIATE SECURITY MEASURES AND REPORT SUSPICIOUS PERSONNEL, VEHICLES, PACKAGES OR ACTIVITIES TO SECURITY PERSONNEL.

(c) FIRE (horn sound, 5 seconds) ATTENTION, ATTENTION. A FIRE EMERGENCY HAS BEEN REPORTED. PLEASE LEAVE THE BUILDING USING THE NEAREST EXIT.

(d) TORNADO WARNING (horn sound, 5 seconds) ATTENTION, ATTENTION. A TORNADO WARNING HAS BEEN ISSUED FOR THIS AREA. A TORNADO WARNING HAS BEEN ISSUED FOR THIS AREA.

(e) CHEMICAL RELEASE WARNING (horn sound, 5 seconds) ATTENTION, ATTENTION. A CHEMICAL RELEASE HAS BEEN ISSUED. STAY INSIDE BUILDINGS AND CLOSE WINDOWS AND DOORS UNLESS ADVISED BY AUTHORITIES TO EVACUATE AREA. CHEMICAL RELEASE. STAY INSIDE BUILDINGS AND CLOSE WINDOWS AND DOORS UNLESS ADVISED BY AUTHORITIES TO EVACUATE AREA.

(f) ALL CLEAR (horn sound, 5 seconds) ATTENTION, ATTENTION. THE EMERGENCY IS OVER. I REPEAT THE EMERGENCY IS OVER. RESUME YOUR NORMAL DUTIES.

(g) EVACUATION WARNING (horn sound, 5 seconds) ATTENTION, ATTENTION. THIS IS AN EMERGENCY EVACUATION ORDER. REMAIN CALM, FOLLOW THE INSTRUCTIONS OF THE EMERGENCY OFFICALS. THIS IS AN EMERGENCY EVACUATION ORDER. OBAY THE EMERGENCY OFFICALS. REMAIN CALM.

(h) BOMB THREAT WARNING (horn sound, 5 seconds) ATTENTION, ATTENTION, A BOMB THREAT ALERT HAS BEEN ISSUED FOR THIS BUILDING. ALL PERSONNEL ARE TO EVACUATE IMMEDIATELY USING THE NEAREST EXIT. FURTHER INSTRUCTIONS WILL BE ISSUED OUTSIDE THE BUILDING BY EMERGENCY RESPONSE TEAMS.

(i) TERRORIST THREAT WARNING. (horn sound, 5 seconds) MAY I HAVE YOUR ATTENTION, PLEASE. A TERRORIST THREAT HAS BEEN RECEIVED. EFFECTIVE IMMEDIATELY, WE ARE OPERATING "SECURE AND LOCKDOWN PROCEDURES." ALL PERSONNEL SHOULD REMAIN CALM AND STAY WHERE YOU ARE. PLEASE AWAIT FURTHER INSTRUCTIONS."

(j) FPCON C (wail, 5 seconds) ATTENTION, ATTENTION. FORT CAMPBELL IS IN FORCE PROTECTION CONDITION CHARLIE. ALL PERSONNEL IMMEDIATELY IMPLEMENT FPCON CHARLIE ACTIONS.

(k) FPCON D (Wail, 5 seconds) ATTENTION, ATTENTION. FORT CAMPBELL IS IN FORCE PROTECTION CONDITION DELTA. ALL PERSONNEL IMMEDIATELY IMPLEMENT FPCON DELTA ACTIONS.

6.13.3. Portable Fire Extinguishers.

6.13.3.1. Provide and install flush or semi-mounted Fire Extinguisher Cabinets and Brackets in accordance with UFC 3-600-01 and NFPA 101 to accommodate Government Furnished/Government Installed Fire Extinguishers. Do not use glass or lockable doors in fire extinguisher cabinets.

6.13.3.2. Government will provide ten-pound portable dry chemical (Class ABC) Fire Extinguishers manufactured by Amerex.

6.14. SUSTAINABLE DESIGN

6.14.1. LEED Rating Tool Version. This project shall be executed using LEED-NC Version 3.

6.14.2. The minimum requirement for this project is to achieve LEED Silver level. Each non-exempt facility (building plus sitework) must achieve this level. In addition to any facilities indicated as exempt in paragraph 3, the following facilities are exempt from the minimum LEED achievement requirement: N/A.

6.14.3. Credit Validation: LEED registration, compiling of documentation at LEED OnLine and use of the LEED Letter Templates is required. Registration and payment of registration fees will be by the Contractor. Administration/team management of the online project will be by the Contractor. Validation of credits will be accomplished by the Government. LEED certification of the project by the Contractor is not required. The Government may choose to seek LEED certification of the project, in which case the Government will pay certification fees and coordinate with the GBCI and the Contractor will furnish audit data as requested at no additional cost.

6.14.4. Commissioning: See Appendix M for Owner's Project Requirements document(s).

6.14.5. LEED Credits Coordination. The following information is provided relative to Sustainable Sites and other credits.

SS Credit 1 Site Selection:

Project site IS NOT considered prime farmland.

Project site is five feet or more above 100-year flood elevation.

Project site contains no habitat for threatened or endangered species.

Delineation of water, wetlands and areas of special concern is shown on site drawings provided in this CONTRACT.

Project site WAS NOT previously used as public parkland.

SS Credit 2 Development Density & Community Connectivity.

Project site DOES NOT meets the criteria for this credit.

SS Credit 3 Brownfield Redevelopment.

Project site DOES NOT meets the criteria for this credit.

SS Credit 4.1 Public Transportation Access.

Project site DOES NOT meets the criteria for this credit.

EA Credit 6 Green Power.

35% of the project's electricity WILL NOT be provided through an Installation renewable energy contract. Do not purchase Renewable Energy Credits (REC's) to earn this credit.

MR Credit 2 Construction Waste Management.

The Installation has an on-post recycling facility.

Regional Priority Credits (Version 3 only)

The project zip code is 42223.

6.14.6. LEED Credit Preferences, Guidance and Resources. See Appendix L LEED Project Credit Guidance for supplemental information relating to individual credits.

6.14.7. Not Used

6.14.8. Additional Information

6.14.8.1 Coordinate with the Government to input Government-achieved Credits into the project's online template. Submit documentation of LEED Credits to the Government in PDF format on three (3) CD's with formatting and directory structure designed for easy access to documentation. Submit LEED Design Credit documentation to the Government no later than 60 days after issuance of Design Complete documents. Submit LEED Construction Credit documentation updates to the Government no less frequently than monthly after construction kickoff. Completion of credit information updates should be tied to pay application review and approvals.

6.14.8.2 Scope of Work contains LEED v 3 project registration and requires LEED Project Checklist and documentation.

6.14.8.3 Appendix L contains modified LEED v 3 Registered Project Checklists for the ORTC LEED. This checklist identifies:

1) those specific Credits/Prerequisites that the DB Contractor must provide, listed in the “Yes DB" column,

2) those Credits/Prerequisites that the Government will provide, listed in the “Yes GOV" column,

3) points that the DB Contractor may provide, above and beyond those points required per LEED prerequisite or elsewhere in the RFP (applies to Energy and Atmosphere Credit 1, where 2 points are required under EA Prerequisite 2, but an additional 8 points may be achieved at the DB Contractor's option) listed in the “? D/B" column,

4) those Credits that may be possible by the Government, but should not be considered in the total point count by the DB Contractor, listed in the "? GOV" column, and

5) those Credits that the DB Contractor is prohibited from pursuing, listed in the “NO" column.

6.15. ENVIRONMENTAL

6.15.1. Solid Waste Disposal/Diversion Practices:

6.15.1.1. Solid Waste Disposal/Diversion Practices shall be in accordance with Appendix E, Environmental information. All construction activities at Fort Campbell shall require at least a 50% diversion of construction materials such as excess lumber, roofing, drywall, carpet, piping, cardboard, etc to be diverted from the landfill. Reference Appendix J, for Borrow/Disposal Area Plan.

6.15.1.2. Government policy shall apply to sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy, the Contractor shall: (1) Practice efficient waste management when sizing, cutting, and installing products and materials, (2) use all reasonable means to divert construction, and demolition waste from landfills and incinerators and to facilitate their recycling or reuse. Recycling Construction and Demolition Debris guidance and documentation requirements can be found on the Fort Campbell Environmental Web Site: (http://www.campbell.army.mil/campbell/directorates/DPW/envdiv/Pages/RecyclingConstructionDemo.aspx).

6.15.1.3. Submit a Waste Management Plan (WMP) within 15 days after Notice to Proceed (NTP) and prior to initiating any site preparation work. Include the following:

(a) Name of individuals on the Contractor's staff responsible for waste prevention and management.

(b) Actions that will be taken to reduce solid waste generation.

(c) Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas and equipment to be used for processing, sorting, and temporary storage of wastes.

(d) Characterization, including estimated types and quantities, of the waste to be generated.

(e) Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.

(f) Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations and accept used materials such as materials exchange networks and Habitat for Humanity.

(g) List of specific waste materials that will be salvaged for resale, salvaged and reused, or recycled. Recycling facilities that will be used shall be identified.

(h) Identification of materials that cannot be recycled / reused with an explanation or justification.

(i) Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

6.15.2. Sediment and Erosion Control:

Design and construct the project in accordance with the Fort Campbell Policy for Stormwater Erosion and Sediment Control at Construction Sites. This policy can be found on the Fort Campbell Environmental Web Site: (http://www.campbell.army.mil/envdiv/en1.htm)

6.15.3. Ban on use of asbestos containing materials, lead based paint and PCB's.

6.15.3.1 Do not use asbestos containing materials (ACMs), lead based paint (LBP), or PCBs.

6.15.3.2 Provide the required No Asbestos – Containing Material (ACM) Certification in accordance with the following.

(a) Design Phase. Before final payment of the project design fee, the designer of record (DOR) shall submit to the government, on their firm's letterhead, a signed, stamped and dated copy of the following statement:

"I hereby certify that no asbestos-containing material (ACM) was specified as a building material in any construction document for this project. Furthermore, I certify that no product containing mineral fibers was specified as a building material in any construction document for this project unless I either

-'Have on file and have submitted to the Government, the manufacturer's certification that the material does not contain asbestos,' or

- ‘Have supplied to the Government documentation to show that the material has been microscopically examined by an AIHA- or NVLAP-certified laboratory and the lab has determine that it does not contain asbestos.’ “

(b) Construction Phase. Before final payment to the Contractor, the Contractor's project engineer/manager will sign and submit to the Government, on the Contractor’s letterhead, a dated copy of the following statement:

“I hereby certify that to the best of my knowledge no asbestos-containing material (ACM) was used as a building material during this project. I understand that the building Owner presumes that all materials marked 'May contain mineral fibers' are asbestos unless I either:

- ‘Have on file and have submitted to the Government the manufacturer's certification that the material does not contain asbestos,’ or

- ‘Have supplied to the Government documentation to show that the material has been microscopically examined by an AIHA- or NVLAP-certified laboratory and the lab has determine that it that it does not contain asbestos.’ “

6.15.4. Air pollution restrictions applicable to this project do not allow materials to be burned on Government premises.

6.15.5. The Installation Forrester must complete a survey before any trees with diameters greater than 6 inches are removed. This is in addition to Section 3.1 Land Resources under Section 01 57 20.00 10.

6.15.6. Maintain all excavations, stockpiles, access roads, waste areas, and all other work ares free from excess dust to such a reasonable degree as to avoid causing hazard or nuisance.

6.15.7. Underground Storage Tanks (USTs):

Do not install UST’s without approval from the DPW Environmental Dvision. If permitted, USTs shall be double walled steel fiberglass coated with interstial monitoring and automatic tank gauging. The monitoring system shall be compatible with the systems already in use and capable of being remotely montitored by the Environmental Division. Do not install used oil USTs.

6.15.8. Aboveground Fuel Storage Tanks (ASTs).

6.15.8.1. ASTs shall conform to all Federal, State, Local regulations and guidelines and these design requirements.

6.15.8.2. ASTs shall be double-walled type tanks. Provide means to establish the integrity of the secondary containment.

6.15.8.3. ASTs shall rest on foundations, made of concrete, masonry, piling, or steel. Design tank foundations to minimize the possibility of uneven settling of the tank and to minimize corrosion in any part of the tank resting on the foundation.

6.15.8.4. The Directorate of Public Works , Environmental Division, Petroleum Storage Tank Manager is the Installation Local Authority Having Jurisdiction (AHJ) who must approve any design proposal and construction before any installation of an AST.

6.15.8.5. Location of Aboveground Fuel Storage Tanks (ASTs). The local AHJ must approve all proposed installations sites of ASTsin writing prior to installation.

(a) No AST shall be installed closer than 5-feet from any type of an electrical disconnect device.

(b) Locate ASTs between the size of 60 U.S. gallons and 2,000 U.S. gallons no closer than 10-feet from any building, lean-to, or property line.

(c) ASTs shall have at the minimum of 5 ft of unobstructed clearance on all sides to facilitate refueling, maintenance and serviceability.

(d) No AST shall be installed without having at least a 15-foot aerial clearance from overhead or underground electrical lines, which includes but limited to weather heads, transformers, and fuses.

(e) The minimum distance between any two ASTs shall be 3-feet.

(f) The minimum distance between an AST with Gasoline or Diesel fuel and a LP tank shall be 20-feet.

(g) Locate Used Oil tanks close to the source of generation, i.e., just outside the building.

6.15.9. Aboveground Fuel Lines.

6.15.9.1. Below ground fuel lines are not permitted for use with an AST.

6.15.9.2. Aboveground supply and return lines. Suspend fuel lines a minimum of 6 inches off the ground and support every 3-feet with some type of approved support. Protect fuel lines against corrosion with protective features that prohibit any collision from motor vehicles. All fuel lines shall be of black carbon-type steel. All AST supply fuel lines shall be ½-inch inside diameter and all return fuel lines shall be ¾-inch inside diameter, unless otherwise directed by Local Authority having Jurisdiction. All supply fuel lines shall have a shut off valve located as close as possible to the AST. There shall be no traps of check valves in the return fuel line to the AST. All pipe joints shall be of the threaded type, no welding of pipes or of the joints shall be permitted. Joints shall be made liquid tight and shall be threaded, except that listed flexible connectors are permitted where installed with prior written approval of the Local AHJ. All threaded joints shall be made up tight with a suitable thread sealant or lubricant. Joints in piping systems handling Class I liquids shall be welded when located in concealed spaces within buildings.

6.15.10. Normal Venting for Aboveground Tanks.

6.15.10.1. Venting requirements shall be in accordance with current Unified Facilities Guide Specifications, Section 13202, Fuel Storage Systems requirements. Stage I vapor recovery is the process of recovering vapors when a storage tank is filled. Stage I vapor recovery is mandatory on all Army Facilities.

6.15.10.2. Prevent the development of vacuum or pressure sufficient to exceed the design pressure due to filling or emptying and the atmospheric temperature changes.

6.15.10.3. If any tank has more than one fill or withdrawal connection and simultaneous filling or withdrawal can be made, base the vent size on the maximum anticipated simultaneous flow.

6.15.10.4. Arrange the outlet of all vents and vent drains on tanks equipped with venting to permit pressures exceeding 2.5 psig to discharge in such a way as to prevent localized overheating of, or flame impingement on, and part of the tank, in the event vapors from such vents are ignited.

6.15.10.5. Where vent pipe outlets for tanks storing Class I liquids are adjacent to building or public ways, locate them so that the vapors are released at a safe pint outside of buildings and not less than 12 ft. above the adjacent ground level. In order to aid their dispersion vapors shall be discharged upward or horizontally away from closely adjacent walls. Locate vent outlets so eaves will not trap the flammable vapors or other obstructions and at least 5 ft from building openings.

6.15.10.6. Emergency Venting for Fire Exposure for Aboveground Tanks.

(a) Every aboveground tank shall have some form of construction or device that will relieve excessive internal pressure caused by exposure fires. This requirement shall also apply to each compartment of a compartmented tank, the interstitial space of a secondary containment type tank, and the enclosed space of tanks of closed top dike construction.

(b) Arrange the outlet of all vents and vent drains on tanks, equipped with emergency venting to permit pressures exceeding 2.5 psig to discharge in such a way as to prevent localized overheating of or flame impingement on any part of the tank, in the event vapors from such vents are ignited.

6.15.11. Miscellaneous AST Requirements.

6.15.11.1. All ASTs permanently installed shall have a device(s) for fuel leak detection, fuel level, and all other monitoring requirements.x

6.15.11.2. Mark ASTs in accordance with NFPA. 704.

6.15.11.3. Mark ASTs in accordance with NFPA. 704.

6.15.11.4. All ASTs shall have some type of spill containment that will hold 110% of the AST capacity.

6.15.11.5. All ASTs that have filling and emptying connections for any Class I or Class II, flammable liquids shall be closed and liquid tight when not in use and shall be properly identified.

6.15.11.6. All ASTs fill caps shall have an AHJ approved means of locking when not being refueled.

6.15.11.7. All ASTs shall have some device of fire-fighting equipment in the immediate area. (Contact Fort Campbell Fire Prevention Section for further details).

6.15.11.8. Provide means for determining the level of liquid in the tank. This means shall be accessible to the delivery operator

6.15.11.9. Take precautions to prevent the ignition of flammable vapors. Sources of ignition include, but are not limited to:

- OpenFlames
- Lightning
- Hot surfaces
- Radiant heat
- Smoking
- Cutting and welding
- Spontaneous ignition
- Frictional heat or sparks
- Static electricity
- Electrical sparks-
-Stray currents-
-Ovens, furnaces, and heating equipment.

6.15.11.10. Install bollards around all ASTs to prevent vehicular collision with the tank.

6.15.11.11. Construction of secondary containment structures for mobile fuel tankers or storage tanks shall be concrete construction and have sufficient capacity to hold 110% of the largest tank / mobile fuel tanker that it will hold. The secondary containment stormwater discharge valve or valves must be

capable of completely draining a containment in 2 hours or less. Four-inch values are recommended. Locate the outlet drain(s) valves and piping at the lowest evevation of the containment. The bottom of the outlet drain pipe shall be flush with bottom of the containment. Berm control expansion/contraction joints shall be filled with a fuel-resistant sealant. If the concrete berm is placed upon existing concrete, then seal the joint between the new and old concrete with a fuel-resistant sealant. Seal storm water drain piping with fuel resistant sealant. Provide an adequate amount of reinforced concrete above and below the drain pipe(s) to prevent crack formation in the concrete at this location.

6.15.12. Contractor Site Specific Spill Plan (CSSSP). Prepare and submit CSSSP through the COR to Fort Campbell Environmental Division. Develop the CSSSP as outlined in the Fort Campbell Environmental Handbook. A link to the fill-in-the-blank version of the CSSSP is located on the Fort Campbell Web site at: (http://www.campbell.army.mil/campbell/directorates/DPW/envdiv/Pages/Spills/aspx).

6.15.13. Green Procurement. Purchase, supply, and use environmentally referable products and services to the maximum extent practicable. Consider Green products as the “first choice” for procurement. Additional information can be obtained in the applicable Appendix.

6.15.14. Sustainable Installation Management System (SIMS). Fort Campbell has implemented an environmental management system entitled SIMS to proactively deal with the environmental impacts of its processes, activities, and services. Fort Campbell’s approved Significant Environmental Aspects are located on the DPW Environmental Division web page (http://www.campbell.army.mil/campbell/directorates/DPW/envdiv/Pages/default.aspx) under “Sustainable Installation Management System (SIMS/EMS)” on the left menu.

6.15.14.1. Fort Campbell uses the ISO 14001:2004 as the standard for its SIMS. All personnel performing work for or on behalf of Fort Campbell should be aware of and understand Fort Campbell Environmental Policy. Fort Campbell offers SIMS General Awareness Training in the form of an 8 minute video. This video can be found on the Fort Campbell Environmental web site (http://www.campbell.army.mil/campbell/directorates/DPW/envdiv/Pages/default.aspx) under “Sustainable Installation Management System (SIMS/EMS)” on the left menu. Ensure that all subcontractors receive SIMS General Awareness Training.

6.15.14.2. Ensure that all goods and services used by the contractor or any of its subcontractors do not deviate from the installation Environmental Policy, objectives and targets of the EMS. Perform work in a manner that conforms to all appropriate Environmental Management Programs and Operational Controls identified by Installation’s SIMS, including pollution prevention, waste reduction, energy use, and natural resource protection. Provide monitoring and measurement information as necessary for the organization to address environmental performance relative to the environmental and energy management goals. In the event of non-compliance with Fort Campbell’s legal or other requirements or non-conformance with the installation SIMS, take immediate corrective action, perform a root-cause analysis of the non-compliance/non-conformance and develop preventive action to keep the non-compliance/non-conformance from recurring. In the event of any noncompliance with any federal, state, or local environmental law, regulation or requirement, immediately respond by taking all appropriate corrective action and notify the Contracting Officer’s Representative (COR) and the DPW Environmental Division. Ensure that employees and subcontract employees are aware of their roles and responsibilities with regard to the SIMS and how these requirements affect the work performed under this contract. Additionally, when ordering supplies for use on Installation, all contractor personnel must favor energy-efficient, recycled or reclaimed material whenever practicable.

6.15.14.3. The responsibility of all contractor personnel include, but are not limited to:

(a) Recycling all eligible material, including glass, paper (including magazines), plastic, aluminum, and cardboard to the maximum extent practicable;

(b) Reducing the amount of hazardous material and/or solvent used by purchasing fewer hazardous materials and by increasing the use of products with recycled content;

(c) Reducing the amount of solid waste from construction and demolition debris, and scrap metal sent to municipal and rubble landfills by reducing, reusing, and recycling; and

(d) Conserving energy and water usage by turning off lights and equipment when not in use and using only the necessary amount of water needed to complete the required tasks. Continuous conservation of our natural resources is a must.

6.15.15. Direct any questions regarding SIMS to the Installation SIMS Action Officer (Karen Kopp-Voshel, phone 270-798-9597, e-mail karen.kopp@us.army.mil) or Contracting Officer's Representative. For more information regarding environmental compliance requirements contact DPW-Environmental at (270) 798-9645.

6.15.16. Inadvertent Disturbance and Discovery of Cultural Resources. If a previously unidentified historic property or archaeological site is disturbed or if any archaeological remains, including human skeletons, are discovered during construction, immediately halt all activity within in a one hundred (100) foot radius of the disturbance and/or discovery, notify the Fort Campbell Cultural Resources Program 270-412-8174, and implement interim measures to protect the site and/or discovery from looting and vandalism.

6.15.16.1. The Fort Campbell Cultural Resources Program will evaluate the disturbance and/or discovery and provide interim recommendations to the contractor within two working days of notification if the contractor can proceed with the planned activities. In accordance with the current Programmatic Agreement of Operations the Cultural Resources Program will then consult with the appropriate Tribal Nations and State offices to meet the Installation's legal obligations.

6.15.17. The project site has been previously harvested of saleable lumber. Therefore, roosting of migratory birds and the Indiana Bat are not of concern.

6.15.18. The project Storm Water Pollution Prevention Plan (SWPPP) shall be designed to meet the requirements of the State of Tennessee NPDES permit that is included in Appendix CC.

6.16. PERMITS

6.16.1. Permits.

Obtain all permits (local, state and federal) required for design and construction of all site features and utilities. Provide information, as described below, to obtain all necessary permits.

6.16.2. Air Permits.

Provide air permit information to Fort Campbell Environmental Division. Two types of permits are required: (1) A construction permit; and (2) An operating permit. Obtain a construction permit based on the design prior to construction. Obtain an operating permit when the equipment is installed. Provide information for both types of permits to Fort Campbell using the Checklist for Non-Process Source and the Vent Stack Checklist. Each checklist is available from the Fort Campbell Environmental Division and shall be completed for each piece of fuel-burning equipment. The lead time for these permits is approximately 30 days, thus submit all information as soon as possible. Point of contact for these items is Patty Lockard, Fort Campbell Environmental Division, and (270) 798-9603.

6.16.2.1. Fort Campbell (Christian (KY) and Montgomery (TN) Counties) was designated an ozone "maintenance" area in 2005. The installations maintenance plan requirements are designed to maintain the average ozone concentration levels at or below the maximum allowed to sustain compliance with the National Ambient Air Quality Standards. The redesignation as an "attainment maintenance area" will be in effect for 12 years. Section 176(c)(1) of the Clean Air Act (CAA) mandates the General Conformity Rule (GCR) analysis be completed by Fort Campbell to establish that any construction activity will not impede the continuation of the attainment status and ensure the action does not impede Kentucky or Tennessee air pollution control efforts in ozone "attainment maintenance areas". The rule requires that an analysis and other procedures (if required as a result of the analysis) be completed prior to the commencement of any of the project activities.

6.16.2.2. Review is required for all proposed construction activity which will result in the emission of surface ozone precursors (volatile organic compounds and nitrogen oxides) to ensure the action does not impede Tennessee air pollution control efforts to gain attainment of the NAAQS for ozone. Non attainment designations for particulate matter (PM) are based on 3-year averages of either each years' annual average concentration (annual average) or on a 24 hour average basis (rolling 24 hour avg.).

(a) PM2.5. Exceedance of either standard can result in an area being classified as non-attainment for PM2.5. If that should occur, PM2.5 will be considered and added to the GCR process as stated above.

6.16.2.3. Data is required to enable the Air Quality Program of the Fort Campbell Environmental Division to calculate the estimated emissions of ozone precursors resulting from construction equipment (mobile and stationary) burning fossil fuels and other Contractor vehicles (Contractor or private owned) operated on Fort Campbell as a result of the construction contract. To obtain this data representatives of the Fort Campbell Air Quality Program will need to contact either a Contractor representative and/or the Resident Office project manager, as designated by the Fort Campbell Resident Office. See 6.16.2.6 for examples of construction equipment and activities, which need to be identified as to their usage.

6.16.2.4. The primary source of the ozone precursors at Fort Campbell during construction activities is the burning of fossil fuels by mobile non-road construction equipment and other vehicles, including privately owned vehicles operated by construction Contractor personnel and Government supervising personnel (this applies only to that portion of usage directly applicable to the construction activity, which includes the commute to the construction site). In addition, stationary and/or portable units such as fossil fuel fired boilers, space heaters, and electric generators must be considered. Additional sources of concern that may be part of major construction activities include, but are not limited to, coating operations (spray booths), solvent cleaning operations, volatile organic fluids (fuels, etc.) dispensing and storage operations, and site remediation activities.

6.16.2.5. In addition to the data concerning ozone precursor emissions during the construction phase, data are also required to estimate what the emissions will be after the completion of the construction project. This includes evaluations to determine emission increases of ozone precursors resulting from any new permanent stationary sources; any potential increase in vehicle miles traveled by fossil fueled tactical, other federal Government owned, and private owned vehicles; and any increase in demands on current utility services (boiler plants, water plants, etc.). This data will be compiled from review of construction plans, drawings, and by interviews of points of contact other than the Contractor or the Fort Campbell Resident Office.

(a) Fuel Burning Equipment (Natural Gas and/or Fuel Oil): For boilers > 10 MBTU or for any boiler that uses fuel oil, contact the Air Quality Program with specifications for boilers. For hot water heaters > 120 gallons, contact the Air Quality Program with specifications for hot water heaters. The Air Quality Program will submit the Boiler NESHAP Notification to EPA.

(b) Concrete/ Asphalt: Describe whether operations of concrete batch plant/asphalt plant (including any use of a pug mill) will be on or off post. If on post, provide capacity and other design data to determine if air permits would be required and to determine other CAA related compliance issues. Approximately 120 day lead time to obtain state operating permit.

(c) Debris Burning: Air pollution restrictions applicable to this project do not allow materials to be burned on the Government premises.

(d) Debris Disposal: If construction debris is to be sent to a grinder for recycling, describe if the grinding equipment will be on or off post and if on-post, providegrinder capacity (tons/hour) and design in order to determine if air permitting and other CAA related compliance issues apply. Approximately 120 day lead time to obtain state operating permit.

(e) Dust: Maintain all excavations, stockpiles, access roads, waste areas, and all other work areas free from excess dust to such a reasonable degree as to avoid causing a hazard or nuisance.

(f) Ozone Depleting Chemicals: Refrigerants shall have an ozone depleting potential (ODP) of 0.05 or less.

(g) Construction Equipment Listing. The list is not purported to be a complete list. It is based on some of the operations conducted during past major construction activities at Fort Campbell.

- Bulldozers
- Graders
- Excavators
- Backhoes
- Dump Trucks
- Fuel/Service Trucks
- Tractors
- Pug Mills (on site Fort Campbell)
- Concrete Batch Plant fossil fuel usage (on site Fort Campbell)
- Scrapers
- Ready-Mix Trucks
- Screed, Concrete, (if fossil fuel powered)
- Portable paint sprayers and any associated fossil fuel powered air compressors
- Fossil fuel fired powered air compressors used for activities other than powering paint applicators
- Fossil fuel powered electric generators,
- Lay Down Machines used in paving activities
- Rollers
- Compactors
- Water Trucks
- Pavement Stripping Machines
- Traffic road striping (vehicle and product applied)
- Loaders
- Compactors
- Curb and Gutter Pavers

6.16.2.6. The analysis must be completed prior to commencement of any of the construction project activities.

6.16.3. Water Permits.

Any change to the water distribution system requires an Approval from the State Government. The Contractor and the utility owner, CH2MHill, shall have shared responsibility in the coordination of the application for permit for work involving the water distribution system. Provide information as necessary during the design of the project to CH2M Hill for preparation of the permit application. Point of Contact for CH2M Hill at Fort Campbell is Chris Semler, (931) 431-2015. Alternate contact for CH2M HILL is Robert Neath (314) 421-0313.

6.16.4. Sanitary Sewer Permits.

Any change to the sanitary sewer system requires State approval. The Contractor and the utility owner, CH2MHill, shall have shared responsibility in the coordination of the application for permit for work involving the sanitary sewer system. Provide information as necessary during the design of the project to CH2M Hill for preparation of the permit application. Point of Contact for CH2M Hill at Fort Campbell is Chris Semler, (931) 431-2015. Alternate contact for CH2M HILL is Robert Neath (314) 421-0313.

6.16.5. Erosion and Sediment Control Permits.

Coordinate with the Fort Campbell Environmental Division to obtain the latest guidance on the Erosion and Sediment Control Permits. The point of contact is Mr. Dan Etson at phone number (270) 798-9784. No ground disturbing activities shall be made without first securing coverage under Fort Campbell's National Pollution Discharge Elimination System (NPDES) Permit and secondly ensuring all storm water controls are in place. DPW-Environmental maintains a blanket storm water discharge coverage under the applicable state permit for all projects constructed during a calendar year. DPW- Environmental will issue the permit in each state to the Contractor once the Storm Water Manager has reviewed and approved all required environmental submittals. Submit all required submittal documents thirty (30) days prior to start of the project.

6.16.6. Fort Campbell Permits.

No electric equipment shall be installed within or on any Fort Campbell building, structure, or premises, nor shall any alteration or addition be made in any such existing equipment without first securing an Electrical Permit from the Fort Campbell Electrical Inspector in accordance with CAM Regulation 420-4 (Quality Assurance "Electrical" Inspection Standards). An Electrical Contractor Registration Form shall be completed. This form will be attached to the back of the copy of the CAM Regulation. The Contractor's license shall be validated against the Fort Campbell Review Board list of State Electrical Licenses valid on Fort Campbell KY before a permit can be obtained. Copies of CAM Regulation 420-4 and permits shall be obtained at DPW, Utilities Maintenance Building 868, Bastogne & 16th Street, Fort Campbell, Kentucky.

6.17. DEMOLITION

No building demolition is required as part of this project.

6.18. ADDITIONAL FACILITIES

6.18.1 Multipurpose Athletic Field (Option - Item No. 0006)

A multipurpose athletic field (360 feet x 200 feet) shall also be constructed. The preferred orientation shall be for the long axis to be northwest-southeast to suit the angle of the sun during the fall playing season, or north-south for longer periods of play. The multipurpose field shall be lighted.

The multipurpose athletic field shall be graded adequately to drain such that ponding water is not an issue. The preferred grading shall be a longitudinal crown with a one percent slope from center to each side. UFC 4-750-02N Design: Outdoor Sports and Recreation Facilities may be used as a guide for field design including grading recommendations (see Appendix AA). Exterior bleachers shall not be included in the project. Football goal posts shall be installed at each end of the playing field.

Lighting requirements for the multipurpose field shall be in accordance with the Illuminating Engineering Society of North America (IESNA) ” Recommended Practice for Sports Lighting” publication, Chapter 20 of the IESNA Lighting Handbook, and IESNA RP-6-01, "Sports and Recreational Area Lighting". The lighting for the multipurpose field shall be a level Class of Play III in accordance with IESNA RP-6-01. This shall be a minimum illumination of 300 Lux and 30 foot candle. Field lighting shall be metal halide or LED and be pole mounted. Fields shall be individually controllable by a programmable timer with manual switch over ride located in the mechanical room of the facility.

Light poles shall be rated for sustained winds of 110 MPH with the combined projected area of luminaries, mounting, and lowering systems. All light poles shall be provided with air terminals, minimum two (2) grounding electrodes, and minimum No. 1/0 AWG copper internal down conductors for lightning protection. The lowest bracket of lights shall be mounted a minimum of 50 feet from the ground. Lighting shall be controllable by a programmable timer with a manual over-ride switch.

Provide multipurpose field with individual transformer. Field does not require looped feeds at the transformers and can be installed using one (1) of the two (2) sectionalizing/isolating switches.

Provide a minimum of two (2) GFCI, 120 V, 20 Amp, weather proof duplex receptacles at approximately the midpoint of each of the longitudinal sides of the multipurpose athletic field.

Provide primary ductbank with minimum of one spare conduit. Ductbank shall be concrete encased.

Primary conductors shall be copper. Aluminum is not permitted.

Underground Secondary Distribution System shall consist of direct buried conduit and copper conductors. Secondary power systems shall provide manholes and/or handholes as required for the application but not less than every two hundred feet (200').

Manholes, handholes and pullboxes shall be the same dimensions and of equivalent, or better, quality as existing manholes, handholes, and pull boxes located at and/or closest the site. Strength of manholes, handholes, and pullboxes and their frames and covers shall be in accordance with the requirements of IEEE C2.

Provide Lightning Protection of Outdoor Recreation Facilities. See Paragraph 6.18.4 requirements for Lightning Protection of Outdoor Recreation Facilities.

6.18.2 Two Softball Fields (Option - Item No. 0007)

Provide two softball fields. At least one of the fields shall be a minimum of 300 feet in depth and accommodate regulation intramural slow pitch men's softball play (NSA Rules). Both softball fields shall be lighted. Provide a 16 foot tall chainlink backstop at least 25 feet behind home plate extending 20 feet down each foul line. The fields shall have a minimum of 6 foot tall chainlink fencing parallel the foul line and along the homerun limit. The fence shall be at least 25 feet away from the foul line. The 6 foot tall chainlink fence shall be topped with yellow corrugated PVC pipe. The infields shall be dirt to accommodate softball play. A dirt mound shall not be constructed. Ft. Campbell will be responsible for providing the bases and pitchers rubber. Home plate shall be permanently installed by the Contractor.

For dust control, a water line with frost proof hydrant shall be provided at each field. The hydrants should be located outside the playing area.

The optimum field orientation is to locate homeplate so that the pitcher is throwing across the sun and the batter is not facing it. The softball fields shall be graded adequately to drain such that ponding water is not an issue. The infield shall be graded so that the baselines and homeplate are level. UFC 4-750-02N Design: Outdoor Sports and Recreation Facilities shall be used as a guide for field design including grading recommendations (see Appendix AA). Exterior bleachers shall not be included in the project.

Lighting requirements for softball fields shall be in accordance with the Illuminating Engineering Society of North America (IESNA) " Recommended Practice for Sports Lighting" publication, Chapter 20 of the IESNA Lighting Handbook, and IESNA RP-6-01, "Sports and Recreational Area Lighting". The lighting for the baseball fields shall be a minimum of a Class of Play of "II" in accordance with IESNA RP-6-01. This shall be a minimum illumination of 500 Lux and 50 foot candle for the infield and a minimum of 300 Lux and 30 foot candle for the outfield. Field lighting shall be metal halide or LED and be pole mounted. Fields shall be individually controllable by a programmable timer with manual switch over ride located in the mechanical room of the facility.

Light poles shall be rated for sustained winds of 110 MPH with the combined projected area of luminaries, mounting, and lowering systems. All light poles shall be provided with air terminals, minimum two (2) grounding electrodes, and minimum No. 1/0 AWG copper internal down conductors for lightning protection. The lowest bracket of lights shall be mounted a minimum of 70 feet from the ground. Light poles shall be constructed of hot dipped galvanized steel. Lighting shall be controllable by a programmable timer with a manual over-ride switch.

Provide the two softball fields with one individual transformer. Fields do not require looped feeds at the transformers and can be installed using one (1) of the two (2) sectionalizing/isolating switches.

Provide a minimum of two (2) GFCI, 120 V, 20 Amp, weather proof duplex receptacles exterior to and within five feet (5') of the back stop of each softball field.

Provide primary ductbank with minimum of one spare conduit. Ductbank shall be concrete encased.

Primary conductors shall be copper. Aluminum is not permitted.

Underground Secondary Distribution System shall consist of direct buried conduit and copper conductors. Secondary power systems shall provide manholes and/or handholes as required for the application but not less than every two hundred feet (200').

Manholes, handholes and pullboxes shall be the same dimensions and of equivalent, or better, quality as existing manholes, handholes, and pull boxes located at and/or closest the site. Strength of manholes, handholes, and pullboxes and their frames and covers shall be in accordance with the requirements of IEEE C2.

Provide Lightning Protection of Outdoor Recreation Facilities. See Paragraph 6.18.4 requirements for Lightning Protection of Outdoor Recreation Facilities.

6.18.3 Additional Parking (Option - Item No. 0009)

Provide lighting and electrical circuits for additional parking lot.

Provide primary ductbank with minimum of one spare conduit. Ductbank shall be concrete encased.

Primary conductors shall be copper. Aluminum is not permitted.

Underground Secondary Distribution System shall consist of direct buried conduit and copper conductors. Secondary power systems shall provide manholes and/or handholes as required for the application but not less than every two hundred feet (200').

Manholes, handholes and pullboxes shall be the same dimensions and of equivalent, or better, quality as existing manholes, handholes, and pull boxes located at and/or closest the site. Strength of manholes, handholes, and pullboxes and their frames and covers shall be in accordance with the requirements of IEEE C2.

6.18.4 Lightning Protection of Outdoor Recreation Facilities

Lightning protection and the installation of lightning protection systems shall be in accordance with NFPA 780 and all applicable criteria of Paragraph 4.1, Criteria, of this Statement of Work.

The Contractor shall provide lightning protection to the *****AMDT 0002*** Outdoor Recreation Facilities, regardless of the results of a Lightning Risk Assessment. A Risk Assessment does not need to be provided for the Outdoor Recreation Faciliites. ***AMDT 0002*****

Ground all fences for lightning protection at each side of all gates, at each corner, at the closest approach to all structures located within 50 feet of the fence, and where the fence alignment changes more than 15 degrees. Grounding locations shall not exceed 300 feet. Each gate panel shall be bonded with a flexible bond strap to its gate post. Ground conductor for fences shall consist of No. 8 AWG solid copper wire. Clamp ground conductor to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods.

For fenced fields: Bond grounding electrode and/or base of all field light poles to fence post and/or grounding electrode of fence, whichever is closest, using a minimum No. 2 AWG copper bonding conductor.

Ground all parking lot, walkway, and path light poles with a minimum one (1) grounding electrode. Ground conductors for parking lot and walkway light poles shall consist of a minimum size of No. 2 AWG copper wire. All exterior electrical systems shall be provided lightning surge protection.

Grounding electrodes shall be 3/4 inch by 10 foot long copper-clad steel rod. Drive electrodes into the earth so that the top of the electrode is at least 1 foot below the grade. The top of the electrode shall not be less than 2 feet or more than 5 feet from the fence or light pole. After installation, the total resistance of fence or light pole to ground shall not be greater than 25 ohms.

6.19 SUPPLEMENTAL REQUIREMENTS TO THE RFP

6.19.1 Revise the following language to Section 00 73 10, Paragraph 1.9 TASK ORDER SITE SAFETY AND HEALTH OFFICER REQUIREMENTS AND QUALIFICATIONS (APR 10):

Replace (b) with the following:

(b) “The SSHO duties will be the employee’s sole, full-time responsibility. The SSHO shall have (1) 3 years safety work on similar type construction, (2) 30-hour OSHA construction safety class or equivalent within last 3 years, and (3) Competent Person Training as required based on applicability (scaffolds, cranes, fall protection, confined space, or others).”

Add the following:

(c) “SSHO shall be provided at the work site at all times to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor. The SSHO shall be assigned no other duties except being the SSHO, shall not be the CQC System Manager or Superintendent. SSHO shall be employed by the prime; SSHO qualifications in resume form with education certifications shall be submitted.

The SSHO can be as follows: An individual other than the CQC System Manager who is not a member of the CQC staff, and is not answerable to the CQC System Manager, but is appointed by an official of the contractor, not the project superintendent. Either the CQC person or the superintendent shall be equally qualified as the SSHO and shall be capable of performing the full duties of the SSHO during any very brief period of work when the SSHO is absent. To ensure that safety and health conditions are maintained/enforced at all times, and a SSHO is present at all times, the Contractor shall an alternate to perform the safety and health requirements stated herein to cover any extended period when the SSHO cannot be present, such as during absences for vacations/extended sickness, or when there are multiple shifts that require additional coverage. The alternate shall have the same qualifications/training as the SSHO.”

6.19.2 Section 01 45 04.00 10, 3.4 QUALITY CONTROL ORGANIZATION, paragraphs 3.4.1. through 3.4.4. shall be replaced in its entirety with the following:

3.4.1. Personnel Requirements

(a) The requirements for the CQC organization are a CQC System Manager, a Design Quality Manager, and sufficient number of additional qualified personnel to ensure safety and contract compliance. A Site Safety Health Officer (SSHO) shall be required for this contract. The CQC System Manager and the Site Safety and Health Officer shall be an employee of the Prime Contractor and as members of the CQC staff. (See Section 01 35 26.00 06 GOVERNMENT SAFETY REQUIREMENTS for the SSHO qualifications and duties.)

(b) The CQC organization shall also include personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly. The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Contracting Officer. Provide adequate office space, filing systems, and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly furnish complete records of all letters, material submittals, shop drawings submittals, schedules and all other project documentation to the CQC organization. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.4.2 CQC System Manager

(a) The Contractor shall identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be either a construction person with a minimum of 10 years in related work or shall possess a degree in engineering or construction management with 5 years of relevant experience.

(b) The CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. An alternate for the CQC System Manager shall be identified in the CQC Plan to serve in the event of the CQC System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

(c)The CQC System Manager shall be assigned no other duties.

3.4.3. CQC Personnel

3.4.3.1. In addition to CQC personnel specified elsewhere in the contract, the Contractor shall provide as part of the CQC organization specialized personnel to assist the CQC System Manager for the following areas identified per Experience Matrix Table. These individuals shall be directly employed by the prime Contractor and may not be employed by a supplier or sub-contractor on this project. These individuals identified per the Experience Matrix Table, shall be responsible to the CQC System Manager; be physically present at the construction site during work on their areas of responsibility; have the necessary education and/or experience in accordance with the experience matrix listed herein. The individuals in the Experience Matrix Table shall have no other duties except as noted in the Experience Matrix Table. The SSHO shall have no other duties.

3.4.4. Experience Matrix Table

The word “graduate” below indicates an individual possessing a four-year college degree accredited in the respective field listed.

3.4.4.1. Area Qualifications

3.4.4.1.1. SSHO – See Section 01 35 29.00 06 Safety and Occupational Health Requirements. Shall be an employee of the Prime and directly responsible to the Corporate Safety.

3.4.4.1.2. Civil – Graduate Civil Engineer with 2 years experience in the type of work being performed on this project or technician with 5 years related experience. Shall be an employee of the Prime and may perform duties as Environmental QC if qualified for both.

3.4.4.1.3. Geotechnical – Graduate Geotechnical Engineer with 3 years of relevant experience. A Civil Engineer may meet this requirement, thus having dual duties.

3.4.4.1.4. Mechanical – Graduate Mechanical Engineer with 2 years experience or person with 5 years related experience. Shall be an employee of the Prime.

3.4.4.1.5. Electrical – Graduate Electrical Engineer with 2 years related experience or person with 5 years related experience. Shall be an employee of the Prime.

3.4.4.1.6. Structural – Graduate Structural Engineer with 2 years experience or person with 5 years related experience. Shall be an employee of the Prime and may perform duties as Architectural QC if qualified for both.

3.4.4.1.7. Architectural – Graduate Architect with 2 years experience or person with 5 years related experience. Shall be an employee of the Prime and may perform duties as Structural QC if qualified for both.

3.4.4.1.8. Environmental – Graduate Environmental Engineer with 3 years experience. Shall be an employee of the Prime and may perform duties as Civil QC if qualified for both.

3.4.4.1.9. LEED-AP BD+C – LEED Accredited by USGBC (US Green Building Council). Shall be an employee of the Prime and may perform other duties.

3.4.4.1.10 Submittals – Submittals Clerk with 1 year experience.

End of Section 01 10 00.TBD

SECTION 01 33 00.TBD
SUBMITTAL PROCEDURES
(DESIGN-BUILD TASK ORDERS)

1.0 GENERAL

1.13. GOVERNMENT APPROVED OR CONCURRED WITH SUBMITTALS

1.14. INFORMATION ONLY SUBMITTALS

1.0 GENERAL

1.1.1. This section contains requirements specifically applicable to this task order. The requirements of Base ID/IQ contract Section 01 33 30 apply to this task order, except as otherwise specified herein.

1.13. GOVERNMENT APPROVED OR CONCURRED WITH SUBMITTALS

Upon completion of review of submittals requiring Government approval or concurrence, the Government will stamp and date the submittals as approved or concurred. The Government will retain two (2) copies of the submittal and return one (1) copy(ies) of the submittal.

1.14. INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe. The Government will retain eight (8) copies of information only submittals.

End of Section 01 33 00.TBD

SECTION 01 33 16
DESIGN AFTER AWARD

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ATTACHMENT B FURNITURE, FIXTURES AND EQUIPMENT REQUIREMENTS

ATTACHMENT C TRACKING COMMENTS IN DRCHECKS

ATTACHMENT D SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW

ATTACHMENT E LEED SUBMITTALS

ATTACHMENT F BUILDING INFORMATION MODELING REQUIREMENTS

ATTACHMENT G DESIGN SUBMITTAL DIRECTORY AND SUBDIRECTORY FILE ARRANGEMENT

1.0 GENERAL INFORMATION

1.1. INTRODUCTION

1.1.1. The information contained in this section applies to the design required after award. After award, the Contractor will develop the accepted proposal into the completed design, as described herein.

1.1.2. The Contractor may elect to fast track the design and construction that is, proceed with construction of parts of the sitework and facilities prior to completion of the overall design. To facilitate fast tracking, the Contractor may elect to divide the design into no more than six (6) design packages per major facility type and no more than three (3) design packages for site and associated work. Designate how it will package the design, consistent with its overall plan for permitting (where applicable) and construction of the project. See Sections 01 33 00 SUBMITTAL PROCEDURES and 01 32 01.00 10 PROJECT SCHEDULE for requirements for identifying and scheduling the design packaging plan in the submittal register and project schedule. See also Sections 01 10 00 STATEMENT OF WORK and 01 57 20.00 10 ENVIRONMENTAL PROTECTION for any specified permit requirements. If early procurement of long-lead item construction materials or installed equipment, prior to completion of the associated design package, is necessary to facilitate the project schedule, also identify those long-lead items and how it will assure design integrity of the associated design package to meet the contract requirements (The Contract consists of the Solicitation requirements and the accepted proposal). Once the Government is satisfied that the long-lead items meet the contract requirements, the Contracting Officer will allow the Contractor to procure the items at its own risk.

1.1.3. The Contractor may proceed with the construction work included in a separate design package after the Government has reviewed the final (100%) design submission for that package, review comments have been addressed and resolved to the Government's satisfaction and the Contracting Officer (or the Administrative Contracting Officer) has agreed that the design package may be released for construction.

1.1.4. INTEGRATED DESIGN. To the maximum extent permitted for this project, use a collaborative, integrated design process for all stages of project delivery with comprehensive performance goals for siting, energy, water, materials and indoor environmental quality and ensures incorporation of these goals. Consider all stages of the building lifecycle, including deconstruction.

1.2. DESIGNER OF RECORD

Identify, for approval, the Designer of Record (“DOR”) that will be responsible for each area of design. One DOR may be responsible for more than one area. Listed, Professional Registered, DOR(s) shall account for all areas of design disciplines. The DOR’s shall stamp, sign, and date each design drawing and other design deliverables under their responsible discipline at each design submittal stage (see contract clause Registration of Designers). If the deliverables are not ready for release for construction, identify them as "preliminary" or "not for release for construction" or by using some other appropriate designation. The DOR(s) shall also be responsible for maintaining the integrity of the design and for compliance with the contract requirements through construction and documentation of the as-built condition by coordination, review and approval of extensions of design, material, equipment and other construction submittals, review and approval or disapproval of requested deviations to the accepted design or to the contract, coordination with the Government of the above activities, and by performing other typical professional designer responsibilities.

2.0 PRODUCTS (Not Applicable)

3.0 EXECUTION

3.1. PRE-WORK ACTIVITIES & CONFERENCES

3.1.1. Design Quality Control Plan

Submit for Government acceptance, a Design Quality Control Plan in accordance with Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL before design may proceed.

3.1.2. Post Award Conference

3.1.2.1. The government will conduct a post award contract administration conference at the project site, as soon as possible after contract award. This will be coordinated with issuance of the contract notice to proceed (NTP). The Contractor and major sub-contractor representatives shall participate. All designers need not attend this first meeting. Government representatives will include COE project delivery team members, facility users, facility command representatives, and installation representatives. The Government will provide an agenda, meeting goals, meeting place, and meeting time to participants prior to the meeting.

3.1.2.2. The post award conference shall include determination and introduction of contact persons, their authorities, contract administration requirements, discussion of expected project progress processes, and coordination of subsequent meetings for quality control (see Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL), Partnering (see below and SCR: Partnering), and the initial design conference (see below).

3.1.2.3. The government will introduce COE project delivery team members, facility users, facility command representatives, and installation representatives. The DB Contractor shall introduce major subcontractors, and other needed staff. Expectations and duties of each person shall be defined for all participants. A meeting roster shall be developed and distributed by the government with complete contact information including name, office, project role, phone, mailing and physical address, and email address.

3.1.3. Partnering & Project Progress Processes

3.1.3.1. The initial Partnering conference may be scheduled and conducted at any time with or following the post award conference. The Government proposes to form a partnership with the DB Contractor to develop a cohesive building team. This partnership will involve the COE project delivery team members, facility users, facility command representatives, installation representatives, Designers of Record, major subcontractors, contractor quality control staff, and contractor construction management staff. This partnership will strive to develop a cooperative management team drawing on the strengths of each team member in an effort to achieve a quality project within budget and on schedule. This partnership will be bilateral in membership and participation will be totally voluntary. All costs, excluding labor and travel expenses, shall be shared equally between the Government and the Contractor. The Contractor and Government shall be responsible for their own labor and travel costs. Normally, partnering meetings will be held at or in the vicinity of the project installation.

3.1.3.2. As part of the partnering process, the Government and Contractor shall develop, establish, and agree to comprehensive design development processes including conduct of conferences, expectations of design development at conferences, fast-tracking, design acceptance, Structural Interior Design (SID)/ Furniture, Fixtures & Equipment (FF&E) design approval, project closeout, etc. The government will explain contract requirements and the DB Contractor shall review their proposed project schedule and suggest ways to streamline processes.

3.1.4. Initial Design Conference

The initial design conference may be scheduled and conducted at the project installation any time after the post award conference, although it is recommended that the partnering process be initiated with or before the initial design conference. Any design work conducted after award and prior to this conference should be limited to site and is discouraged for other items. All Designers of Record shall participate in

the conference. The purpose of the meeting is to introduce everyone and to make sure any needs the contractor has are assigned and due dates established as well as who will get the information. See also Attachment F, BUILDING INFORMATION MODELING REQUIREMENTS for discussion concerning the BIM Implementation Plan demonstration at this meeting. The DB Contractor shall conduct the initial design conference.

3.1.5. Pre-Construction Conference

Before starting construction activities, the Contractor and Government will jointly conduct a pre-construction administrative conference to discuss any outstanding requirements and to review local installation requirements for start of construction. It is possible there will be multiple Pre-Construction Conferences based on the content of the design packages selected by the Contractor. The Government will provide minutes of this meeting to all participants.

3.2. STAGES OF DESIGN SUBMITTALS AND OVER THE SHOULDER PROGRESS REVIEWS

The stages of design submittals described below define Government expectations with respect to process and content. The Contractor shall determine how to best plan and execute the design and review process for this project, within the parameters listed below. As a minimum, the Government expects to see at least one interim design submittal, at least one final design submittal before construction of a design package may proceed and at least one Design Complete submittal that documents the accepted design. The Contractor may sub-divide the design into separate packages for each stage of design and may proceed with construction of a package after the Government accepts the final design for that package. See discussion on waivers to submission of one or more intermediate design packages where the parties partner during the design process. See also Attachment F, BUILDING INFORMATION MODELING REQUIREMENTS for discussion concerning BIM and the various stages of design submittals and over-the-shoulder progress reviews**.**

3.2.1. Site/Utilities

To facilitate fast-track design-construction activities the contractor may submit a final (100%) site and utility design as the first design submittal or it may elect to submit interim and final site and utility design submittals as explained below. Following review, resolution, and incorporation of all Government comments, and submittal of a satisfactory set of site/utility design documents, after completing all other pre-construction requirements in this contract and after the pre-construction meeting, the Government will allow the Contractor to proceed with site development activities, including demolition where applicable, within the parameters set forth in the accepted design submittal. For the first site and utility design submission, whether an interim or final, the submittal review, comment, and resolution times from this specification apply, except that the Contractor shall allow the Government a 14 calendar day review period, exclusive of mailing time. No on-site construction activities shall begin prior to written Government clearance to proceed.

3.2.2. Interim Design Submittals

The Contractor may submit either a single interim design for review, representing a complete package with all design disciplines, or split the interim design into smaller, individual design packages as it deems necessary for fast-track construction purposes. As required in Section 01 32 01.00 10 PROJECT SCHEDULE, the Contractor shall schedule its design and construction packaging plan to meet the contract completion period. This submission is the Government's primary opportunity to review the design for conformance to the solicitation and to the accepted contract proposal and to the Building Codes at a point where required revisions may be still made, while minimizing lost design effort to keep the design on track with the contract requirements. The requirements for the interim design review submittals and review conferences are described hereinafter. This is not necessarily a hold point for the design process; the Contractor may designate the interim design submittal(s) as a snapshot and proceed with design development at its own risk. See below for a waiver, where the parties establish an effective

over-the-shoulder progress review procedure through the partnering process that would eliminate the need for or expedite a formal intermediate design review on one or more individual design packages.

3.2.3. Over-the-Shoulder Progress Reviews

To facilitate a streamlined design-build process, the Government and the Contractor may agree to one-on-one reviewer or small group reviews, electronically, on-line (if available within the Contractor's standard design practices) or at the Contractor's design offices or other agreed location, when practicable to the parties. The Government and Contractor will coordinate such reviews to minimize or eliminate disruptions to the design process. Any data required for these reviews shall normally be provided in electronic format, rather than in hard copy. If the Government and Contractor establish and implement an effective, mutually agreeable partnering procedure for regular (e.g., weekly) over-the shoulder review procedures that allow the Government reviewers the opportunity to keep fully informed of the progress, contents, design intent, design documentation, etc. of the design package, the Government will agree to waive or to expedite the formal intermediate design review period for that package. The Contractor shall still be required to submit the required intermediate design documentation, however the parties may agree to how that material will be provided, in lieu of a formal consolidated submission of the package. It should be noted that Government funding is extremely limited for non-local travel by design reviewers, so the maximum use of virtual teaming methods must be used. Some possible examples include electronic file sharing, interactive software with on-line or telephonic conferencing, televideo conferencing, etc. The Government must still perform its Code and Contract conformance reviews, so the Contractor is encouraged to partner with the reviewers to find ways to facilitate this process and to facilitate meeting or bettering the design-build schedule. The Contractor shall maintain a fully functional configuration management system as described herein to track design revisions, regardless of whether or not there is a need for a formal intermediate design review. The formal intermediate review procedures shall form the contractual basis for the official schedule, in the event that the partnering process determines that the formal intermediate review process to be best suited for efficient project execution. However, the Government pledges to support and promote the partnering process to work with the Contractor to find ways to better the design schedule.

3.2.4. Final Design Submissions

This submittal is required for each design package prior to Government acceptance of that design package for construction. The requirements for the final design submittal review conferences and the Government's acceptance for start of construction are described herein after.

3.2.5. Design Complete Submittals

After the final design submission and review conference for a design package, revise the design package to incorporate the comments generated and resolved in the final review conferences, perform and document a back-check review and submit the final, design complete documents, which shall represent released for construction documents. The requirements for the design complete submittals are described hereinafter.

3.2.6. Holiday Periods for Government Review or Actions

Do not schedule meetings, Government reviews or responses during the last two weeks of December or other designated Government Holidays (including Friday after Thanksgiving). Exclude such dates and periods from any durations specified herein for Government actions.

3.2.7. Late Submittals and Reviews

If the Contractor cannot meet its scheduled submittal date for a design package, it must revise the proposed submittal date and notify the government in writing, at least one (1) week prior to the submittal, in order to accommodate the Government reviewers’ other scheduled activities. If a design submittal is

over one (1) day late in accordance with the latest revised design schedule, or if notification of a proposed design schedule change is less than seven (7) days from the anticipated design submission receipt date, the Government review period may be extended up to seven (7) days due to reviewers' schedule conflicts. If the Government is late in meeting its review commitment and the delay increases the Contractor's cost or delays completion of the project, the Suspension of Work and Defaults clauses provide the respective remedy or relief for the delay.

3.3. DESIGN CONFIGURATION MANAGEMENT

3.3.1. Procedures

Develop and maintain effective, acceptable design configuration management (DCM) procedures to control and track all revisions to the design documents after the Interim Design Submission through submission of the As-Built documents. During the design process, this will facilitate and help streamline the design and review schedule. After the final design is accepted, this process provides control of and documents revisions to the accepted design (See Special Contract Requirement: Deviating From the Accepted Design). The system shall include appropriate authorities and concurrences to authorize revisions, including documentation as to why the revision must be made. Include the DCM procedures in the Design Quality Control Plan. The DCM data shall be available to the Government reviewers at all times. The Contractor may use its own internal system with interactive Government concurrences, where necessary or may use the Government's "DrChecks Design Review and Checking System" (see below and Attachment C).

3.3.2. Tracking Design Review Comments

Although the Contractor may use its own internal system for overall design configuration management, the Government and the Contractor shall use the DrChecks Design Review and Checking System to initiate, respond to, resolve and track Government design compliance review comments. This system may be useful for other data which needs to be interactive or otherwise available for shared use and retrieval. See Attachment C for details on how to establish an account and set-up the DrChecks system for use on the project.

3.3.3. Design and Code Checklists

Develop and complete various discipline-specific checklists to be used during the design and quality control of each submittal. Submit these completed checklists with each design submittal, as applicable, as part of the project documentation. See Section 01 45 04.00 10 Contractor Quality Control, Attachment D for a Sample Fire Protection and Life Safety Code review checklist and Attachment E for LEED SUBMITTALS.

3.4. INTERIM DESIGN REVIEWS AND CONFERENCES

3.4.1. General

At least one interim design submittal, review and review conference is required for each design package (except that, per paragraph 3.2.1, the Contractor may skip the interim design submission and proceed directly to final design on the sitework and utilities package). The DB Contractor may include additional interim design conferences or over-the-shoulder reviews, as needed, to assure continued government concurrence with the design work. Include the interim submittal review periods and conferences in the project schedule and indicate what part of the design work is at what percentage of completion. The required interim design conferences shall be held when interim design requirements are reached as described below. See also Paragraph: **Over-the-Shoulder Progress Reviews** for a waiver to the formal interim design review.

3.4.2. Procedures

After receipt of an Interim Design submission, allow the Government fourteen (14) calendar days after receipt of the submission to review and comment on the interim design submittal. For smaller design packages, especially those that involve only one or a few separate design disciplines, the parties may agree on a shorter review period or alternative review methods (e.g., over-the–shoulder or electronic file sharing), through the partnering process. For each interim design review submittal, the COR will furnish, to the Contractor, a single consolidated, validated listing of all comments from the various design sections and from other concerned agencies involved in the review process using the DrChecks Design Review and Checking System. The review will be for conformance with the technical requirements of the solicitation and the Contractor's RFP proposal. If the Contractor disagrees technically with any comment or comments and does not intend to comply with the comment, he/she must clearly outline, with ample justification, the reasons for noncompliance within five (5) days after receipt of these comments in order that the comment can be resolved. Furnish disposition of all comments, in writing, through DrChecks. The Contractor is cautioned that if it believes the action required by any comment exceeds the requirements of this contract, that it should take no action and notify the COR in writing immediately. The Interim Review conference will be held for each design submittal at the installation. Bring the personnel that developed the design submittal to the review conference. The conference will take place the week after the receipt of the comments by the Contractor. For smaller fast-track packages that involve only a few reviewers, the parties may agree to alternative conferencing methods, such as teleconferencing, or televideo, where available, as determined through Partnering.

3.4.3. Conference Documentation

3.4.3.1. In order to facilitate and accelerate the Government code and contract conformance reviews, identify, track resolution of and maintain all comments and action items generated during the design process and make this available to the designers and reviewers prior to the Interim and subsequent design reviews.

3.4.3.2. The DB Contractor shall prepare meeting minutes and enter final resolution of all comments into DrChecks. Copies of comments, annotated with comment action agreed on, will be made available to all parties before the conference adjourns. Unresolved problems will be resolved by immediate follow-on action at the end of conferences. Incorporate valid comments. The Government reserves the right to reject design document submittals if comments are significant. Participants shall determine if any comments are critical enough to require further design development prior to government concurrence. Participants shall also determine how to proceed in order to obtain government concurrence with the design work presented.

3.5. INTERIM DESIGN REQUIREMENTS

Interim design deliverables shall include drawings, specifications, and design analysis for the part of design that the Contractor considers ready for review.

3.5.1. Drawings

Include comments from any previous design conferences incorporated into the documents to provide an interim design for the “part” submitted.

3.5.2. Design Analyses

3.5.2.1. The designers of record shall prepare and present design analyses with calculations necessary to substantiate and support all design documents submitted. Address design substantiation required by the applicable codes and references and pay particular attention to the following listed items:

3.5.2.2. For parts including sitework, include site specific civil calculations.

3.5.2.3. For parts including structural work, include structural calculations.

(a) Identify all loads to be used for design.

(b) Describe the method of providing lateral stability for the structural system to meet seismic and wind load requirements. Include sufficient calculations to verify the adequacy of the method.

(c) Provide calculations for all principal roof, floor, and foundation members and bracing and secondary members.

(d) Provide complete seismic analyses for all building structural, mechanical, electrical, architectural, and building features as dictated by the seismic zone for which the facility is being constructed.

(e) Computer generated calculations must identify the program name, source, and version. Provide input data, including loads, loading diagrams, node diagrams, and adequate documentation to illustrate the design. The schematic models used for input must show, as a minimum, nodes/joints, element/members, materials/properties, and all loadings, induced settlements/deflections, etc., and a list of load combinations. Include an output listing for maximum/minimum stresses/forces and deflections for each element and the reactions for each loading case and combination.

(f) See also the Security (Anti-Terrorism) requirements below for members subject to Anti-Terrorist Force Protection (ATFP) and Progressive Collapse requirements.

(g) Fully coordinate and integrate the overall structural design between two different or interfacing construction types, such as modular and stick-built or multistory, stacked modular construction. Provide substantiation of structural, consolidation/settlement analysis, etc., as applicable, through the interfaces.

3.5.2.4. For Security (Anti-Terrorism): Provide a design narrative and calculations where applicable, demonstrating compliance with each of the 22 standards in UFC 4-010-01, which includes Design of Buildings to Resist Progressive Collapse (use the most recent version of UFC 4-023-03, regardless of references to any specific version in UFC 4-010-01). Where sufficient standoff distance is not being provided, show calculations for blast resistance of the structural system and building envelope. Show complete calculations for members subjected to ATFP loads, e.g., support members of glazed items (jambs, headers, sills) connections of windows to support members and connections of support members to the rest of the structure. For 3 story and higher buildings, provide calculations to demonstrate compliance with progressive collapse requirements.

3.5.2.5. For parts including architectural work, include building floor area analysis.

3.5.2.6. For parts including mechanical work, include HVAC analysis and calculations. Include complete design calculations for mechanical systems. Include computations for sizing equipment, compressed air systems, air duct design, and U-factors for ceilings, roofs and exterior walls and floors. Contractor shall employ commercially available energy analysis techniques to determine the energy performance of all passive systems and features. Use of hourly energy load computer simulation is required (see paragraph 3.5.5.2 for list of acceptable software). Based on the results of calculations, provide a complete list of the materials and equipment proposed with the manufacturer's published cataloged product installation specifications and roughing-in data.

3.5.2.7. For parts including life safety, include building code analysis and sprinkler and other suppression systems. Notwithstanding the requirements of the Codes, address the following:

(a) A registered fire protection engineer (FPE) must perform all fire protection analyses. Provide the fire protection engineer’s qualifications. See Section 01 10 00, paragraph 5 for qualifications.

(b) Provide all references used in the design including Government design documents and industry standards used to generate the fire protection analysis.

(c) Provide classification of each building in accordance with fire zone, building floor areas and height and number of stories.

(d) Provide discussion and description of required fire protection requirements including extinguishing equipment, detection equipment, alarm equipment and water supply. Alarm and detection equipment shall interface to requirements of Electronic Systems.

(e) Provide hydraulic calculations based on water flow test for each sprinkler system to insure that flow and pressure requirements can be met with current water supply. Include copies of Contractor's water flow testing done to certify the available water source.

3.5.2.8. For parts including plumbing systems:

(a) List all references used in the design.

(b) Provide justification and brief description of the types of plumbing fixtures, piping materials and equipment proposed for use.

(c) Detail calculations for systems such as sizing of domestic hot water heater and piping; natural gas piping; LP gas piping and tanks, fuel oil piping and tanks, etc., as applicable.

(d) When the geotechnical report indicates expansive soils are present, indicate in the first piping design submittal how piping systems will be protected against damage or backfall/backflow due to soil heave (from penetration of slab to the 5 foot building line).

3.5.2.9. For elevator systems:

(a) List all criteria codes, documents and design conditions used.

(b) List any required permits and registrations for construction of items of special mechanical systems and equipment.

3.5.2.10. For parts including electrical work, include lighting calculations to determine maintained foot-candle levels, electrical load analysis and calculations, electrical short circuit and protective device coordination analysis and calculations and arc fault calculations.

3.5.2.11. For parts including telecommunications voice/data (including SIPRNET, where applicable), include analysis for determining the number and placement of outlets

3.5.2.12. For Cathodic Protection Systems, provide the following stamped report by the licensed corrosion engineer or NACE specialist with the first design submission. The designer must be qualified to engage in the practice of corrosion control of buried or submerged metallic surfaces. He/she must be accredited or certified by the National Association of Corrosion Engineers (NACE) as a NACE Accredited Corrosion Specialist or a NACE certified Cathodic Protection Specialist, or must be a registered professional engineer with a minimum of five years experience in corrosion control and cathodic protection, Clearly describe structures, systems or components in soil or water to be protected. Describe methods proposed for protection of each.

3.5.2.13. Air Barrier System: Provide a narrative of the design and installation requirements for the Air Barrier system. As part of the design quality control process an air barrier consultant shall review drawing details to assure that details of critical Air Barrier components are properly detailed and incorporated during the design drawings and process (i.e. window flashing details, penetration in air barrier details, door flashing details, roofing/ceiling barrier interface details and etc.). Furnish the Government written review details and results.

3.5.3. Geotechnical Investigations and Reports:

3.5.3.1. The contractor’s licensed geotechnical engineer shall prepare a final geotechnical evaluation report, to be submitted along with the first foundation design submittal. Make this information available as early as possible during the over-the-shoulder progress review process. Summarize the subsurface conditions and provide recommendations for the design of appropriate utilities, foundations, floor slabs, retaining walls, embankments, and pavements. Include compaction requirements for fill and backfill under

buildings, sidewalks, other structures and open areas. Recommend foundation systems to be used, allowable bearing pressures for footings, lateral load resistance capacities for foundation systems, elevations for footings, grade beams, slabs, etc. Provide an assessment of post-construction settlement potential including total and differential. Provide recommendations regarding lateral earth pressures (active, at-rest, passive) to be used in the design of retaining walls. Include the recommended spectral accelerations and Site Class for seismic design along with an evaluation of any seismic hazards and recommendations for mitigation, if required. Include calculations to support the recommendations for bearing capacity, settlement, and pavement sections. Include supporting documentation for all recommended design parameters such as Site Class, shear strength, earth pressure coefficients, friction factors, subgrade modulus, California Bearing Ratio (CBR), etc. Provide earthwork recommendations, expected frost penetration, expected groundwater levels, recommendations for dewatering and groundwater control and the possible presence of any surface or subsurface features that may affect the construction of the project such as sinkholes, boulders, shallow rock, old fill, old structures, soft areas, or unusual soil conditions. Include pH tests, salinity tests, resistivity measurements, etc., required to design corrosion control and grounding systems. Include the raw field data. Arrange a meeting with the Government subsequent to completion and evaluation of the site specific geotechnical exploration to outline any differences encountered that are inconsistent with the Government provided preliminary soils information. Clearly outline differences which require changes in the foundation type, or pavement and earthwork requirements from that possible and contemplated using the Government furnished preliminary soils investigation, which result in a change to the design or construction. Any equitable adjustment is subject to the provisions of the contract's Differing Site Conditions Clause.

3.5.3.2. Vehicle Pavements: The Contractor's geotechnical report shall contain flexible and rigid pavement designs, as applicable for the project, including design CBR and modulus of subgrade reaction and the required compaction effort for subgrades and pavement layers. Provide Information on the types of base course materials available in the area and design strengths.

3.5.3.3. The Contractor and the professional geotechnical engineer consultant shall certify in writing that the design of the project has been developed consistent with the Contractor's final geotechnical report. The certification shall be stamped by the consulting professional geotechnical engineer and shall be submitted with the first design submission. If revisions are made to the initial design submission, a new certification shall be provided with the final design submission.

3.5.4. LEED Documentation:

Assign a LEED Accredited Professional, responsible to track LEED planning, performance and documentation for each LEED credit through construction closeout. Incorporate LEED credits in the plans, specifications and design analyses. Develop LEED supporting documentation as a separable portion of the Design Analysis and provide with each required design submittal. Include the LEED Project checklist for each non-exempt facility (one checklist may be provided for multiple facilities in accordance with the LEED-NC Application Guide for Multiple Buildings and On-Campus Building Projects and the LEED SUBMITTALS (Attachment E, herein) with each submittal. Final design submittal for each portion of the work must include all required design documentation relating to that portion of work (example - all site credit design documents with final site design). Submittal requirements are as indicated in Attachment E, LEED SUBMITTALS. Submit all documentation indicated on Attachment E as due at final design at final design submittal (for fast-track projects with multiple final design submittals, this shall be at the last scheduled final design submittal). All project documentation related to LEED shall conform to USGBC requirements for both content and format, including audit requirements and be separate from other design analyses. Maintain and update the LEED documentation throughout project progress to construction closeout and shall compile product data, receipts, calculations and other data necessary to substantiate and support all credits claimed. The Government may audit any or all individual credits. Audit documentation is not required to be submitted unless requested. These requirements apply to all projects. If the project requires the Contractor to obtain USGBC certification, the Contractor shall also be responsible for obtaining USGBC certification and shall provide written evidence of certification with the construction closeout LEED documentation submittal. Install the USGBC building plaque at the location

indicated by the Government upon receipt. If Contractor obtains USGBC interim design review, submit the USGBC review to the Government within 30 days of receipt for information only.

3.5.4.1. LEED Documentation for Technology Solution Set. If the Solicitation provides a Prescriptive Technology Solution Set, use of the Technology Solution set has no effect on LEED documentation requirements. Provide all required LEED documentation, including energy analysis, in accordance with LEED requirements when using the Technology Solution Set.

3.5.5. Energy Conservation:

3.5.5.1. Refer to Section 01 10 00, Paragraph 5. Interim and Final Design submittals shall demonstrate that each building including the building envelope, HVAC systems, service water heating, power, and lighting systems meet the Mandatory Provisions and the Prescriptive Path requirements of ASHRAE 90.1. Use Compliance Documentation forms available from ASHRAE and included in the ASHRAE 90.1 User's Manual for this purpose. The Architectural Section of the Design Analysis shall include completed forms titled "Building Envelope Compliance Documentation Parts I and II". The Heating Ventilating and Air Conditioning (HVAC) Section of the Design Analysis shall include a completed form titled "HVAC Simplified Approach Option - Part I" if this approach is allowed by the Standard. Otherwise, the HVAC Section of the Design Analysis shall include completed forms titled "HVAC Mandatory Provisions - Part II" and "HVAC Prescriptive Requirements - Part III". The Plumbing Section of the Design Analysis shall include a completed form titled "Service Water Heating Compliance Documentation". The Electrical Section of the Design Analysis shall include an explanatory statement on how the requirements of ASHRAE 90.1 Chapter 8 Power were met. The Electrical Section of the Design Analysis shall also include a completed form titled "Lighting Compliance Documentation".

3.5.5.2. Interim and Final Design submittals which address energy consuming systems, (heating, cooling, service hot water, lighting, power, etc.) must also include calculations in a separate Energy Conservation Section of the Design Analysis which demonstrate and document (a) the baseline energy consumption for the facility or facilities under contract, that would meet the requirements of ANSI/ASHRAE/IESNA Standard 90.1 and (b) the energy consumption of the facility or facilities under contract utilizing the materials and methods required by this construction contract. Use the USGBC Energy and Atmosphere (EA) Credit 1 compliance template / form or an equivalently detailed form for documenting compliance with the energy reduction requirements. This template / form is titled PERFORMANCE RATING METHOD and is available when the project is registered for LEED. The calculation methodology used for this documentation and analysis shall follow the guidelines set forth in Appendix G of ASHRAE 90.1, with two exceptions: a) receptacle and process loads may be omitted from the calculation; and b) the definition of the terms in the formula for Percentage Improvement found in paragraph G1.2 are modified as follows: Baseline Building Performance shall mean the annual energy consumption calculated for a building design intended for use as a baseline for rating above standard design meeting the minimum requirements of the energy standard, and Proposed Building Performance shall mean annual energy consumption calculated for the proposed building design intended for construction. This calculation shall address all energy consuming systems in a single integrated methodology. Include laboratory fume hoods and kitchen ventilation loads in the energy calculation. They are not considered process loads. Individual calculations for heating, cooling, power, lighting, power, etc. systems will not be acceptable. The following building simulation software is acceptable for use in calculating building energy consumption: Hourly Analysis Program (HAP) by Carrier Corp., TRACE 700 by Trane Corp., DOE-2 by US Department of Energy, EnergyPlus by DOD/DOE.

3.5.6. Specifications

Specifications may be any one of the major, well known master guide specification sources. Uuse only one source. Examples include specifications from MASTERSPEC from the American Institute of Architects, SPECTEXT from Construction Specification Institute or Unified Facility Guide Specifications (UFGS using MASTERFORMAT 2004 numbering system), etc. The UFGS are available through the "Whole Building Design Guide" website, using a websearch engine. Manufacturers' product specifications, utilizing CSI's Manu-Spec, three part format may be used in conjunction with the selected

specifications. The designers of record shall edit and expand the appropriate Specifications to insure that all project design requirements, current code requirements, and regulatory requirements are met. Specifications shall clearly identify, where appropriate, specific products chosen to meet the contract requirements (i.e., manufacturers' brand names and model numbers or similar product information). Note that the UFGS are NOT written for Design-Build and must be edited appropriately. For instance, they assume that the Government will approve most submittals, whereas in Design-Build, the Designer of Record has that action, unless this Solicitation requires Government approval for specific submittals. The Designer of Record should also note that some UFGS sections might either prescribe requirements exceeding the Government's own design standards in applicable references or contain requirements that should be selected where appropriately required by the applicable references. At any rate, where the UFGS are consistent with other major, well known master commercial guide specifications, then generally retain such requirements, as good practices.

3.5.7. Building Rendering

Present and provide a draft color computer, artist, or hand drawn rendering with the conceptual design submittal of the building exterior. Perspective renderings shall include a slightly overhead view of the entire building to encompass elevations and the roof configuration of the building. After Government review and acceptance, provide a final rendering, including the following:

Three (3) 18" x 24" color prints, framed and matted behind glass with project title underneath the print.

One (1) Image file (high resolution) in JPG format on CD for those in the submittal distribution list.

3.5.8. Interim Building Design Contents

The following list represents what the Government considers should be included in the overall completed design for a facility or project. It is not intended to limit the contractor from providing different or additional information as needed to support the design presented, including the require design analyses discussed above. As the Contractor develops individual design packages and submits them for Interim review, include as much of the applicable information for an individual design package as is developed at the Interim design level for review purposes. These pieces shall be developed as the design progresses toward the design complete stage.

3.5.8.1. Lawn and Landscaping Irrigation System

3.5.8.2. Landscape, Planting and Turfing

3.5.8.3. Architectural

(a) Design Narrative

(b) Architectural Floor Plans, Typical Wall and Roof Sections, Elevations

(c) Finish schedule

(d) All required equipment

(e) Special graphics requirements

(f) Door and Window Schedules

(g) Hardware sets using BHMA designations

(h) Composite floor plan showing all pre-wired workstations

(i) Structural Interior Design (SID) package: See ATTACHMENT A for specific requirements

(j) Furniture, Fixtures & Equipment (FF&E) design package: See ATTACHMENT B for specific requirements

(k) Air Barrier Design: Details of all Air Barrier components, (i.e. window flashing details, penetrations in air barrier details, door flashing details, roofing/ceiling barrier interface details and etc.)

3.5.8.4. Structural Systems. Include:

(a) Drawings showing principal members for roof and floor framing plans as applicable

(b) Foundation plan showing main foundation elements where applicable

(c) Typical sections for roof, floor, and foundation conditions

3.5.8.5. Plumbing Systems

(a) Show locations and general arrangement of plumbing fixtures and major equipment

(b) Plan and isometric riser diagrams of all areas including hot water, cold water, waste and vent piping. Include natural gas (and meter as required), (natural gas and meter as required), (LP gas), (fuel oil) and other specialty systems as applicable.

(c) Include equipment and fixture connection schedules with descriptions, capacities, locations, connection sizes and other information as required

3.5.8.6. HVAC Systems

(a) Mechanical Floor Plans: The floor plans shall show all principle architectural features of the building which will affect the mechanical design. The floor plans shall also show the following:

(1) Room designations.

(2) Mechanical legend and applicable notes.

(3) Location and size of all ductwork and piping.

(4) Location and capacity of all terminal units (i.e., registers, diffusers, grilles, hydronic baseboards).

(5) Pre-Fabricated Paint Spray Booth (where applicable to project scope)

(6) Paint Preparation Area (where applicable to project scope)

(7) Exhaust fans and specialized exhaust systems.

(8) Thermostat location.

(9) Location of heating/cooling plant (i.e., boiler, chiller, cooling tower, etc).

(10) Location of all air handling equipment.

(11) Air balancing information.

(12) Flue size and location.

(13) Piping diagram for forced hot water system (if used).

(b) Equipment Schedule: Provide complete equipment schedules. Include:

(1) Capacity

(2) Electrical characteristics

(3) Efficiency (if applicable)

(4) Manufacturer's name

(5) Optional features to be provided

(6) Physical size

(7) Minimum maintenance clearances

(a) Details: Provide construction details, sections, elevations, etc., only where required for clarification of methods and materials of design.

(b) HVAC Controls: Submit complete HVAC controls equipment schedules, sequences of operation, wiring and logic diagrams, Input/Output Tables, equipment schedules, and all associated information. See the Statement of Work for additional specific requirements.

3.5.8.7. Fire Protection and Life Safety.

(a) Provide plan for each floor of each building that presents a compendium of the total fire protection features being incorporated into the design. Include the following types of information:

(1) The location and rating of any fire-resistive construction such as occupancy separations, area separations, exterior walls, shaft enclosures, corridors, stair enclosures, exit passageways, etc.

(2) The location and coverage of any fire detection systems

(3) The location and coverage of any fire suppression systems (sprinkler risers, standpipes, etc.)

(4) The location of any other major fire protection equipment

(5) Indicate any hazardous areas and their classification

(6) Schedule describing the internal systems with the following information: fire hazard and occupancy classifications, building construction type, GPM/square foot sprinkler density, area of operation and other as required

(b) Working plans and all other materials submitted shall meet NFPA 13 requirements, with respect to required minimum level of detail.

3.5.8.8. Elevators. Provide:

(a) Description of the proposed control system

(b) Description, approximate capacity and location of any special mechanical equipment for elevators.

3.5.8.9. Electrical Systems.

(a) Electrical Floor Plan(s): Show all principle architectural features of the building which will affect the electrical design. Show the following:

(1) Room designations.

(2) Electrical legend and applicable notes.

(3) Lighting fixtures, properly identified.

(4) Switches for control of lighting.

(5) Receptacles.

(6) Location and designation of panelboards. Clearly indicate type of mounting required (flush or surface) and reflect accordingly in specifications.

(7) Service entrance (conduit and main disconnect).

(8) Location, designation and rating of motors and/or equipment which requires electrical service. Show method of termination and/or connection to motors and/or equipment. Show necessary junction boxes, disconnects, controllers (approximate only), conduit stubs, and receptacles required to serve the motor and/or equipment.

(b) Building Riser Diagram(s) (from pad-mounted transformer to unit load center panelboard): Indicate the types and sizes of electrical equipment and wiring. Include grounding and metering requirements.

(c) Load Center Panelboard Schedule(s): Indicate the following information:

(1) Panelboard Characteristics (Panel Designation, Voltage, Phase, Wires, Main Breaker Rating and Mounting.

(2) Branch Circuit Designations.

(3) Load Designations.

(4) Circuit Breaker Characteristics. (Number of Poles, Trip Rating, AIC Rating)

(5) Branch Circuit Connected Loads (AMPS).

(6) Special Features

(d) Lighting Fixture Schedule(s): Indicate the following information:

(1) Fixture Designation.

(2) General Fixture Description.

(3) Number and Type of Lamp(s).

(4) Type of Mounting.

(5) Special Features.

(e) Details: Provide construction details, sections, elevations, etc. only where required for clarification of methods and materials of design.

3.5.8.10. Electronic Systems including the following responsibilities:

(a) Fire Detection and Alarm System. Design shall include layout drawings for all devices and a riser diagram showing the control panel, annunciator panel, all zones, radio transmitter and interfaces to other systems (HVAC, sprinkler, etc.)

(b) Fire Suppression System Control. Specify all components of the Fire Suppression (FS) System in the FS section of the specifications. Clearly describe how the system will operate and interact with other systems such as the fire alarm system. Include a riser diagram on the drawings showing principal components and interconnections with other systems. Include FS system components on drawing legend. Designate all components shown on floor plans “FS system components” (as opposed to “Fire Alarm components”). Show location of FS control panels, HVAC control devices, sensors, and 120V power panel connections on floor plans. Indicate zoning of areas by numbers (1, 2, 3) and detectors sub-zoned for cross zoning by letter designations (A and B). Differentiate between ceiling mounted and under floor detectors with distinct symbols and indicate sub-zone of each.

(c) Public Address System

(d) Special Grounding Systems. Completely reflect all design requirements in the specifications and drawings. Specifications shall require field tests (in the construction phase), witnessed by the Government, to determine the effectiveness of the grounding system. Include drawings showing existing construction, if any.

(e) Cathodic Protection.

(f) Intrusion Detection, Card Access System

(g) Central Control and Monitoring System

(h) Mass Notification System

(i) Electrical Power Distribution Systems

3.5.8.11. Separate detailed Telecommunications drawings for Information Systems including the following responsibilities:

(a) Telecommunications Cabling

(b) Supporting Infrastructure

(c) Outside Plant (OSP) Cabling - Campus or Site Plans - Exterior Pathways and Inter-Building Backbones

(d) Include a layout of the voice/data outlets (including voice only wall & pay phones) on telecommunication floor plan drawing, location of SIPRNET data outlets (where applicable), and a legend and symbol definition to indicate height above finished floor. Show size of conduit and cable type and size on Riser Diagram. Do not show conduit runs between backboard and outlets on the floor plans. Show underground distribution conduit and cable with sizing from point of presence to entrance facility of building.

(e) Layout of complete building per floor - Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways including Serving Zones Drawings - Drop Locations and Cable ID's

(f) Communication Equipment Rooms - Plan Views - Tech and AMEP/Elevations - Racks and Walls. Elevations with a detailed look at all telecomm rooms. Indicate technology layout (racks, ladder-racks, etc.), mechanical/electrical layout, rack elevation and backboard elevation. They may also be an enlargement of a congested area of T1 or T2 series drawing.

3.6. FINAL DESIGN REVIEWS AND CONFERENCES

A final design review and review conference will be held upon completion of final design at the project installation, or – where equipment is available - by video teleconference or a combination thereof, for any design package to receive Government acceptance to allow release of the design package for construction. For smaller separate design packages, the parties may agree on alternative reviews and conferences (e.g., conference calls and electronic file sharing, etc.) through the Partnering process. Include the final design conference in the project schedule and shall indicate what part of the design work is at 100% completion. The final design conference will be held after the Government has had seven (7) calendar days after receipt of the submission to review the final design package and supporting data. For smaller packages, especially those involving only one or a few design disciplines the parties may agree on a shorter period.

3.7. FINAL DESIGN REQUIREMENTS

Final design deliverables for a design package shall consist of 100% complete drawings, specifications, submittal register and design analyses for Government review and acceptance. The 100% design submission shall consist of drawings, specifications, updated design analyses and any permits required by the contract for each package submitted. In order to expedite the final design review, prior to the conference, ensure that the design configuration management data and all review comment resolutions are up-to-date. Include the 100% SID and 100% FF&E binders for government approval. The Contractor shall have performed independent technical reviews (ITR's) and back-checks of previous comment resolutions, as required by Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL, including providing documentation thereof. Use DrChecks or other acceptable comment tracking system during the ITR and submit the results with each final design package

3.7.1. Drawings

3.7.1.1. Submit drawings complete with all contract requirements incorporated into the documents to provide a 100% design for each package submitted.

3.7.1.2. Prepare all drawings with the Computer-Aided Design and Drafting (CADD)/Computer-Aided Design (CAD) system, organized and easily referenced electronically, presenting complete construction information.

3.7.1.3. Drawings shall be complete. The Contractor is encouraged to utilize graphics, views, notes, and details which make the drawings easier to review or to construct but is also encouraged to keep such materials to those that are necessary.

3.7.1.4. Provide detail drawings that illustrate conformance with the contract. Include room finish schedules, corresponding color/finish/special items schedules, and exterior finish schedules that agree with the submitted SID binders.

3.7.1.5. The design documents shall be in compliance with the latest version of the A/E/C CAD Standard, available at https://cadbim.usace.army.mil/CAD. Use the approved vertical Corps of Engineers title blocks and borders on all drawings with the appropriate firm name included within the title block area.

3.7.1.6. CAD System and Building Information Modeling (BIM) (NOTE: If this is a Single Award or Multiple Award, Indefinite Delivery/Indefinite Quantity Contract, this information will be provided for each task order.)

All CAD files shall be fully compatible with MicroStation V8 or higher. Save all design CAD files as MicroStation V8 or higher files. All submitted BIM Models and associated Facility Data shall be fully compatible with Bentley BIM file format and the USACE Bentley BIM v8 Workspace.

(a) CAD Data Final File Format: During the design development capture geo-referenced coordinates of all changes made to the existing site (facility footprint, utility line installations and alterations, roads, parking areas, etc) as a result of this contract. There is no mandatory methodology for how the geo-referenced coordinates will be captured, however, Engineering and Construction Bulletin No. 2006-15, Subject: Standardizing Computer Aided Design (CAD) and Geographic Information Systems (GIS) Deliverables for all Military Design and Construction Projects identifies the format for final as-built drawings and data sets to be delivered to the government. Close-out requirements at the as-built stage; require final geo-referenced GIS Database of the new facility along with all exterior modifications. The Government will incorporate this data set into the Installation's GIS Masterplan or Enterprise GIS System. See also, Section 01 78 02.00 10 Closeout Submittals.

(b) Electronic Drawing Files: In addition to the native CAD design files, provide separate electronic drawing files (in editable CAD format and Adobe Acrobat PDF version 7.0 or higher) for each project drawing.

(c) Each file (both CAD and PDF) shall represent one complete drawing from the drawing set, including the date, submittal phase, and border. Each drawing file shall be completely independent of any data in any other file, including fonts and shapes not included with the basic CAD software program utilized. Fonts that are not included as part of the default CAD software package installation or recognized as an allowable font by the A/E/C CAD Standard are not acceptable in delivered CAD files. All displayed graphic elements on all levels of the drawing files shall be part of the project drawing image. The drawing files shall not contain any graphic element that is not part of the drawing image.

(d) Deliver BIM Model and associated Facility Data files in their native format. At a minimum, BIM files shall address major architecture design elements, major structural components, mechanical systems and electrical/communication distribution and elements as defined in Attachment F. See Attachment F for additional BIM requirements.

(e) Drawing Index: Provide an index of drawings sheet in CAD as part of the drawing set, and an electronic list in Microsoft Excel of all drawings on the CD. Include the electronic file name, the sheet reference number, the sheet number, and the sheet title, containing the data for each drawing.

(f) Hard Copies: Plot submitted hard copy drawings directly from the "electronic drawing files" and copy for quantities and sizes indicated in the distribution list at the end of this specification section. The Designers of Record shall stamp, sign and date original hard copy sheets as Released For Construction, and provide copies for distribution from this set.

3.7.2. Design Analyses

3.7.2.1. The designers of record shall update, finalize and present design analyses with calculations necessary to substantiate and support all design documents submitted.

3.7.2.2. The responsible DOR shall stamp, sign and date the design analysis. Identify the software used where, applicable (name, version, vendor). Generally, provide design analyses, individually, in an original (file copy) and one copy for the assigned government reviewer.

3.7.2.3. All disciplines review the LEED design analysis in conjunction with their discipline-specific design analysis; include a copy of the separable LEED design analysis in all design analysis submittals.

3.7.2.4. Do not combine multi-disciplined volumes of design-analysis, unless multiple copies are provided to facilitate multiple reviewers (one copy per each separate design analysis included in a volume).

3.7.3. Specifications

Specifications shall be 100% complete and in final form.

3.7.4. Submittal Register

Prepare and update the Submittal Register and submit it with the 100% design specifications (see Specification Section 01 33 00, SUBMITTAL PROCEDURES) with each design package. Include the required submittals for each specification section in a design package in the submittal register.

3.7.5. Preparation of DD Form 1354 (Transfer of Real Property)

This form itemizes the types, quantities and costs of various equipment and systems that comprise the project, for the purpose of transferring the new construction project from the Corps Construction Division to the Installation's inventory of real property. The Government will furnish the DB Contractor's design manager a DD Form 1354 checklist to use to produce a draft Form 1354. Submit the completed checklist and prepared draft Form DD 1354 with the 100% design in the Design Analysis. The Corps will use these documents to complete the final DD 1354 upon completion of construction.

3.7.6. Acceptance and Release for Construction

3.7.6.1. At the conclusion of the Final Design Review (after resolutions to the comments have been agreed upon between DOR and Government reviewers), the Contracting Officer or the ACO will accept the Final Design Submission for the design package in writing and allow construction to start for that design package. The Government may withhold acceptance until all major corrections have been made or if the final design submission requires so many corrections, even though minor, that it isn't considered acceptably complete.

3.7.6.2. Government review and acceptance of design submittals is for contract conformance only and shall not relieve the Contractor from responsibility to fully adhere to the requirements of the contract, including the Contractor’s accepted contract proposal, or limit the Contractor’s responsibility of design as prescribed under Special Contract Requirement: “Responsibility of the Contractor for Design” or limit the Government’s rights under the terms of the contract. The Government reserves the right to rescind inadvertent acceptance of design submittals containing contract deviations not separately and expressly identified in the submittal for Government consideration and approval.

3.8. DESIGN COMPLETE CONSTRUCTION DOCUMENT REQUIREMENTS

After the Final Design Submission and Review Conference and after Government acceptance of the Final Design submission, revise the design documents for the design package to incorporate the comments generated and resolved in the final review conference, perform and document a back-check review and submit the final, design complete documents. Label the final design complete documents “FOR

CONSTRUCTION" or use similar language. In addition to the final drawings and specifications, the following deliverables are required for distribution and field use. The deliverable includes all documentation and supporting design analysis in final form, as well as the final review comments, disposition and the back-check. As part of the quality assurance process, the Government may perform a back-check of the released for construction documentation. Promptly correct any errors or omissions found during the Government back-check. The Government may withhold retainage from progress payments for work or materials associated with a final design package until this submittal has been received and the Government determines that it is complete.

3.9. SUBMITTAL DISTRIBUTION, MEDIA AND QUANTITIES

3.9.1. Submittal Distribution and Quantities

General: The documents which the Contractor shall submit to the Government for each submittal are listed and generally described in preceding paragraphs in this Section. Provide copies of each design submittal and design substantiation as follows (NOTE: If this is a Single Award or Multiple Award, Indefinite Delivery/Indefinite Quantity Contract, this information will be provided for each task order):

Activity and Address	Drawing Size (Full Size) **Full-22x34** Full Sets/ *Partial Sets	Design Analyses & Specs Full Sets/ *Partial Sets	Drawing Size (Half Size) **Half-11x17** Full Sets/ *Partial Sets	Non-BIM Data CD-ROM or DVD as Necessary (PDF& **.dgn**)	Furniture Submittal (Per Attachment B)	Structural Interior Design Submittal	BIM Data DVD (Per Attach F)
Commander, U.S.Army Engineer District **Louisville District - Ft. Campbell Resident Office**	2/0	2/0	8/9	8	1	3	1
Commander, U.S.Army Engineer District, Center of Standardization **Huntsville**	1/0	2/0	2/0	2	N/A	2	1
Installation	0/0	0/0	3/0	36	2	1	1
U.S.Army Corps of Engineers Construction Area Office	2/0	2/0	2/0	2	1	1	1

Activity and Address	Drawing Size (Full Size) **Full-22x34** Full Sets/ *Partial Sets	Design Analyses & Specs Full Sets/ *Partial Sets	Drawing Size (Half Size) **Half-11x17** Full Sets/ *Partial Sets	Non-BIM Data CD-ROM or DVD as Necessary (PDF& **.dgn**)	Furniture Submittal (Per Attachment B)	Structural Interior Design Submittal	BIM Data DVD (Per Attach F)
Information Systems Engineering Command (ISEC)	0/0	0/1	0/0	1	*Partial Set (Work Station/System Furniture- IT Details)	N/A	1
Huntsville Engineer & Support Center, Central Furnishings Program	N/A	N/A	N/A	N/A	1 Interim/Refer to attachment B for the final submission Qty	N/A	N/A
Other Offices	1/0	0/0	8/0	1	N/A	1	0

***NOTE: For partial sets of drawings, specifications and design analyses, see paragraph 3.9.3.3, below.**

****NOTE: When specified below in 3.9.2, furnish Installation copies of Drawings as paper copies, in lieu of the option to provide secure web-based submittals.**

3.9.2. Web based Design Submittals

Web based design submittals will be acceptable as an alternative to the paper copies listed in the Table above, provided a single hard-copy PDF based record set is provided to the Contracting Officer for record purposes. Where the contract requires the Contractor to submit documents to permitting authorities, still provide those authorities paper copies (or in an alternate format where required by the authority). Web based design submittal information shall be provided with adequate security and availability to allow unlimited access those specifically authorized to Government reviewers while preventing unauthorized access or modification. File sizes must be of manageable size for reviewers to quickly download or open on their computers. As a minimum, drawings shall be full scale on American National Standards Institute (ANSI) D sheets (34" x 22"). In addition to the optional website, provide the BIM data submission on DVD to each activity and address noted above in paragraph 3.9.1 for each BIM submission required in Attachment F.

3.9.3. Mailing of Design Submittals

3.9.3.1. Mail all design submittals to the Government during design and construction, using an overnight mailing service. The Government will furnish the Contractor addresses where each copy shall be mailed to after award of the contract (or individual task order if this is an indefinite delivery/indefinite quantity, task order contract). Mail the submittals to forty four (44) different addresses. Assemble drawing sheets, specs, design analyses, etc. into individual sets; do not combine duplicate pages from individual sets so that the government has to assemble a set.

3.9.3.2. Each design submittal shall have a transmittal letter accompanying it indicating the date, design percentage, type of submittal, list of items submitted, transmittal number and point of contact with telephone number.

3.9.3.3. Provide partial sets of drawings, specifications, design analyses, etc., as designated in the Table in paragraph 3.9.1, to those reviewers who only need to review their applicable portions of the design, such as the various utilities. The details of which office receives what portion of the design documentation will be worked out after award.

3.10. AS-BUILT DOCUMENTS

Provide as-built drawings and specifications in accordance with Section 01 78 02.00 10, CLOSEOUT SUBMITTALS. Update LEED design phase documentation during construction as needed to reflect construction changes and advancing project completion status (example - Commissioning Plan updates during construction phase) and include updated LEED documentation in construction closeout submittal.

ATTACHMENT A
STRUCTURAL INTERIOR DESIGN (SID) REQUIREMENTS

1.0 GENERAL INFORMATION

Structural Interior Design includes all building related elements and components generally part of the building itself, such as wall finishes, ceilings finishes, floor coverings, marker/bulletin boards, blinds, signage and built in casework. Develop the SID in conjunction with the furniture footprint.

2.0 STRUCURAL INTERIOR DESIGN (SID) REQUIREMENTS FOR THE INTERIM AND FINAL DESIGN SUBMITTALS

2.1. FORMAT AND SCHEDULE

Prepare and submit for approval an interior and exterior building finishes scheme for an interim design submittal. The DOR shall meet with and discuss the finish schemes with the appropriate Government officials prior to preparation of the schemes to be presented. Present original sets of the schemes to reviewers at an interim design conference.

At the conclusion of the interim phase, after resolutions to the comments have been agreed upon between DOR and Government reviewers, the Contractor may proceed to final design with the interior finishes scheme presented.

The SID information and samples are to be submitted in 8 ½" x 11" format using three ring binders with pockets on the inside of the cover. When there are numerous pages with thick samples, use more than one binder. Large D-ring binders are preferred to O-ring binders. Use page protectors that are strong enough to keep pages from tearing out. Anchor large or heavy samples with mechanical fasteners, Velcro, or double-faced foam tape rather than rubber cement or glue. Fold out items must have a maximum spread of 25 ½". Provide cover and spine inserts sheets identifying the document as "Structural Interior Design" package. Include the project title and location, project number, Contractor/A/E name and phone number(s), submittal stage and date.

Design submittal requirements include, but are not limited to:

2.1.1. Narrative of the Structural Interior Design Objectives

The SID shall include a narrative that discusses the building related finishes. Include topics that relate to base standards, life safety, sustainable design issues, aesthetics, durability and maintainability, discuss the development and features as they relate to the occupants requirements and the building design.

2.1.2. Interior Color Boards

Identify and key each item item on the color boards to the contract documents to provide a clear indication of how and where each item will be used. Arrange finish samples to the maximum extent possible by room type in order to illustrate room color coordination. Label all samples on the color boards with the manufacturer's name, patterns and colors name and number. Key or code samples to match key code system used on contract drawings.

Material and finish samples shall indicate true pattern, color and texture. Provide photographs or colored photocopies of materials or fabrics to show large overall patterns in conjunction with actual samples to show the actual colors. Finish samples must be large enough to show a complete pattern or design where practical.

Color boards shall include but not be limited to original color samples of the following:

All walls finishes and ceiling finishes, including corner guards, acrylic wainscoting and wall guards/chair rail finishes

All tile information, including tile grout color and tile patterns.

- All flooring finishes, including patterns.
- All door, door frame finishes and door hardware finishes
- All signage, wall base, toilet partitions, locker finishes and operable/folding partitions and trim
- All millwork materials and finishes (cabinets, counter tops, etc.)
- All window frame finishes and window treatments (sills, blinds, etc.)

Color board samples shall reflect all actual finish textures, patterns and colors required as specified. Patterned samples shall be of sufficient size to adequately show pattern and its repeat if a repeat occurs.

2.1.3. Exterior Color Boards

Prepare exterior finishes color boards in similar format as the interior finishes color boards, for presentation to the reviewers during an interim design conference. Provide original color samples of all exterior finishes including but not limited to the following:

- All Roof Finishes
- All Brick and Cast Stone Samples
- All Exterior Insulation and Finish Samples
- All Glass Color Samples
- All Exterior Metals Finishes
- All Window & Door Frame Finishes
- All Specialty Item Finishes, including trim

Identify each item on the exterior finishes color boards and key to the building elevations to provide a clear indication of how and where each item will be used.

2.2. STRUCTURAL INTERIOR DESIGN DOCUMENTS

2.2.1. General

Structural interior design related drawings must indicate the placement of extents of SID material, finishes and colors and must be sufficiently detailed to define all interior work. The following is a list of minimum requirements:

2.2.2. Finish Color Schedule

Provide finish color schedule(s) in the contract documents. Provide a finish code, material type, manufacturer, series, and color designations. Key the finish code to the color board samples and drawings.

2.2.3. Interior Finish Plans

Indicate wall and floor patterns and color placement, material transitions and extents of interior finishes.

2.2.4. Furniture Footprint Plans

Provide furniture footprint plans showing the outline of all freestanding and systems furniture for coordination of all other disciplines.

2.2.5. Interior Signage

Include interior signage plans or schedules showing location and quantities of all interior signage. Key each interior sign to a quantitative list indicating size, quantity of each type and signage text.

2.2.6. Interior Elevations, Sections and Details

Indicate material, color and finish placement.

ATTACHMENT B
FURNITURE, FIXTURES & EQUIPMENT (FF&E) REQUIREMENTS

1.0 FF&E REQUIREMENTS FOR THE INTERIM AND FINAL DESIGN SUBMITTALS

1.1. FORMAT AND SCHEDULE

Prepare and submit for approval a comprehensive FF&E scheme for an interim design submittal. The Contractor's interior designer, NOT A FURNITURE DEALER, shall develop the design. FF&E is the selection, layout, specification and documentation of furniture and includes but is not limited to workstations, seating, tables, storage and shelving, filing, trash receptacles, clocks, framed artwork, artificial plants, and other accessories. Contract documentation is required to facilitate pricing, procurement and installation. The FF&E package is based on the furniture footprint developed in the Structural Interior Design (SID) portion of the interior design. Develop the FF&E package concurrently with the building design to ensure that there is coordination between the electrical outlets, switches, J-boxes, communication outlets and connections, and lighting as appropriate. In addition, coordinate layout with other building features such as architectural elements, thermostats, location of TV's, GF/GI equipment (for example computers, printers, copiers, shredders, faxes), etc. Locate furniture in front of windows only if the top of the item falls below the window and unless otherwise noted, do not attach furniture including furniture systems to the building. If project has SIPRNET and/or NIPRNET, coordinate furniture layout with SIPRNET and NIPRNET separation requirements. Verify that access required by DOIM for SIPRNET box and conduit is provided. The DOR shall interview appropriate Government personnel to determine FF&E requirements for furniture and furnishings prior to preparation of the scheme to be presented. Determine FFE items and quantities by, but not limited to: (1) the number of personnel to occupy the building, (2) job functions and related furniture/office equipment to support the job function, (3) room functions, (4) rank and grade. Present original sets of the scheme to reviewers at an interim design conference upon completion of the interim architectural submittal or three months prior to the submittal of the final FF&E package (whichever comes first).

Design may proceed to final with the FF&E scheme presented at the conclusion of the interim phase, after resolutions to the comments have been agreed upon between DOR and Government reviewers.

Provide six copies of the electronic versions of all documents upon completion of the final architectural submittal or ten months prior to the contract completion date (whichever comes first), to ensure adequate time for furniture acquisition. Provide unbound, electronic drawings in CAD and BIM. Provide all files needed to v,/iew complete drawings. Submit all text documents in Microsoft Word or Excel..

Submit four copies of the final and complete FF&E information and samples in 8 ½" x 11" format using three ring binders with pockets on the inside of the cover upon completion of the final architectural submittal or ten months prior to the contract completion date (whichever comes first). Use more than one binder when there are numerous pages with thick samples. Large D-ring binders are preferred to O-ring binders. Use page protectors that are strong enough to keep pages from tearing out for upholstery and finish boards. Anchor large or heavy samples with mechanical fasteners, Velcro, or double-faced foam tape rather than rubber cement or glue. Fold out items must have a maximum spread of 25 ½". Provide cover and spine inserts sheets identifying the document as "Furniture, Fixtures & Equipment" package and include the project title and location, project number, Contractor/A/E name and phone number(s), submittal stage and date.

Provide electronic copies of all documents upon completion of the final architectural submittal or ten months prior to the contract completion date (whichever comes first), to ensure adequate time for furniture acquisition. Provide six compact disks with all drawings files needed to view the complete drawings unbound and in the latest version AutoCAD. Provide six additional compact disks of all text documents in Microsoft Word or Excel.

Design submittal requirements include, but are not limited to:

1.1.1. Narrative of Interior Design Objectives

Provide a narrative description of the furniture, to include functional, safety and ergonomic considerations, durability, sustainability, aesthetics, and compatibility with the building design.

1.1.2. Furniture Order Form

Prepare one Furnishings Order Form for each item specified in the design. This form identifies all information required to order each individual item. In addition to the project name and location, project number, and submittal phase, the order form must include:

(a) Furniture item illustration and code

(b) Furniture item name

(c) Job name, location, and date

(d) General Services Administration (GSA) FSC Group, part, and section

(e) GSA Contract Number, Special Item Number (SIN), and contract expiration date

(f) Manufacturer, Product name and Product model number or National Stock Number (NSN)

(g) Finish name and number (code to finish samples)

(h) Fabric name and number, minimum Wyzenbeek Abrasion Test double rubs (code to fabric samples)

(i) Dimensions

(j) Item location by room number and room name

(k) Quantity per room

(l) Total quantity

(m) Special instructions for procurement ordering and/or installation (if applicable)

(n) Written Product Description: include a non-proprietary paragraph listing the salient features of the item to include but not limited to:

(1) required features and characteristics

(2) ergonomic requirements

(3) functional requirements

(4) testing requirements

(5) furniture style

(6) construction materials

(7) minimum warranty

The following is an example for “m” features and characteristics, ergonomic requirements and functional requirements:

Chair Description:

(1) Mid-Back Ergonomic Task Chair

(2) Pneumatic Gaslift; Five Star Base

(3) Mesh Back; Upholstered Seat

(4) Height and Width Adjustable Task Arms:

a. Arm Height: 6”- 11” (+-1/2”)

b. Arm Width: 2”– 4” adjustment

(5) Height Adjustable Lumbar Support

(6) Adjustable Seat Height 16”-21” (+- 1”)

(7) Sliding Seat Depth Adjustment 15”-18” (+-1”)

(8) Standard Hard Casters (for carpeted areas)

(9) Overall Measurements:

a. Overall width: 25” - 27”

b. Overall depth: 25”– 28”

(10) Must have a minimum of the following adjustments (In addition to the above):

a. 360 Degree Swivel

b. Knee-Tilt with Tilt Tension

c. Back angle

d. Forward Tilt

e. Forward Tilt and Upright Tilt Lock

For projects with systems furniture, also provide a written description of the following minimum requirements:

(1) Type furniture systems (panel, stacking panels, spine wall, desk based system, or a combination)

(2) Minimum noise reduction coefficient (NRC)

(3) Minimum sound transfer coefficient (STC)

(4) Minimum flame spread and smoke development

(5) UL testing for task lighting and electrical system

(6) Panel widths and heights and their locations (this may be done on the drawings)Worksurface types and sizes (this may be done on the drawings)

(7) Worksurface edge type

(8) Varying panel/cover finish materials and locations (locations may be shown on the drawings)

(9) Storage requirements

(10) Keyboard requirements

(11) Lock and keying requirements

(12) Accessory components (examples: tack boards, marker boards, paper management)

(13) Electrical and communication raceway requirement; type, capacity and location (base, beltline, below and/or above beltline)

(14) Locations of communication cables (base, beltline, below and/or above beltline, top channel)

(15) Types of electrical outlets

(16) Types of communication jacks; provided and installed by others

(17) Locations of electrical outlets and communication jacks (this may be done on the drawings)

(18) Type of cable (examples: Cat. 5, Cat. 6, fiber optic; UTP or STP, etc.) system needs to support; provided and installed by others

1.1.3. Manufacturer & Alternate Manufacturer List

Provide a table consisting of all the major furniture items in the order forms and two alternate manufacturers for each item. ALTERNATE MANUFACTURER ITEMS MUST BE SELECTED FROM GSA SCHEDULE AND MEET ALL THE SALIENT FEATURES OF THE ORIGINALLY SPECIFIED ITEM. Provide manufacturer name, address, telephone number, product series and product name for each item and the two alternate items. Major furniture items include, but are not limited to, casegoods, furniture systems, seating, and tables. Organize matrix by item code and item name.

1.1.4. FF&E Procurement List

Provide a table that lists all FF&E furniture, mission unique equipment and building Contractor Furnished/Contractor Installed (CF/CI) items. Give each item a code and name and designate whether item will be procured as part of the FF&E furniture, mission unique equipment or the building construction contract. Use the item code to key all FF&E documents including location plans, color boards, data sheets, cost estimate, etc. Divide the FF&E package into different sections based on this listing, applies to order forms and cost estimates.

1.1.5. Points of Contact (POCs)

Provide a comprehensive list of POCs needed to implement the FF&E package. This would include but not be limited to appropriate project team members, using activity contacts, interior design representatives, construction contractors and installers involved in the project. In addition to name, address, phone, fax and email, include each contact's job function. Divide the FF&E package into different sections based on this listing, applies to order forms and cost estimates.

1.1.6. Color Boards

Provide color boards for all finishes and fabrics for all FF&E items. Finishes to be included but not limited to paint, laminate, wood finish, fabric, etc.

1.1.7. Itemized Furniture Cost Estimate

Provide an itemized cost estimate of furnishings keyed to the plans and specifications of products included in the package. This cost estimate should be based on GSA price schedules. The cost estimate must include separate line items for general contingency, installation, electrical hook-up for systems furniture or other furniture requiring hardwiring by a licensed electrician, freight charges and any other related costs. Installation and freight quotes from vendors should be used in lieu of a percentage allowance when available. Include a written statement that the pricing is based on GSA schedules. An estimate developed by a furniture dealership may be provided as support information for the estimate, but must be separate from the contractor provided estimate.

1.2. INTERIOR DESIGN DOCUMENTS

1.2.1. Overall Furniture and Area Plans

Provide floor Plans showing locations and quantities of all freestanding, and workstation furniture proposed for each floor of the building. Key each room to a large scale Furniture Placement Plan showing the furniture configuration, of all furniture. Provide enlarged area plans with a key plan identifying the area in which the building is located. Key all the items on the drawings by furniture item code. Do not provide manufacturer specific information such as product names and numbers on

drawings, Drawings shall be non-proprietary. This is typical for FFE on all plans, including those mentioned below.

1.2.2. Workstation Plans

Show each typical workstation configuration in plan view. In addition, provide either elevations or an isometric view. Drawings shall illustrate panels and all major components for each typical workstation configuration. Identify workstations using the same numbering system as shown on the project drawings. Key components to a legend on each sheet which identifies and describes the components along with dimensions. Provide the plan, elevations and isometric of each typical workstation together on the same drawing sheet.

1.2.3. Panel Plans

Show panel locations and critical dimensions from finished face of walls, columns, panels including clearances and aisle widths. Key panel assemblies to a legend which shall include width, height, configuration of frames, panel fabric and finishes (if there are different selections existing within a project), powered or non-powered panel and wall mount locations.

1.2.4. Desk Plans

Provide typical free standing desk configurations in plan view. In addition, provide either elevation or an isometric view and identify components to clearly represent each desk configuration.

1.2.5. Reflected Ceiling Plans

Provide typical plans showing ceiling finishes and heights, lighting fixtures, heating ventilation and air conditioning supply and return, and sprinkler head placement for coordination of furniture.

1.2.6. Electrical and Telecommunication Plans

Show power provisions including type and locations of feeder components, activated outlets and other electrical componentsShow locations and quantities of outlets for workstations. Clearly identify different outlets, i.e. electrical, LAN and telecommunication receptacles indicating each type proposed. Show wiring configuration, (circuiting, switching, internal and external connections) and provide as applicable.

1.2.7. Artwork Placement Plans

Provide an Artwork Placement Plan to show location of artwork, assign an artwork item code to each piece of artwork. As an alternative, artwork can be located on the Furniture Plans. Provide a schedule that identifies each piece by room name and number. Provide installation instructions; include mounting height.

1.2.8. Window Drapery Plans

Provide Interior Window Drapery Plans. Key each drapery treatment to a schedule showing color, pattern, material, drapery size and type, draw direction, location and quantities.

1.3. FURNITURE SELECTION

1.3.1. Select furniture from the GSA Schedules. Specify furniture available open market when an item is not available on the GSA Schedules. Provide justification fort items not available on the GSA Schedules.

1.3.2. To the greatest extent possible when specifying furniture work within a manufacturer's family of furniture for selections, example: Steelcase, Turnstone, Brayton International, Metro, and Vecta are all Steelcase companies. Each alternate should also be specified from a manufacturer's family of furniture, example: first set of alternates would be specified from Knoll's family of furniture and the second from Herman Miller family of furniture. It may be necessary to make some selections from other than a manufacturer's family of furniture if costs are not reasonable for particular items, some items are not available or appropriate for the facility or the items are not on GSA Schedule. If this occurs, consider specifying product from an open line that is accessible by numerous dealerships. Select office furniture including case goods, tables, storage, seating, etc. that is compatible in style, finish and color. Select furniture that complies with ANSI/BIFMA and from manufacturer's standard product line as shown in the most recent published price list and/or amendment and not custom product.

1.4. CONSTRUCTION

1.4.1. Provide knee space at workstations and tables that is not obstructed by panels/legs that interfere with knee space of seated person and specificy modesty panels at walls to be of a height or be hinged to allow access to building wall electrical outlets and communication jacks. Provide desks, storage and tables with leveling devices to compensate for uneven floors.

1.4.2. Unless otherwise noted, specify workstations and storage of steel construction. Provide high pressure laminate worksurface tops constructed to prevent warpage (thermallyfused worksurfaces are not acceptable). Provide user friendly features such as radius edges. Do not use sharp edges and exposed connections and ensure the underside of desks, tables and worksurfaces are completely and smoothly finished. Provide abutting worksurfaces that mate closely and are of equal heights when used in side-by-side configurations in order to provide a continuous and level worksurface.

1.4.3. Drawers shall stay securely closed when in the closed position and protect wires from damage during drawer operation. Include a safety catch to prevent accidental removal when fully open

1.4.4. Unless otherwise noted, provide lockable desks and workstations, filing cabinets and storage. Key all locks within a one person office the same; key all one person offices within a building differently. If an office or open office area has more than one workstation, key all the workstations differently, but key all locks within an individual workstation the same. Use tempered glass glazing when glazing is required. Use light-emitting diode (LED)/solid state lighting where task lighting is required in furniture.

1.5. FINISHES AND UPHOLSTERY

1.5.1. Specify neutral colors for casegoods, furniture systems, storage and tables. Specify desk worksurfaces and table tops that are not too light or too dark in color and have a pattern to help hide soiling. Accent colors are allowed in break and lounge areas. Keep placement of furniture systems panel fabric accent colors to a minimum. All finishes shall be cleanable with ordinary household cleaning solutions.

1.5.2. Use manufacturer's standard fabrics; including textile manufacturers fabrics that have been graded into the furniture manufactures fabric grades and are available through their GSA Schedule. Customers Own Material (COM) can be used in headquarter buildings in command suites with executive furniture. Coordinate specific locations with Corps of Engineers Interior Designer.

1.5.3. Specify seating upholstery that meets Wyzenbeek Abrasion Test, 55,000 minimum rubs. Specify a soil retardant finish for woven fabrics if Crypton or vinyl upholstery is not provided for seating in dining areas. Use manufacturer's standard fabrics. This includes textile manufacturers fabrics that have been graded into the furniture manufactures fabric grades and are available through their GSA Schedule. Specify upholstery and finish colors and patterns that help hide soiling. Specify finishes that can be cleaned with ordinary household cleaning solutions.

1.6. ACCESSORIES

1.6.1. Specify all accessories required for completely finished furniture installation. Provide filing cabinets and storage for office supplies. Provide tack surfaces at workstations with overhead storage. Provide tackable surfaces at workstations with overhead storage.

1.6.2. Not Used.

1.6.3. Workstations are to be equipped with stable keyboard trays that have height adjustability, tilting capability, including negative tilt, have a mouse pad at same height as the keyboard tray that can accommodate both left and right handed users, and retractable under worksurface.

1.7. MISSION UNIQUE EQUIPMENT

Funding for FF&E furniture items and mission unique equipment (MUE) items are from two different sources. Separate the designs and procurement documentation for FFE items and MUE. MUE includes, but is not limited to, items such as commerical appliances, fitness equipment, IT equipment and supporting carts. The User will purchase and install mission unique equipment items, unless otherwise noted. Identify locations of known MUE items such as commercial appliances, etc. for space planning purposes.

1.8. SUSTAINABILITY

1.8.1. For all designs provided regardless of facility type, make every effort to implement all aspects of sustainability to the greatest extent possible for all the selections made in the FF&E package. This includes but is not limited to the selection of products that consider: **Material Chemistry and Safety of Inputs** (What chemicals are used in the construction of the selections?); **Recyclability** (Do the selections contain recycled content?); **Disassembly** (Can the selections be disassembled at the end of their useful life to recycle their materials?).

1.8.2. Make selections to the greatest extent possible of products that possess current McDonough Braungart Design Chemistry (MBDC) certification or other “third-party” certified Cradle to Cradle program, Forest Stewardship Council (FSC) certification, GREENGAURD certification or similar “third-party” certified products consisting of low-emitting materials.

1.9. FURNITURE SYSTEMS

1.9.1. General.

Where appropriate, design furniture systems in open office areas. Coordinate style and color of furniture systems with other storage, seating, etc. in open office areas. Minimize the number of workstation typicals and the parts and pieces required for the design to assist in future reconfiguration and inventorying.

1.9.2. Connector Systems.

Specify a connector system that allows removal of a single panel or spine wall within a typical workstation configuration without requiring disassembly of the workstation or removal of adjacent panels. Specify connector system with tight connections and continuous visual seals. When Acoustical panels are used, provide connector system with continuous acoustical seals. Specify concealed clips, screws, and other construction elements, where possible.

1.9.3. Panels and Spine Walls

Specify panels and spine walls with hinged or removable covers that permit easy access to the raceway when required but are securely mounted and cannot be accidentally dislodged under normal conditions. Panels shall be capable of structurally supporting more than 1 fully loaded component per panel per side. Raceways are to be an integral part of the panel and must be able to support lay-in cabling and have a large capacity for electrical and IT. Do not thread cables through the frame.

1.9.4. Electrical And Information/Technology (IT)

Design furniture with electrical systems that meets requirements of UL 1286 when powered panels are required and UL approved task lights that meet requirements of NFPA 70. Dependent on user requirements and Section 01 10 00, paragraph 3 requirements, it is recommended that workstation electrical and IT wiring entry come from the building walls to eliminate the use of power poles and access at the floor. Design electrical and IT systems that are easily accessed in the spine wall and panels without having to move return panels and components. Electrical and IT management will be easily accessible by removable wall covers which can be removed while workstation components are still attached. Specify connector system that has continuation of electrical and IT wiring within workstations and workstation to workstation.

1.9.5. Pedestals

Specify pedestals that are interchangeable from left to right, and right to left, and retain pedestal locking system capability.

1.10. EXECUTIVE FURNITURE

1.10.1. Design for executive furniture in command areas, coordinate specific locations with Corps of Engineers Interior Designer. Use upgraded furniture, upholsteries and finishes in command suites. This includes but is not limited to wood casegoods, seating and tables. Select executive furniture casegoods from a single manufacturer and style line, to include workstations, credenzas, filing, and storage, etc.

1.10.2. Specify furniture with wood veneer finish with mitered solid wood edge of same wood type. Other executive office furniture such as seating, tables, executive conference room furniture, etc. shall be compatible in style, finish and color with executive furniture casegoods.

1.11. SEATING

1.11.1. General

Specify appropriate chair casters and glides for the floor finish where the seating is located. All task seating shall support up to a minimum of 250 lbs.

1.11.2. Desk and Guest Seating

Select ergonomic desk chairs with casters, waterfall front, swivel, tilt, variable back lock, adjustable back height or adjustable lumbar support, pneumatic seat height adjustment, and padded, contoured upholstered seat and back. Desk and guest chair backs may be other than upholstered such as mesh fabric if it is ergonomically designed, forms to back and is comfortable. Depending on scale of desk chair provide seat pan forward and back adjustment to increase or decrease depth of seat pan. All desk chairs shall have an adjustable seat height range of 4 1/2", range to include 16 1/2-20". Select guest chairs that are compatible in style, finish and color with the desk chairs.

1.11.3. Conference Room Seating

At tables, select ergonomic conference seating with casters, non-upholstered arms, waterfall front, swivel, tilt, pneumatic seat height adjustment, and padded, contoured seat and back, unless otherwise noted.

Select arm height and/or design that allows seating to be moved up closely to the table top. Conference chair backs may be other than upholstered such as mesh fabric if it is ergonomically designed, forms to back and is comfortable. Perimeter conference chairs shall be compatible in style, finish and color with conference seating at the tables.

1.11.4. Lounge, Waiting and Reception Area Seating

Select seating with arms and cushioned, upholstered seat and back. In heavy use areas, arms shall be easily cleaned such as non-upholstered arms or upholstered arms with wood arm caps unless otherwise noted.

1.11.5. Break Room Seating

Select stackable seating that is easily cleaned. Seating shall be appropriate for table and counter heights as applicable with non-upholstered arms if arms are required. Chairs shall have metal legs and composite materials for seats.

1.12. FILING AND STORAGE.

Select storage and shelving units that meet customer’s functional load requirements for stored items. Specify counterweights for filing cabinets when required by the manufacturer for stability. File drawers shall allow only one drawer to be opened at a time. Provide heavy duty storage and shelving if information is not available.

1.13. TRAINING TABLES.

raining tables shall be reconfigurable, moveable and storable; lighter weight folding with dollies or castered as necessary. Plastic laminate self edges are unacceptable. Specify power and data requirements and dollies as required.

1.14. FURNITURE WARRANTIES.

Specify manufacturer's performance guarantees or warranties that include parts, labor and transportation as follows:

Furniture System, unless otherwise noted – 10 year minimum
Furniture System Task Lights – 2 year minimum, excluding bulbs
Furniture System Fabric – 3 year minimum
Wood Desks - 10 year minimum

Metal Desks – 12 year minimum
Seating, unless otherwise noted - 10 year minimum
Seating Mechanisms and Pneumatic Cylinders - 10 years
Seating Fabric - 3 years minimum
Wood Filing and Storage - 10 year minimum

Tables, unless otherwise noted - 10 year minimum
Table Mechanisms – 5 year minimum
Table Ganging Device - 1 year minimum
Items not listed above - 1 year minimum

ATTACHMENT C
TRACKING COMMENTS IN DRCHECKS

1.0 General

The Government and DB Contractor shall set up the project in Dr Checks. Throughout the design process, the parties shall enter, track, and back-check comments using the DrChecks system. Government and Contractor reviewers enter design review comments into DrChecks. Designers of Record shall annotate comments timely and specifically to indicate for the review conference exactly what action will be taken or why the action is not required. After the design review conference and prior to the next design submittal for the package, the DOR's will annotate those comments that require DOR action, design revision, etc. to show how and where it has been addressed in the design documents, This shall be part of the required design configuration management plan. Comments considered critical by the conference participants shall be flagged as such.

2.0 DrChecks Review Comments

The Contractor and the Government shall monitor DrChecks to assure all comments are annotated and resolved prior to the next submittal. Print and include the DrChecks comments and responses and included in the design analysis for record in the next design submittal for that package.

2.1. Upon review of comments prior to the design review conference, the DOR(s) shall identify whether they concur, non-concur, mark it "for information only" or mark it "check and resolve". Indicate exactly what action will be taken or why the action is not required.

2.2. Conference participants (reviewers) will expect coordination between Design Analysis calculations and the submitted design. Reviewers will also focus on the design submittal's satisfaction of the contract requirements.

2.3. After the conference, the DOR(s) shall formally respond to each applicable comment in DrChecks a second time prior to the next submittal, clearly indicating what action was taken and what drawing/spec/design analysis changed. Designers of Record are encouraged to directly contact reviewers to discuss and agree to the formal comment responses rather than relying only on DrChecks and review meetings to discuss comments. With the next submittal, reviewers will back-check answers to the comments against the new submittal, in addition to reviewing additional design work.

2.4. Clearly annotate in DrChecks those comments that, in the DB Contractor's opinion, require effort outside the scope of the contract. Do not proceed with work outside the contract until a modification to the contract is properly executed, if one is necessary.

3.0 DrChecks Initial Account Set-Up

To initialize an office's use of DrChecks, choose a contact person within the office to call the DrChecks Help Desk at 800-428-HELP, M-F, 8AM-5PM, Central time. This POC will be given an office password to distribute to others in the office. Individuals can then go to the hyperlink at http://www.projnet.org and register as a first time user. Upon registration, each user will be given a personal password to the DrChecks system.

3.1. Once the office and individuals are registered, the COE's project manager or lead reviewer will assign the individuals and/or offices to the specific project for review. At this point, persons assigned can make comments, annotate comments, and close comments, depending on their particular assignment.

4.0 DrChecks Reviewer Role

The Contractor is the technical reviewer and the Government is the compliance reviewer of the DB's design documents. Each reviewer enters their own comments into the Dr Checks system. To enter comments:

4.1. Log into DrChecks.

4.2. Click on the appropriate project.

4.3. Click on the appropriate review conference. An Add comment screen will appear.

4.4. Select or fill out the appropriate sections (particularly comment discipline and type of document for sorting) of the comment form and enter the comment in the space provided.

4.5. Click the Add Comment button. The comment will be added to the database and a fresh screen will appear for the next comment you have.

4.6. Once comments are all entered, exit DrChecks by choosing "My Account" and then Logout.

5.0 DrChecks Comment Evaluation (Step 1 of 2)

The role of the DOR(s) is to evaluate and respond to the comments entered by the Government's and DB Contractor's reviewers. To respond to comments:

5.1. Log into DrChecks.

5.2. Click on the appropriate project.

5.3. Under "Evaluate" click on the number under "Pending".

5.4. Locate the comments that require your evaluation. (Note: If you know the comment number you can use the Quick Pick window on your home page in DrChecks; enter the number and click on go.)

5.5. Select the appropriate evaluation radio button (concur, non-concur, for information only, or check and resolve) and respond with a brief explanation in the Discussion field. An explanation other than to say "concur" is not necessary for "Concur", but may be useful for the Design Configuration Management purposes.

5.6. Click on the Add button. The evaluation will be added to the database and a fresh screen will appear with the next comment.

5.7. Once evaluations are all entered, exit DrChecks by choosing "My Account" and then Logout.

6.0 DrChecks Comment Evaluation (Step 2 of 2)

This is where the DOR(s) respond to each applicable comment in DrChecks after the design review conference, prior to the next submittal, clearly indicating what action was taken and what drawing/spec/design analysis changed. Respond to the previous comments, following the same steps as above, adding the narrative in the discussion field.

7.0 DrChecks Back-Check

At the following design conference, (where applicable) or at some other agreed time, Government and Contractor reviewers will back-check comment annotations against newly presented documents to verify that the designers' responses are acceptable and that all revisions have been completed. Reviewers

shall either enter additional back-check comments, if necessary, or close those where actions are complete.

7.1. Log into DrChecks.

7.2. Click on the appropriate project.

7.3. Under “My Backcheck” click on the number under “Pending”.

7.4. If you agree with the designer’s response select “Close Comment” and add a closing response if desired.

7.5. If you do not agree with the designer’s response or the submittal does not reflect the response given, select “Issue Open”, enter additional information.

7.6. Click on the Add button. The back-check will be added to the database and a fresh screen will appear with the next comment.

7.7. Once back-checks are all entered, exit DrChecks by choosing “My Account” and then Logout. The design is completed and final when there are no pending comments to be evaluated and there are no pending or open comments under back-check.

ATTACHMENT D
SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW

Instructions: Use the information outlined in this document to provide the minimum requirement for development of Fire Protection and Life Safety Code submittals for all building projects. Additional and supplemental information may be used to further develop the code review. Insert N/A after criteria, which may be “not applicable”.

1.0 SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW

1.1. Project Name (insert name and location)

1.2. Applicable Codes and Standards

1.2.1. Unified Facilities Criteria (UFC): 3-600-01, Design: Fire Protection Engineering For Facilities

1.2.2. International Building Code (IBC) for fire resistance requirements, allowable floor area, building height limitations and building separation distance requirements, except as modified by UFC 3-600-01.

1.2.3. National Fire Protection Association (NFPA) 101 Life Safety Code (latest edition), for building egress and life safety and applicable criteria in UFC 3-600-01.

1.2.4. ADA and ABA Accessibllity Guidelines. For Buildings and Facilities See Section 01 10 00, Paragraph 3 for facility specific criteria.

1.3. Occupancy Classification
IBC chapters 3 and 4

1.4. Construction Type
IBC chapter 6

1.5. Area Limitations
IBC chapter 5, table 503

1.6. Allowable Floor Areas
IBC section 503, 505

1.7. Allowable area increases
IBC section 506, 507

1.8. Maximum Height of Buildings
IBC section 504

1.9. Fire-resistive substitution

1.10. Occupancy Separations
IBC table 302.3.2

1.11. Fire Resistive Requirements

1.11.1. Exterior Walls - [_____] hour rating, IBC table 601, 602

1.11.2. Interior Bearing walls - [_____] hour rating

1.11.3. Structural frame - [_____] hour rating

1.11.4. Permanent partitions - [_____] hour rating

1.11.5. Shaft enclosures - [_____] hour rating

1.11.6. Floors & Floor-Ceilings - [_____] hour rating

1.11.7. Roofs and Roof Ceilings - [_____] hour rating

1.12. Automatic Sprinklers and others used to determine the need for automatic Extinguishing Equipment, Extinguishing Systems, Foam Systems, Standpipe

1.12.1. UFC 3-600-01, chapters 4 and 6 systems, wet chemical systems, etc. State which systems are required and to what criteria they will be designed.

1.12.2. UFC 3-600-01, Appendix B Occupancy Classification. Note the classification for each room. This may be accomplished by classifying the entire building and noting exceptions for rooms that differ (E.g. The entire building is Light Hazard except boiler room and storage rooms which are [_____], etc.)

1.12.3. UFC 3-600-01, Chapter 3 Sprinkler Design Density, Sprinkler Design Area, Water Demand for Hose Streams (supply pressure and source requirements).

1.12.4. UFC 3-600-01, Chapter 4 Coverage per sprinkler head. Extended coverage sprinkler heads are not permitted.

1.12.5. Available Water Supply. Provide the results of the water flow tests showing the available water supply static pressure and residual pressure at flow. Based on this data and the estimated flow and pressure required for the sprinkler system, determine the need for a fire pump.

1.12.6. NFPA 13, Para. 8.16.4.6.1. Provide backflow preventer valves as required by the local municipality, authority, or water purveyor. Provide a test valve located downstream of the backflow preventer for flow testing the backflow preventer at full system demand flow. Route the discharge to an appropriate location outside the building.

1.13. Kitchen Cooking Exhaust Equipment

Describe when kitchen cooking exhaust equipment is provided for the project. Type of extinguishing systems for the equipment should be provided. per NFPA 96. Show all interlocks with manual release switches, fuel shutoff valves, electrical shunt trips, exhaust fans, and building alarms.

1.14. Portable Fire Extinguishers, fire classification and travel distance. per NFPA 10

1.15. Enclosure Protection and Penetration Requirements. - Opening Protectives and Through Penetrations

1.15.1. IBC Section712, 715 and Table 715.3. Mechanical rooms, exit stairways, storage rooms, janitor [_____] hour rating. IBC Table 302.1.1

1.15.2. Fire Blocks, Draft Stops, Through Penetrations and Opening Protectives

1.16. Fire Dampers. Describe where fire dampers and smoke dampers are to be used (IBC Section 716 and NFPA 90A}. State whether isolation smoke dampers are required at the air handler.

1.17. Detection Alarm and Communication. UFC 3-600-01, (Chapter 5); NFPA 101 para. 3.4 (chapters 12-42); NFPA 72

1.18. Mass Notification. Describe building/facility mass notification system (UFC 4-021-01) type and type of base-wide mass notification/communication system. State whether the visible notification appliances will be combined with the fire alarm system or kept separate. (Note: Navy has taken position to combine visible notification appliances with fire alarm).

1.19. Interior Finishes (classification). NFPA 101.10.2.3 and NFPA 101.7.1.4

1.20. Means of Egress

1.20.1. Separation of Means of Egress, NFPA 101 chapters 7 and 12-42; NFPA101.7.1.3

1.20.2. Occupant Load, NFPA101.7.3.1 and chapters 12-42.

1.20.3. Egress Capacity (stairs, corridors, ramps and doors) NFPA101.7.3.3

1.20.4. Number of Means of Egress, NFPA101.7.4 and chapters 12-42.

1.20.5. Dead end limits and Common Path of Travel, NFPA 101.7.5.1.6 and chapters 12-42.

1.20.6. Accessible Means of Egress (for accessible buildings), NFPA101.7.5.4

1.20.7. Measurement of Travel Distance to Exits, NFPA101.7.6 and chapters 12-42.

1.20.8. Discharge from Exits, NFPA101.7.7.2

1.20.9. Illumination of Means of Egress, NFPA101.7.8

1.20.10. Emergency Lighting, NFPA101.7.9

1.20.11. Marking of Means of Egress, NFPA101.7.10

1.21. Elevators, UFC 3-600-01, Chapter 6; IBC and ASME A17.1 - 2000,(Safety Code for Elevators and Escalators)

1.22. Accessibility Requirements, ADA and ABA Accessibility Guidelines for Buildings and Facilities

1.23. Certification of Fire Protection and Life Safety Code Requirements. (Note: Edit the Fire team membership if necessary). Preparers of this document certify the accuracy and completeness of the Fire Protection and Life Safety features for this project in accordance with the attached completed form(s).

1.24. Designer of Record. Certification of Fire protection and Life Safety Code Requirements. (Note: Edit the Fire team members if necessary). Preparers of this document certify the accuracy and completeness of the Fire Protection and Life Safety features of this project.

Fire Protection Engineer of Record:

_____

Signature and Stamp

Date

OR

Architect of Record:

_____

Signature and Stamp

Date

Mechanical Engineer of Record:

_____

Signature and Stamp

Date

Electrical Engineer of Record:

_____

Signature/Date

ATTACHMENT E
LEED SUBMITTALS

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	**LEED-NC v3 Submittals (OCT09)**		Provide for Credit Audit Only		Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		**FEATURE**	**DUE AT**		**REQUIRED DOCUMENTATION**	**DATE**	**REV**
GENERAL							
	GENERAL - All calculations shall be in accordance with LEED 2009 Reference Guide.						
	GENERAL: Obtain excel version of this spreadsheet at http://en.sas.usace.army.mil/enWeb, "Engineering Criteria".						
	GENERAL - For all credits, narrative/comments may be added to describe special circumstances or considerations regarding the project's credit approach.						
	GENERAL - Include all required LEED drawings indicated below in contract drawings with applicable discipline drawings, labeled For Reference Only.						
	NOTE: Each submittal indicated with "**" differs from LEED certified project submittals by either having a different due date or being an added submittal not required by GBCI.						
	NOTE: Projects seeking LEED certification need only submit to GBCI whatever documentation is acceptable to GBCI (for example, licensed professional certifications). This checklist identifies what must be submitted to the Government for internal review purposes. Government review of LEED documentation in no way supercedes or modifies the requirements and rulings of of GBCI for purposes of compliance with project requirement to obtain LEED certifiaction.						
	GENERAL - Audit documentation may include but is not limited to what is indicated in this table.						
			Closeout		List of all Final Design submittals revised after final design to reflect actual closeout conditions. Revised Final Design submittals. - OR - Statement confirming that no changes have been made since final design that effect final design submittal documents.		Proj Engr (PE)
CATEGORY 1 - SUSTAINABLE SITES							
SSPR1		Construction Activity Pollution Prevention (PREREQUISITE)	**Final Design		List of drawings and specifications that address the erosion control, particulate/dust control and sedimentation control measures to be implemented.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			**Final Design		Narrative that indicates which compliance path was used (NPDES or Local standards) and describes the measures to be implemented on the project. If a local standard was followed, provide specific information to demonstrate that the local standard is equal to or more stringent than the NPDES program.		CIV
SS1		Site Selection	Final Design		Statement confirming that project does not meet any of the prohibited criteria.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design	X	LEED Site plan drawing that shows all proposed development, line depicting boundary of all bodies of water and/or wetlands within 100 feet of project boundary and a line depicting 5' elevation above 100 year flood line that falls within project boundary. Not required if neither condition applies.		CIV
SS2		Development Density & Community Connectivity	Final Design		Option 1: LEED Site vicinity plan showing project site and surrounding development. Show density boundary or note drawing scale.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design		Option 1: Table indicating, for project site and all surrounding sites within density radius (keyed to site vicinity plan), site area and building area. Project development density calculation. Density radius calculation. Development density calculation within density radius.		CIV
			Final Design		Option 2: LEED Site vicinity plan showing project site, the 1/2 mile community radius, pedestrian walkways and the locations of the residential development(s) and Basic Services surrounding the project site.		CIV
			Final Design		Option 2: List (including business name and type) of all Basic Services facilities within the 1/2 mile radius, keyed to site vicinity plan.		CIV
SS3		Brownfield Redevelopment	Final Design		Narrative describing contamination and the remediation activities included in project. Include statement indicating how site was determined to be a brownfield.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
SS4.1		Alternative Transportation: Public Transportation Access	Final Design		Statement indicating which option for compliance applies. State whether public transportation is existing or proposed and, if proposed, cite source of this information.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design		Option 1: LEED Site vicinity plan showing project site, mass transit stops and pedestrian path to them with path distance noted.		CIV
			Final Design		Option 2: LEED Site vicinity plan showing project site, bus stops and pedestrian path to them with path distance noted.		CIV
SS4.2		Alternative Transportation: Bicycle Storage & Changing Rooms	Final Design		FTE calculation. Bicycle storage spaces calculation. Shower/changing facilities calculation.		CIV
			Final Design		List of drawings that show the location(s) of bicycle storage areas. Statement indicating distance from building entrance.		CIV
			Final Design		List of drawings that show the location(s) of shower/changing facilities and, if located outside the buiding, statement indicating distance from building entrance.		ARC

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	**LEED-NC v3 Submittals (OCT09)**		Provide for Credit Audit Only		Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		**FEATURE**	**DUE AT**		**REQUIRED DOCUMENTATION**	**DATE**	**REV**
SS4.3		Alternative Transportation: Low Emitting & Fuel Efficient Vehicles	Final Design		Statement indicating which option for compliance applies. FTE calculation. Statement indicating total parking capacity of site.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design		Option 1: Low-emission & fuel-efficient vehicle calculation.		CIV
			Final Design		Option 1: List of drawings and specification references that show location and number of preferred parking spaces for low-emission & fuel-efficient vehicles and signage.		CIV
			Final Design		Option 1: Statement indicating quantity, make, model and manufacturer of low-emission & fuel-efficient vehicles to be provided. Statement confirming vehicles are zero-emission or indicating ACEEE vehicle scores.		CIV
			Final Design		Option 2: Low-emission & fuel-efficient vehicle parking calculation.		CIV
			Final Design		Option 2: List of drawings and specification references that show location and number of preferred parking spaces and signage.		CIV
			Final Design		Option 3: Low-emission & fuel-efficient vehicle refueling station calculation.		CIV
			Final Design		Option 3: List of drawings and specifications indicating location and number of refueling stations, fuel type and fueling capacity for each station for an 8-hour period.		CIV
			Closeout	X	Option 3: Construction product submittals indicating what was provided and confirming compliance with respect to fuel type and fueling capacity for each station for an 8-hour period.		CIV
SS4.4		Alternative Transportation: Parking Capacity	Final Design		Statement indicating which option for compliance applies.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design		Option 1: Preferred parking calculation including number of spaces required, total provided, preferred spaces provided and percentage.		CIV
			Final Design		Option 2: FTE calculation. Preferred parking calculation including number of spaces provided, preferred spaces provided and percentage.		CIV
			Final Design		Options 1 and 2: List of drawings and specification references that show location and number of preferred parking spaces and signage.		CIV
			Final Design		Option 3: Narrative indicating number of spaces required and provided and describing infrastructure and support programs with description of project features to support them.		CIV
SS5.1		Site Development: Protect or Restore Habitat	**Final Design		Option 1: List of drawing and specification references that convey site disturbance limits.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			**Final Design		Option 2: LEED site plan drawing that delineates boundaries of each preserved and restored habitat area with area (sf) noted for each.		CIV
			**Final Design		Option 2: Percentage calculation of restored/preserved habitat to total site area. List of drawings and specification references that convey restoration planting requirements.		CIV
SS5.2		Site Development: Maximize Open Space	Final Design		Option 2: LEED site plan drawing delineating boundary of vegetated open space adjacent to building with areas of building footprint and designated open space noted.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
SS6.1		Stormwater Design: Quantity Control	Final Design		Statement indicating which option for compliance applies.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design		Option 1: Indicate pre-development and post-development runoff rate(cfs) and runoff quantity (cf) -OR - Narrative describing site conditions, measures and controls to be implemented to prevent excessive stream velocities and erosion.		CIV
			Final Design		Option 2: Indicate pre-development and post-development runoff rate(cfs) and runoff quantity (cf). Indicate percent reduction in each.		CIV
SS6.2		Stormwater Design: Quality Control	Final Design		For non-structural controls, list all BMPs used and, for each, describe the function of the BMP and indicate the percent annual rainfall treated. List all structural controls and, for each, describe the pollutant removal and indicate the percent annual rainfall treated.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
SS7.1		Heat Island Effect: Non-Roof	**Final Design		LEED site plan drawing indicating locations and quantities of each paving type, including areas of shaded pavement. Percentage calculation indicating percentage of reflective/shaded/open grid area.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV

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SS7.2		Heat Island Effect: Roof	Final Design		Option 1: Percentage calculation indicating percentage of SRI compliant roof area. List of drawings and specification references that convey SRI requirements and roof slopes.		ARC
			Final Design		Option 1: List of specified roof materials indicating, for each, type, manufacturer, product name and identification if known, SRI value and roof slope.		ARC
			**Closeout		Option 1: List of installed roof materials indicating, for each, manufacturer, product name and identification, SRI value and roof slope.		PE
			Closeout	X	Option 1: Manufacturer published product data or certification confirming SRI		PE
			Final Design		Option 2: Percentage calculation indicating percentage of vegetated roof area.		ARC
			Final Design		Option 3: Combined reflective and green roof calculation.		ARC
			Final Design		Option 3: List of specified roof materials indicating, for each, type, manufacturer, product name and identification if known, SRI value and roof slope.		ARC
			**Closeout		Option 3: List of installed roof materials indicating, for each, manufacturer, product name and identification, SRI value and roof slope.		PE
			Closeout	X	Option 3: Manufacturer published product data or certification confirming SRI		PE
SS8		Light Pollution Reduction	Final Design		Interior Lighting: List of drawings and specification references that convey interior lighting requirements (location and type of all installed interior lighting, location of non-opaque exterior envelope surfaces, allowing confirmation that maximum candela value from interiorfixtures does not intersect non-opaque building envelope surfaces). - OR - List of drawings and specification references that show automatic lighting controls compliance with credit requirement.		ELEC
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		ELEC
			Final Design		Exterior Lighting: List of drawings and specification references that convey exterior lighting requirements (location and type of all site lighting and building façade/landscape lighting).		ELEC
			Final Design		Exterior Site Lighting Power Density (LPD): Tabulation for exterior site lighting indicating, for each location identification or description, units of measure, area or distance of the location, actual LPD using units consistent with ASHRAE 90.1, and the ASHRAE allowable LPD for that type of location. Percentage calculation of actual versus allowable LPD for all site lighting.		ELEC
			Final Design		Exterior Building Facade/Landscape Lighting Power Density (LPD): Tabulation for exterior building facade/landscape lighting indicating, for each location identification or description, units of measure, area or distance of the location, actual LPD using units consistent with ASHRAE 90.1, and the ASHRAE allowable LPD for that type of location. Percentage calculation of actual versus allowable LPD for all building facade/landscape lighting.		ELEC
			Final Design		Exterior Lighting IESNA Zone: Indicate which IESNA zone is applicable to the project.		ELEC
			Final Design		Exterior Lighting Site Lumen table indicating, for each fixture type, quantity installed, initial lamp lumens per luminaire, initial lamp lumens above 90 degrees from Nadir, total lamp lumens and total lamp lumens above 90 degrees. Percentage of site lamp lumens above 90 degrees from nadir to total lamp lumens.		ELEC
			Final Design		Exterior Lighting Narrative describing analysis used for addressing requirements for light trespass at site boundary and beyond.		ELEC
CATEGORY 2 – WATER EFFICIENCY							
WEPR1		Water Use Reduction: 20% Reduction	Final Design		Statement confirming which occupancy breakdown applies (default or special). For special occupancy breakdown, indicate source and explanation for ratio.		MEC
			Final Design		Occupancy calculation including male/female numbers for FTEs, visitors, students, customers, residential and other type occupants/users		MEC
			Final Design		Statement indicating percent of male restrooms with urinals. Statement indicating annual days of operation.		MEC

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			Final Design		Baseline flush fixture calculation spreadsheet indicating, for each fixture type, gender, flush rate, daily uses per person for each occupant type identified in occupancy calculation and annual baseline flush fixture water usage.		MEC
			Final Design		Design case flush fixture calculation spreadsheet indicating, for each fixture type, gender, fixture manufacturer, fixture model number, flush rate, percent of occupants using this fixture type, daily uses per person for each occupant type identified in occupancy calculation and annual design case flush fixture water usage.		MEC
			Closeout	X	Manufacturer published product data or certification confirming fixture water usage.		PE
WE1.1		Water Efficient Landscaping: Reduce by 50%	Final Design		Statement indicating which option for compliance applies.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design		Calculation indicating, for baseline and design case, total water applied, total potable water applied, total non-potable water applied. Design case percent potable water reduction. If nonpotable water is used, indicate source of nonpotable water.		CIV
			Final Design		List of landscape plan drawings.		CIV
			Final Design		Narrative describing landscaping and irrigation design strategies, including water use calculation methodology used to determine savings and, if non-potable water is used, specific information about source and available quantity.		CIV
WE1.2		Water Efficient Landscaping: No Potable Water Use or No Irrigation	Same as WE1.1		Same as WE1.1		CIV
WE2		Innovative Wastewater Technologies	Final Design		Statement confirming which option for compliance applies.		MEC
			Final Design		Statement confirming which occupancy breakdown applies (default or special). For special occupancy breakdown, indicate source and explanation for ratio.		MEC
			Final Design		Occupancy calculation including male/female numbers for FTEs, visitors, students, customers, residential and other type occupants/users		MEC
			Final Design		Statement indicating percent of male restrooms with urinals. Statement indicating annual days of operation.		MEC
			Final Design		Baseline flush fixture calculation spreadsheet indicating, for each fixture type, gender, flush rate, daily uses per person for each occupant type identified in occupancy calculation and annual baseline flush fixture water usage.		MEC
			Final Design		Design case flush fixture calculation spreadsheet indicating, for each fixture type, gender, fixture manufacturer, fixture model number, flush rate, percent of occupants using this fixture type, daily uses per person for each occupant type identified in occupancy calculation and annual design case flush fixture water usage.		MEC
			Final Design		Option 1: If onsite non-potable water is used, identify source(s), indicate annual quantity from each source and indicate total annual quantity from all onsite non-potable water sources.		MEC
			Final Design		Option 1: Summary calculation indicating baseline annual water consumption, design case annual water consumption, non-potable annual water consumption and total percentage annual water savings.		MEC
			Final Design		Option 2: Statement confirming on-site treatment of all generated wastewater to tertiary standards and all treated wastewater is either infiltrated or used on-site.		MEC
			Final Design		Option 2: List of drawing and specification references that convey design of on-site wastewater treatment features.		CIV
			Final Design		Option 2: On-site water treatment quantity calculation indicating all on-site wastewater source(s), annual quantity treated, annual quantity infiltrated and annual quantity re-used on site from each source and totals for annual quantity treated, annual quantity infiltrated and annual quantity re-used on site from all sources.		CIV
			Final Design		Option 2: Wastewater summary calculation indicating design case annual flush fixture water usage, annual on-site water treatment and percentage sewage convyance reduction.		MEC
			Final Design		Narrative describing project strategy for reduction of potable water use for sewage conveyance, including specific information on reclaimed water usage and treated wastewater usage.		MEC
WE3		Water Use Reduction: 30% - 40% Reduction	Same as WEPR1		Same as WEPR1		MEC
CATEGORY 3 – ENERGY AND ATMOSPHERE							

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EAPR1		Fundamental Commissioning of the Building Energy Systems (PREREQUISITE)	**Final Design		**Owner's Project Requirements document		ALL
			**Final Design		**Basis of Design document for commissioned systems		MEC, ELEC
			**Final Design		**Commissioning Plan		MEC, ELEC
			Closeout		Statement confirming all commissioning requirements have been incorporated into construction documents.		PE
			Closeout		Commissioning Report		PE
EAPR2		Minimum Energy Performance (PREREQUISITE)	Final Design		Statement listing the mandatory provisions of ASHRAE 90.1 that project meets relative to compliance with this prerequisite and indicating which compliance path was used.		MEC ELEC ARC
			Final Design		Statement indicating which compliance path option applies.		MEC
			Final Design		Option 1: Statement confirming simulation software capabilities and confirming assumptions and methodology.		MEC
			Final Design		Option 1: General information including simulation program, principal heating source, percent new construction and renovation, weather file, climate zone and Energy Star Target Finder score.		MEC
			Final Design		Option 1: Space summary listing, for each building use, the conditioned area, unconditioned area and total area and include total area for each category		MEC
			Final Design		Option 1: List of all simulation output advisory message data and show difference between baseline and proposed design		MEC
			Final Design		Option 1: Comparison summary for energy model inputs including description of baseline and design case energy model inputs, showing both by element type		MEC
			Final Design		Option 1: Energy type summary lising, for each energy type, utility rate description, units of energy and units of demand		MEC
			Final Design		Option 1: Statement indicating whether project uses on-site renewable energy. If yes, list all sources and indicate, for each source, backup energy type, annual energy generated, rated capacity and renewable energy cost		MEC
			Final Design		Option 1: If analysis includes exceptional calculation methods, statement describing how exceptional calculation measure cost savings is determined		MEC
			Final Design		Option 1: If analysis includes exceptional calculation methods, for each exceptional calculation method indicate energy types and, for each energy type, annual energy savings, annual cost savings, and brief descriptive narrative		MEC
			Final Design		Option 1: Baseline performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand for all four orientations. For each orientation indicate total annual energy use for each orientation and total annual process energy use.		MEC
			Final Design		Option 1: Baseline energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.		MEC
			Final Design		Option 1: Proposed Design performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand, baseline annual and peak energy demand and percent savings. Indicate total annual energy use and total annual process energy use for both proposed design and baseline and percent savings.		MEC
			Final Design		Option 1: Proposed Design energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.		MEC
			Final Design		Option 1: Energy cost and consumption by energy type report indicating, for each energy type, proposed design and baseline annual use and annual cost, percent savings annual use and annual cost. Indicate for renewable energy annual energy generated and annual cost. Indicate exceptional calculations annual energy savings and annual cost savings. Indicate building total annual energy use, annual energy cost for proposed design and baseline and indicate percent savings annual energy use and annual energy cost.		MEC

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			Final Design		Option 1: Compliance summaries from energy simulation software. If software does not produce compliance summaries provide output summaries and example input summaries for baseline and proposed design supporting data in the tables. Output summaries must include simulated energy consumption by end use and total energy use and cost by energy type. Example input summaries should represent most common systems and must include occupancy, use pattern, assumed envelope component sizes and descriptive features and assumed mechanical equipment types and descriptive features		MEC
			Final Design		Option 1: Energy rate tariff from project energy providers (only if not using LEED Reference Guide default rates)		MEC
EAPR3		Fundamental Refrigerant Management (PREREQUISITE)	Final Design		Statement indicating which option for compliance applies.		MEC
			Final Design		Option 2: Narrative describing phase out plan, including specific information on phase out dates and refrigerant quantities.		MEC
EA1		Optimize Energy Performance	Final Design		Statement indicating which compliance path option applies.		MEC
			Final Design		Option 1: Statement confirming simulation software capabilities and confirming assumptions and methodology.		MEC
			Final Design		Option 1: General information including simulation program, principal heating source, percent new construction and renovation, weather file, climate zone and Energy Star Target Finder score.		MEC
			Final Design		Option 1: Space summary listing, for each building use, the conditioned area, unconditioned area and total area and include total area for each category		MEC
			Final Design		Option 1: List of all simulation output advisory message data and show difference between baseline and proposed design		MEC
			Final Design		Option 1: Comparison summary for energy model inputs including description of baseline and design case energy model inputs, showing both by element type		MEC
			Final Design		Option 1: Energy type summary lising, for each energy type, utility rate description, units of energy and units of demand		MEC
			Final Design		Option 1: Statement indicating whether project uses on-site renewable energy. If yes, list all sources and indicate, for each source, backup energy type, annual energy generated, rated capacity and renewable energy cost		MEC
			Final Design		Option 1: If analysis includes exceptional calculation methods, statement describing how exceptional calculation measure cost savings is determined		MEC
			Final Design		Option 1: If analysis includes exceptional calculation methods, for each exceptional calculation method indicate energy types and, for each energy type, annual energy savings, annual cost savings, and brief descriptive narrative		MEC
			Final Design		Option 1: Baseline performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand for all four orientations. For each orientation indicate total annual energy use for each orientation and total annual process energy use.		MEC
			Final Design		Option 1: Baseline energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.		MEC
			Final Design		Option 1: Proposed Design performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand, baseline annual and peak energy demand and percent savings. Indicate total annual energy use and total annual process energy use for both proposed design and baseline and percent savings.		MEC
			Final Design		Option 1: Proposed Design energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.		MEC
			Final Design		Option 1: Energy cost and consumption by energy type report indicating, for each energy type, proposed design and baseline annual use and annual cost, percent savings annual use and annual cost. Indicate for renewable energy annual energy generated and annual cost. Indicate exceptional calculations annual energy savings and annual cost savings. Indicate building total annual energy use, annual energy cost for proposed design and baseline and indicate percent savings annual energy use and annual energy cost.		MEC

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			Final Design		Option 1: Compliance summaries from energy simulation software. If software does not produce compliance summaries provide output summaries and example input summaries for baseline and proposed design supporting data in the tables. Output summaries must include simulated energy consumption by end use and total energy use and cost by energy type. Example input summaries should represent most common systems and must include occupancy, use pattern, assumed envelope component sizes and descriptive features and assumed mechanical equipment types and descriptive features		MEC
			Final Design		Option 1: Energy rate tariff from project energy providers (only if not using LEED Reference Guide default rates)		MEC
EA2.1		On-Site Renewable Energy	Final Design		Statement indicating which compliance path option applies.		ELEC
			Final Design		List all on-site renewable energy sources and indicate, for each source, backup energy type, annual energy generated, rated capacity and renewable energy cost. Indicate total annual energy use (all sources), total annual energy cost (all sources) and percent renewable energy cost.		ELEC MEC
			Final Design		Option 1: Indicate, for renewable energy,proposed design total annual energy generated and annual cost.		ELEC MEC
			Final Design		Option 2: Indicate CBECS building type and building gross area. Provide the following CBECS data: median annual electrical intensity, median annual non-electrical fuel intensity, average electric energy cost, average non-electric fuel cost, annual electric energy use and cost, annual non-electric fuel use and cost.		ELEC MEC
			Final Design		Option 2: Narrative describing renewable systems and explaining calculation method used to estimate annual energy generated, including factors influencing performance.		ELEC MEC
EA2.2		On-Site Renewable Energy	Same as EA2.1		Same as EA2.1		ELEC MEC
EA2.3		On-Site Renewable Energy	Same as EA2.1		Same as EA2.1		ELEC MEC
EA3		Enhanced Commissioning	**Final Design		**Owner's Project Requirements document (OPR)		ALL
			**Final Design		**Basis of Design document for commissioned systems (BOD)		ELEC MEC
			**Final Design		**Commissioning Plan		ELEC MEC
			Closeout		Statement confirming all commissioning requirements have been incorporated into construction documents.		PE
			Closeout		**Commissioning Report		PE
			**Final Design		Statement by CxA confirming Commissioning Design Review		
			Closeout		Statement by CxA confirming review of Contractor submittals for compliance with OPR and BOD		PE
			Closeout		**Systems Manual		PE
			Closeout		Statement by CxA confirming completion of O&M staff and occupant training		PE
			Closeout		**Scope of work for post-occupancy review of building operation, including plan for resolution of outstanding issues		PE
			**Predesign		Statement confirming CxA qualifications and contractual relationships relative to work on this project, demonstrating that CxA is an independent third party.		MEC
EA4		Enhanced Refrigerant Management	Final Design		Refrigerant impact calculation table with all building data and calculation values as shown in LEED 2009 Reference Guide Example Calculations		MEC
			Final Design		Narrative describing any special circumstances or explanatory remarks		
			Closeout	X	Cut sheets highlighting refrigerant data for all HVAC components.		PE
EA5		Measurement & Verification	Closeout		Statement indicating which compliance path option applies.		PE
			Closeout		Measurement and Verification Plan including Corrective Action Plan		PE
			Closeout		**Scope of work for post-occupancy implementation of M&V plan including corrective action plan.		PE
EA6		Green Power	Closeout		Statement indicating which compliance path option applies.		PE
			Closeout		Option 1: Indicate proposed design total annual electric energy usage		PE
			Closeout		Option 2: Indicate actual total annual electric energy usage		PE
			Closeout		Option 3: Calculation indicating building type, total gross area, median electrical intensity and annual electric energy use		PE

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			Closeout		Green power provider summary table indicating, for each purchase type, provider name, annual quantity green power purchased and contract term. Indicate total annual green power use and indicate percent green power		PE
			Closeout		Narrative describing how Green Power or Green Tags are purchased		PE
CATEGORY 4 – MATERIALS AND RESOURCES							
MRPR1		Storage & Collection of Recyclables (PREREQUISITE)	Final Design		Statement confirming that recycling area will accommodate recycling of plastic, metal, paper, cardboard and glass. Narrative indicating any other materials addressed and coordination with pickup.		ARC
MR1.1		Building Reuse: Maintain 55% of Existing Walls, Floors & Roof	**Final Design		If project includes a building addition, confirm that area of building addition does not exceed 2x the area of the existing building.		ARC
			**Final Design		Spreadsheet listing, for each building structural/envelope element, the existing area and reused area. Total percent reused.		ARC
MR1.2		Building Reuse: Maintain 75% of Existing Walls, Floors & Roof	Same as MR1.1		Same as MR1.1		ARC
MR1.3		Building Reuse: Maintain 95% of Existing Walls, Floors & Roof	Same as MR1.1		Same as MR1.1		ARC
MR1.4		Building Reuse: Maintain 50% of Interior Non-Structural Elements	**Final Design		If project includes a building addition, confirm that area of building addition does not exceed 2x the area of the existing building.		ARC
			**Final Design		Spreadsheet listing, for each building interior non-structural element, the existing area and reused area. Total percent reused.		ARC
MR2.1		Construction Waste Management: Divert 50% From Disposal	**Preconstruction		Waste Management Plan		PE
			**Construction Quarterly and Closeout		Spreadsheet calculations indicating material description, disposal/diversion location (or recycling hauler), weight, total waste generated, total waste diverted, diversion percentage		PE
			**Construction Quarterly and Closeout		Receipts/tickets for all items on spreadsheet		PE
MR2.2		Construction Waste Management: Divert 75% From Disposal	Same as MR2.1		Same as MR2.1		PE
MR3.1		Materials Reuse: 5%	Closeout		Statement indicating total materials value and whether default or actual.		PE
			Closeout		Spreadsheet calculations indicating, for each reused/salvaged material, material description, source or vendor, cost. Total reused/salvaged materials percentage.		PE
MR3.2		Materials Reuse: 10%	Same as MR3.1		Same as MR3.1		PE
MR4.1		Recycled Content: 10% (post-consumer + 1/2 pre-consumer)	Closeout		Statement indicating total materials value and whether default or actual.		PE
			Closeout		Spreadsheet calculations indicating, for each recycled content material, material name/description, manufacturer, cost, post-consumer recycled content percent, pre-consumer recycled content percent, source of recycled content data. Total post-consumer content materials cost, total pre-consumer content materials cost, total combined recycled content materials cost, recycled content materials percentage.		PE
			Final Design or NLT Preconstruction		**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal.		PE
			Closeout	X	Manufacturer published product data or certification, confirming recycled content percentages in spreadsheet		PE
MR4.2		Recycled Content: 20% (post-consumer + 1/2 pre-consumer)	Same as MR4.1		Same as MR4.1		PE
MR5.1		Regional Materials:10% Extracted, Processed & Manufactured Regionally	Closeout		Statement indicating total materials value and whether default or actual.		PE
			Closeout		Spreadsheet calculations indicating, for each regional material, material name/description, manufacturer, cost, percent compliant, harvest distance, manufacture distance, source of manufacture and harvest location data. Total regional materials cost, regional materials percentage.		PE
			Preconstruction		**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal.		PE
			Closeout	X	Manufacturer published product data or certification confirming regional material percentages in spreadsheet		PE

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MR5.2		Regional Materials:20% Extracted, Processed & Manufactured Regionally	Same as MR5.1		Same as MR5.1		PE
MR6		Rapidly Renewable Materials	Closeout		Statement indicating total materials value and whether default or actual.		PE
			Closeout		Spreadsheet calculations indicating, for each rapidly renewable material, material name/description, manufacturer, cost, rapidly renewable content percent, rapidly renewable product value. Total rapidly renewable product value, rapidly renewable materials percentage.		PE
			Final Design		**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal.		ARC
			Closeout	X	Manufacturer published product data or certification confirming rapidly renewable material percentages in spreadsheet		PE
MR7		Certified Wood	Closeout		Statement indicating total materials value and whether default or actual.		PE
			Closeout		Spreadsheet calculations indicating, for each certified wood material, material name/description, vendor, cost, wood component percent, certified wood percent of wood component, FSC chain of custody certificate number. Total certified wood product value, certified wood materials percentage.		PE
			Final Design or NLT Preconstruction		**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal.		PE
			Closeout	X	Vendor invoices, FSC chain of custody certificates and anufacturer published product data or certification confirming all certified wood materials percentages in spreadsheet.		PE
INDOOR ENVIRONMENTAL QUALITY							
EQPR1		Minimum IAQ Performance (PREREQUISITE)	Final Design		Statement indicating which option for compliance applies, stating applicable criteria/requirement, and confirming that project has been designed to meet the applicable requirements.		MEC
			Final Design		Narrative describing the project's ventilation design, including specifics about fresh air intake volumes and special considerations.		MEC
EQPR2		Environmental Tobacco Smoke (ETS) Control (PREREQUISITE)	Final Design		Statement indicating which option for compliance applies, stating applicable criteria/requirement, and confirming that project has been designed to meet the applicable requirements.		ARC
			Final Design		List of drawing and specification references that convey conformance to applicable requirements (signage, exhaust system, room separation details, etc).		ARC
EQ1		Outdoor Air Delivery Monitoring	Final Design		Statement indicating which option for compliance applies and confirming that project has been designed to meet the applicable requirements.		MEC
			Final Design		List of drawing and specification references that convey conformance to applicable requirements.		MEC
			Final Design		Narrative describing the project's ventilation design and CO2 monitoring system, including specifics about monitors, operational parameters and setpoints.		MEC
			Closeout	X	Cut sheets for CO2 monitoring system.		PE
EQ2		Increased Ventilation	Final Design		Statement indicating which option for compliance applies and confirming that project has been designed to meet the applicable requirements.		MEC
			Final Design		Narrative describing the project's ventilation design, including specifics about zone fresh air intake volumes and demonstrating compliance.		MEC
			Final Design		Option 2: Narrative describing design method used for determining natural ventilation design, including calculation methodology/model results and demonstrating compliance.		MEC
			Final Design		List of drawing and specification references that convey conformance to applicable requirements.		MEC
EQ3.1		Construction IAQ Management Plan: During Construction	**Preconstruction		Construction IAQ Management Plan		PE
			Closeout		Statement confirming whether air handling units were operated during construction		PE
			Closeout		Dated jobsite photos showing examples of IAQ management plan practices being implemented. Label photos to indicate which practice they demonstrate. Minimum one photo of each practice at each building.		PE

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			Closeout		Spreadsheet indicating, for each filter installed during construction, the manufacturer, model number, MERV rating, location installed, and if it was replaced immediately prior to occupancy.		PE
EQ3.2		Construction IAQ Management Plan: Before Occupancy	**Preconstruction		Construction IAQ Management Plan		PE
			Closeout		Statement indicating which option for compliance applies and confirming that required activities have occurred that meet the applicable requirements.		PE
			Closeout		Option 1a: Narrative describing the project's flushout process, including specifics about temperature, airflow and duration, special considerations (if any) and demonstrating compliance.		PE
			Closeout		Option 1b: Narrative describing the project's pre-occupancy and post-occupancy flushout processes, including specifics about temperature, airflow and duration, special considerations (if any) and demonstrating compliance.		PE
			Closeout		Option 2: Narrative describing the project's IAQ testing process, including specifics about contaminants tested for, locations, remaining work at time of test, retest parameters and special considerations (if any).		PE
			Closeout		Option 2: IAQ testing report demonstrating compliance.		PE
EQ4.1		Low Emitting Materials: Adhesives & Sealants	Closeout		Spreadsheet indicating, for each applicable indoor adhesive, sealant and sealant primer used, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data.		PE
			Closeout		Spreadsheet indicating, for each applicable indoor aerosol adhesive, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data - OR - Statement confirming no indoor aerosol adhesives were used for the project.		PE
			Closeout	X	Manufacturer published product data or certification confirming material VOCs in spreadsheet		PE
EQ4.2		Low Emitting Materials: Paints & Coatings	Closeout		Spreadsheet indicating, for each applicable indoor paint and coating used, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data.		PE
			Closeout		Spreadsheet indicating, for each applicable indoor anti-corrosive/anti-rust paint and coating used, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data - OR - Statement confirming no indoor anti-corrosive/anti-rust paints were used for the project .		PE
			Closeout	X	Manufacturer published product data or certification confirming material VOCs in spreadsheet		PE
EQ4.3		Low Emitting Materials: Flooring Systems	Closeout		Spreadsheet indicating, for each indoor flooring system used, the manufacturer, product name/model number, if it meets LEED requirement (yes/no) and source of LEED compliance data.		PE
			Closeout		Spreadsheet indicating, for each indoor carpet cushion used, the manufacturer, product name/model number, if it meets LEED requirement (yes/no) and source of LEED compliance data - OR - Statement confirming no indoor carpet cushion was used for the project.		PE
			Closeout	X	Manufacturer published product data or certification confirming material compliance label in spreadsheet		PE
EQ4.4		Low Emitting Materials: Composite Wood & Agrifiber Products	Closeout		Spreadsheet indicating, for each indoor composite wood and agrifiber product used, the manufacturer, product name/model number, if it contains added urea formaldehyde (yes/no) and source of LEED compliance data.		PE
			Closeout	X	Manufacturer published product data or certification confirming material urea formaldehyde in spreadsheet		PE
EQ5		Indoor Chemical & Pollutant Source Control	Closeout		Spreadsheet indicating, for each permanent entryway system used, the manufacturer, product name/model number and description of system.		PE
			Final Design		List of drawing and specification references that convey locations and installation methods for entryway systems.		ARC
			Final Design		Spreadsheet indicating, for each chemical use area, the room number, room name, description of room separation features (walls, floor/ceilings, openings) and pressure differential from surrounding spaces with doors closed - OR - Statement confirming that project includes no chemical use areas and that no hazardous cleaning materials are needed for building maintenance.		ARC MEC
			Final Design		If project includes chemical use areas: List of drawing and specification references that convey locations of chemical use areas, room separation features and exhaust system.		ARC MEC

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	**LEED-NC v3 Submittals (OCT09)**		Provide for Credit Audit Only		Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		**FEATURE**	**DUE AT**		**REQUIRED DOCUMENTATION**	**DATE**	**REV**
			Final Design		If project includes places where water and chemical concentrate mixing occurs: List of drawing and specification references that convey provisions for containment of hazardous liquid wastes OR - Statement confirming that project includes no places where water and chemical concentrate mixing occurs.		ARC MEC
			Closeout		If project includes chemical use areas: Spreadsheet indicating, for AHUs/mechanical ventilation equipment serving occupied areas, the manufacturer, model number, MERV rating, location installed, and if it was replaced immediately prior to occupancy (yes/no) - OR - Statement confirming that project does not use mechanical equipment for ventilation of occupied areas.		PE
EQ6.1		Controllability of Systems: Lighting	Final Design		Calculation indicating total number of individual workstations, number of workstations with individual lighting controls and the percentage of workstations with individual lighting controls.		ELEC
			Final Design		For each shared multi-occupant space, provide a brief description of lighting controls.		ELEC
			Final Design		Narrative describing lighting control strategy, including type and location of individual controls and type and location of controls in shared multi-occupant spaces.		ELEC
EQ6.2		Controllability of Systems: Thermal Comfort	Final Design		Calculation indicating total number of individual workstations, number of workstations with individual thermal comfort controls and the percentage of workstations with individual thermal comfort controls.		MEC
			Final Design		For each shared multi-occupant space, provide a brief description of thermal comfort controls.		MEC
			Final Design		Narrative describing thermal comfort control strategy, including type and location of individual and shared multi-occupant controls.		MEC
EQ7.1		Thermal Comfort: Design	Final Design		Design criteria spreadsheet indicating, for spring, summer, fall and winter, maximum indoor space design temperature, minimum indoor space design temperature and maximum indoor space design humidity.		MEC
			Final Design		Narrative describing method used to establish thermal comfort control conditions and how systems design addresses the design criteria, including compliance with the referenced standard.		MEC
EQ7.2		Thermal Comfort: Verification	Final Design		Narrative describing the scope of work for the thermal comfort survey, including corrective action plan development		MEC
			Final Design		List of drawing and specification references that convey permanent monitoring system.		MEC
EQ8.1		Daylight & Views: Daylight 75% of Spaces	Final Design		Option 2: Table indicating all regularly occupied spaces with space area and space area with compliant daylight zone. Sum of regularly occupied areas and regularly occupied areas withcompliant daylight zone. Percentage calculation of areas withcompliant daylight zone to total regularly occupied areas.		ARC
			Final Design		Option 1: Simulation model method, software and output data		ELEC
			Final Design		Option 1: Table indicating all regularly occupied spaces with space area, space area with minimum 25 footcandles daylighting illumination, and method of providing glare control. Sum of regularly occupied areas and regularly occupied areas with 25 fc daylighting. Percentage calculation of areas with 25 fc daylighting to total regularly occupied areas.		ELEC
			Final Design		For all occupied spaces excluded from the calculation, provide narrative indicating reasons for excluding the space.		ARC
			Final Design		List of drawing and specification references that convey exterior glazed opening head and sill heights, glazing performance properties and glare control/sunlight redirection devices.		ARC
			Closeout	X	Manufacturer published product data or certification confirming glazing Tvis in spreadsheet		PE
EQ8.2		Daylight & Views: Views for 90% of Spaces	Final Design		Table indicating all regularly occupied spaces with space area and space area with access to views. Sum of regularly occupied areas and regularly occupied areas with access to views. Percentage calculation of areas with views to total regularly occupied areas.		ARC
			Final Design		For all occupied spaces excluded from the calculation, provide narrative indicating reasons for excluding the space.		ARC
			Final Design		LEED Floor plan drawings showing line of sight diagramming of views areas in each regularly occupied space. List of drawing/specification references that convey exterior glazed opening head and sill heights.		ARC
INNOVATION & DESIGN PROCESS							

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	**LEED-NC v3 Submittals (OCT09)**		Provide for Credit Audit Only		Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		**FEATURE**	**DUE AT**		**REQUIRED DOCUMENTATION**	**DATE**	**REV**
IDc1.1		Innovation in Design	Final Design		Narrative decribing intent, requirement for credit, project approach to the credit. List of drawings and specification references that convey implementation of credit. All other documentation that validates claimed credit.		
IDc1.2		Innovation in Design	Final Design				
IDc1.3		Innovation in Design	Final Design				
IDc1.4		Innovation in Design	Final Design				
IDc2		LEED Accredited Professional	Final Design		Narrative indicating name of LEED AP, company name of LEED AP, description of LEED AP's role and responsiblilities in the project.		ARC

ATTACHMENT F
Version 05-31-2011

BUILDING INFORMATION MODELING REQUIREMENTS

1.0 Section 1 - General

1.1. Definitions. See Section 7 for definitions of terms used in this document.

1.2. Submittal Format

1.2.1. The Model shall be developed using Building Information Modeling ("BIM") supplemented with Computer Aided Design ("CAD") content as necessary to produce a complete set of Construction Documents. Printed design submittal drawings shall be Full-22x34 size, suitable for half-size scaled reproduction.

1.2.2. BIM submittals shall conform to the requirements of Sections 3 and 4 below.

1.2.3. For each Center of Standardization (CoS) facility type included in this Project, all Models and associated Facility Data shall be submitted in V8i. The submittals shall be fully operable, compatible, and editable within the native BIM tools.

2.0 Section 2 – Design Requirements

2.1. Use of BIM for Design. Contractor shall use BIM application(s) and software(s) to develop Project designs consistent with the following requirements.

2.1.1. Baseline Model. The Contractor will not be provided a baseline multi-discipline BIM Project Model.

2.1.2. USACE BIM Workspace. The USACE Bentley BIM Workspace [Not Supplied - SubmittalReqCADDSystem : USACE_WORKSPACE_VERSION] must be used and can be downloaded from the CAD/BIM Technology Center website, currently https://cadbim.usace.army.mil.

2.1.3. Reference. Refer to ERDC TR-06-10, "U.S. Army Corps of Engineers Building Information Modeling Road Map" from the CAD/BIM Technology Center website for more information on the USACE BIM implementation goals.

2.1.4. Industry Foundation Class (IFC) Support. The Contractor's selected BIM application(s) and software(s) must be consistent with the current IFC property sets. Any deviations from or additions to the IFC property sets for any new spaces, systems, and equipment must be submitted for Government acceptance.

2.1.5. BIM Project Execution Plan.

2.1.5.1. Develop a BIM Project Execution Plan ("Plan" or "PxP") documenting the BIM uses, analysis technologies and workflows.

2.1.5.2. Contractors shall utilize the link for the USACE BIM PROJECT EXECUTION PLAN (USACE PxP) Template located in Attachment H to develop an acceptable Plan.

2.2. BIM Requirements.

2.2.1. Facility Data. Develop the Facility Data to include material definitions and attributes that are necessary for the Project facility design and construction as described in Section 4.0. Additional data in support of Section 6.0 Contractor Electives is encouraged to be added to the Model.

2.2.2. Model Content. The Model and Facility Data shall include, at a minimum, the requirements of Section 4 below.

2.2.3. Model Granularity. Individual elements may vary in level of detail within the Model, but at a minimum must include all features that would be included on a quarter inch (1/4" = 1'0") scaled drawing (e.g., at least 1/16th, 1/8th and 1/4th), or on appropriately scaled civil drawings.

2.3. Output. Submitted Drawings (e.g., plans, elevations, sections, schedules, details, etc.) shall be derived (commonly known as extractions, views or sheets) from the Model and Facility Data. Drawings derived from the Model shall remain connected to the Model for the life of the Project and documented in the PxP. Drawings not derived from the Model shall also be documented in the PxP.

2.3.1. Drawings derived from the Model shall be compliant with the A/E/C CAD Standard. Deliver electronic CAD files used for the creation of the Construction Documents per requirements in Section 01 33 16, the criteria of the USACE Louisville District District, and as noted herein.

2.3.2. The CAD file format specified for drawings shall not dictate which application(s) are used for development and execution of the Model and Facility Data. Application(s) used shall be documented in the PxP.

2.4. Quality Control Parameters. Implement quality control ("QC") parameters for the Model, including:

2.4.1. Model Standards Checks. QC validation ensures that the Project Facility Data set has no undefined, incorrectly defined or duplicated elements. Identify and report non-compliant elements and submit a corrective action plan. Provide the Government with detailed justification and request Government acceptance for any non-compliant element that the Contractor proposes to be allowed to remain in the Model.

2.4.2. CAD Standards Checks. QC checking ensures that the fonts, dimensions, line styles, levels and other construction document formatting issues are followed per requirements in Section 01 33 16. Identify and report non-compliant content and submit a corrective action plan.

2.4.3. Other Parameters. Develop such other QC parameters as Contractor deems appropriate for the Project and provide to the Government for acceptance.

2.5. Design and Construction Reviews. Perform design and construction reviews at each submittal stage under Section 3 to test the Model, including:

2.5.1. Visual Checks. Checking to ensure the design intent has been followed and that there are no unintended elements in the Model.

2.5.2. Interference Management Checks. Locate conflicting spatial data in the Model where two elements are occupying the same space. Log hard interferences (e.g., mechanical vs. structural, or mechanical vs. mechanical, overlaps in the same location) and soft interferences, (e.g., conflicts regarding equipment clearance, service access, fireproofing, insulation, code space requirements) in a written report and resolve.

2.5.3. IFC Coordination View. Provide an IFC Coordination View in IFC Express format for all deliverables. Provide exported property set data for all IFC supported named building elements.

2.5.4. Other Parameters. Develop other design and construction review parameters as the Contractor deems appropriate for the Project and provide to the Government for acceptance.

3.0 Section 3 – Submittal Requirements

3.1. General Submittal Requirements.

3.1.1. Provide submittals in compliance with the PxP deliverables at stages as described below.

3.1.2. For each Interim Design Submittal as set forth in Paragraphs 3.3 through 3.6, provide a Contractor-certified written report confirming that consistency checks as identified in Paragraphs 2.4 and 2.5 above have been completed. This report shall be discussed as part of the review process and shall address cross-discipline interferences, if any.

3.1.3. At each Interim Design Submittal as set forth in Paragraphs 3.3 through 3.6, provide the Government with:

3.1.3.1. The Model, Facility Data, Workspace and CAD Data files in the native BIM/CAD format.

3.1.3.2. A copy of the Model in an interactive review format such as Bentley Navigator, Autodesk Navisworks, Adobe 3D PDF 7.0 (or later), Google Earth KMZ or other format per PxP requirements. The format for reviews can change between submittals.

3.1.3.3. A list of all submitted electronic files including a description, directory, and file name for each file submitted. For all CAD printed sheets, include a list of the sheet titles and sheet numbers. Identify which files have been produced from the Model and Facility Data.

3.1.4. The Government shall confirm acceptability of all submittals identified in Section 3 in coordination with the USACE Geographic District BIM Manager.

3.2. Initial Design Conference Submittal.

3.2.1. Submit a digital copy of the PxP where, in addition to Paragraph 3.1.4, the USACE Geographic District BIM Manager will coordinate with the USACE CoS BIM Manager to confirm acceptability of the Plan or advise as to additional processes or activities necessary to be incorporated into the PxP.

3.2.2. Within thirty (30) days after the acceptance of the PxP, conduct a demonstration to review the Plan for clarification, and to verify the functionality of planned Model technology workflow and processes. If modifications are required, the Contractor shall complete the modifications and resubmit the PxP performing a subsequent demonstration for Government acceptance. There will be no payment for design or construction until the PxP is completed and accepted by the Government. The Government may also withhold payment if there is design and construction for unacceptable performance in executing the accepted PxP.

3.3. Interim Design Submittals.

3.3.1. BIM and CAD Data. Submit the Model with Facility Data per the requirements identified in Paragraphs 2.2 and 2.3 as applicable to the Interim Design package(s).

3.4. Final Design Submissions and Design Complete Submittals.

3.4.1. BIM and CAD Data. Submit the Model with Facility Date per the requirements identified in Paragraphs 2.2 and 2.3. Acceptance according to Paragraph 3.1.4 is required before commencement of construction, as described in Paragraph 3.7.6 of Section 01 33 16.

3.5. Construction Submittals – Over-The-Shoulder Progress Reviews. Periodic quality control meetings or construction progress review meetings shall include quality control reviews on the implementation and use of the Model, including interference management and design change tracking information.

3.6. Final As-Built BIM and CAD Data Submittal. Submit the final Model, Facility Data, and CAD files reflecting as-built construction conditions for Government acceptance, as specified in Section 01 78 02.00 10, PROJECT CLOSEOUT.

4.0 Section 4 – BIM Model Minimum Requirements and Output

4.1. General Provisions. The Model shall be developed to include the systems described below as they would be built, the processes of installing them, and to reflect final as-built construction conditions. The deliverable Model at the Interim Design Stage and at the Final Design Stage ("released for construction") shall be developed to include as many of the systems described below as are necessary and appropriate at that design stage.

4.2. Architectural/Interior Design. The Architectural systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Additional minimum Model requirements include:

4.2.1. Spaces. The Model shall include spaces defining actual net square footage and net volume, and holding data to develop the room finish schedule including room names and numbers. Include program information to verify design space against programmed space, using this information to validate area quantities.

4.2.2. Walls and Curtain Walls. Each wall shall be depicted to the exact height, length, width and ratings (thermal, acoustic, fire) to properly reflect wall types. The Model shall include all walls, both interior and exterior, and the necessary intelligence to produce accurate plans, sections and elevations depicting these design elements.

4.2.3. Doors, Windows and Louvers. Doors, windows and louvers shall be depicted to represent their actual size, type and location. Doors and windows shall be modeled with the necessary intelligence to produce accurate window and door schedules.

4.2.4. Roof. The Model shall include the roof configuration, drainage system, penetrations, specialties, and the necessary intelligence to produce accurate plans, building sections and generic wall sections where roof design elements are depicted.

4.2.5. Floors. The floor slab(s) shall be developed in the Structural Model and then referenced by the Architectural Model.

4.2.6. Ceilings. All heights and other dimensions of ceilings, including soffits, ceiling materials, or other special conditions shall be depicted in the Model with the necessary intelligence to produce accurate plans, building sections and wall sections where ceiling design elements are depicted.

4.2.7. Vertical Circulation. All continuous vertical components (i.e., non-structural shafts, architectural stairs, handrails and guardrails) shall be accurately depicted and shall include the necessary intelligence to produce accurate plans, elevations and sections in which such design elements are referenced.

4.2.8. Architectural Specialties. All architectural specialties (i.e., toilet room accessories, toilet partitions, grab bars, lockers, and display cases) and millwork (i.e., cabinetry and counters) shall be accurately depicted with the necessary intelligence to produce accurate plans, elevations, sections and schedules in which such design elements are referenced.

4.2.9. Signage. The Model shall include all signage and the necessary intelligence to produce accurate plans and schedules.

4.2.10. Schedules. Provide door, window, hardware sets using BHMA designations, flooring, wall finish, and signage schedules from the Model, indicating the type, materials and finishes used in the design.

4.3. Furniture. The furniture Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4”=1’0”) scaled drawing, and have necessary intelligence to produce accurate plans. Representation of furniture elements is to be 2D. Contractor may provide a minimal number of 3D representations as examples. Examples of furniture include, but are not limited to, desks, furniture systems, seating, tables, and office storage.

4.3.1. Furniture Coordination. Furniture that makes use of electrical, data or other features shall include the necessary intelligence to produce coordinated documents and data.

4.4. Equipment. The Model may vary in level of detail for individual elements. Equipment shall be depicted to meet layout requirements with the necessary intelligence to produce accurate plans and schedules, indicating the configuration, materials, finishes, mechanical, and electrical requirements.. Examples of equipment include but are not limited to copiers, printers, refrigerators, ice machines and microwaves.

4.4.1. Schedules. Provide furniture and equipment schedules from the model indicating the materials, finishes, mechanical, and electrical requirements.

4.5. Structural. The Structural systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4”=1’0”) scaled drawing. Additional minimum Model requirements include:

4.5.1. Foundations. All necessary foundation and/or footing elements, with necessary intelligence to produce accurate plans and elevations.

4.5.2. Floor Slabs. Structural floor slabs shall be depicted with all necessary recesses, curbs, pads, closure pours, and major penetrations accurately depicted.

4.5.3. Structural Steel. All steel columns, primary and secondary framing members, and steel bracing for the roof and floor systems (including decks), including all necessary intelligence to produce accurate structural steel framing plans, related building/wall sections, and schedules.

4.5.4. Cast-in-Place Concrete. All walls, columns, beams, including necessary intelligence to produce accurate plans and building/wall sections, depicting cast-in-place concrete elements.

4.5.5. Expansion/Contraction Joints. Joints shall be accurately depicted.

4.5.6. Stairs. All framing members for stair systems, including necessary intelligence to produce accurate plans and building/wall sections depicting stair design elements.

4.5.7. Shafts and Pits. All shafts and pits, including necessary intelligence to produce accurate plans and building/wall sections depicting these design elements.

4.5.8. Openings and Penetrations. All major openings and penetrations that would be included on a quarter inch (1/4”=1’0”) scaled drawing.

4.6. Mechanical. The Mechanical systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4”=1’0”)

scaled drawing. Small diameter (less than 1-1/2" NPS) field-routed piping is not required to be depicted in the Model. Additional minimum Model requirements include:

4.6.1. HVAC. All necessary heating, ventilating, air-conditioning and specialty equipment, including air distribution for supply, return, ventilation and exhaust ducts, control systems, registers, diffusers, grills, and hydronic baseboards with necessary intelligence to produce accurate plans, elevations, building/wall sections and schedules.

4.6.1.1. Mechanical Piping. All necessary piping and fixture layouts, and related equipment, including necessary intelligence to produce accurate plans, elevations, building/wall sections, and schedules.

4.6.2. Plumbing. All necessary plumbing piping and fixture layouts, floor and area drains, and related equipment, including necessary intelligence to produce accurate plans, elevations, building/wall sections, riser diagrams, and schedules.

4.6.3. Equipment Clearances. All Mechanical equipment clearances shall be modeled for use in interference management and maintenance access requirements.

4.6.4. Elevator Equipment. All necessary equipment and control systems, including necessary intelligence to produce accurate plans, sections and elevations depicting these design elements.

4.7. Electrical/Telecommunications. The Electrical and Telecommunications systems Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Small diameter (less than 1-1/2"Ø) field-routed conduit is not required to be depicted in the Model. Additional minimum Model requirements include:

4.7.1. Interior Electrical Power and Lighting. All necessary interior electrical components (i.e., lighting, receptacles, special and general purpose power receptacles, lighting fixtures, panelboards, cable trays and control systems), including necessary intelligence to produce accurate plans, details and schedules. Lighting and power built into furniture/equipment shall be modeled.

4.7.2. Special Electrical. All necessary special electrical components (i.e., security, mass notification, public address, nurse call and other special electrical occupancy sensors, and control systems), including necessary intelligence to produce accurate plans, details and schedules.

4.7.3. Grounding. All necessary grounding components (i.e., lightning protection systems, static grounding systems, communications grounding systems, and bonding), including necessary intelligence to produce accurate plans, details and schedules.

4.7.4. Telecommunications. All existing and new telecommunications service controls and connections, both above ground and underground, with necessary intelligence to produce accurate plans, details and schedules. Cable tray routing shall be modeled without detail of cable contents.

4.7.5. Exterior Building Lighting. All necessary exterior lighting including all lighting fixtures, relevant existing and proposed support utility lines and equipment with necessary intelligence to produce accurate plans, details and schedules.

4.7.6. Equipment Clearances. All Electrical equipment clearances shall be modeled for use in interference management and maintenance access requirements.

4.8. Fire Protection. The fire protection system Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a quarter inch (1/4"=1'0") scaled drawing. Additional minimum Model requirements include:

4.8.1. Fire Protection System. All relevant fire protection components (i.e., branch piping, sprinkler heads, fittings, drains, pumps, tanks, sensors, control panels) with necessary intelligence to produce accurate plans, elevations, building/wall sections, riser diagrams, and schedules. All fire protection piping shall be modeled.

4.8.2. Fire Alarms. Fire alarm/mass notification devices and detection system shall be indicated with necessary intelligence to produce accurate plans depicting them.

4.9. Civil. The Civil Model may vary in level of detail for individual elements, but at a minimum must include all features that would be included on a one inch (1"=100') scaled drawing. Additional minimum Model requirements include:

4.9.1. Terrain (DTM). All relevant site conditions and proposed grading, including necessary intelligence to produce accurate Project site topographical plans and cross sections.

4.9.2. Drainage. All existing and new drainage piping, including upgrades thereto, including necessary intelligence to produce accurate plans and profiles for the Project site.

4.9.3. Storm Water and Sanitary Sewers. All existing and new sewer structures and piping, including upgrades thereto, with necessary connections to mains or other distribution points as appropriate, including necessary intelligence to produce accurate plans and profiles .

4.9.4. Utilities. All necessary new utilities connections from the Project building(s) to the existing or newly-created utilities, and all existing above ground and underground utility conduits, including necessary intelligence to produce accurate plans and site-sections.

4.9.5. Roads and Parking. All necessary roadways, parking lots, and parking structures, including necessary intelligence to produce accurate plans, profiles and cross-sections.

5.0 Section 5 - Ownership and Rights in Data

5.1. Ownership. The Government has ownership of and rights at the date of Closeout Submittal to all CAD files, BIM Model, and Facility Data developed for the Project in accordance with FAR Part 27, clauses incorporated in Section 00 72 00, Contract Clauses and Special Contract Requirement 1.14 GOVERNMENT RE-USE OF DESIGN (Section 00 73 00). The Government may make use of this data following any deliverable.

6.0 Section 6 – Contractor Electives

6.1. Applicable Criteria. If the Contractor elected to include one or more of the following features as an elective in its accepted contract proposal for additional credit, as described in the proposal submission requirements and evaluation criteria, the requirements of paragraphs 6.2 through 6.5 are as applicable for those elective feature(s) that will be included in the project.

6.2. COBIE Compliance. The Model and Facility Data for the Project shall fulfill Construction Operations Building Information Exchange (COBIE) requirements on the Whole Building Design Guide website (www.wbdg.org) , including all requirements for the indexing and submission of Portable Document Format (PDF) and other appropriate records that would otherwise be printed and submitted in compliance with Project operations and maintenance handover requirements.

6.3. Project Scheduling using the Model. In the PxP and during the Initial Design Conference Submittal Demonstration, provide an overview of the use of BIM in the development and support of the Project construction schedule.

6.3.1. Submittal Requirements. During the Stages identified in Paragraphs 3.3 through 3.6, the Contractor shall deliver the construction schedule derived from the Model.

6.3.1.1. Construction Submittals – Over-The-Shoulder Progress Reviews. Periodic quality control meetings or construction progress review meetings shall include quality control reviews on the implementation and use of the Model for Project scheduling.

6.4. Cost Estimating. In the PxP and during the Initial Design Conference Submittal Demonstration, provide an overview of the use of BIM in the development and support of cost estimating, or other costing applications such as comparative cost analysis for proposed changes and estimate validation.

6.4.1. Submittal Requirements. During the Stages identified in Paragraphs 3.3 through 3.6, the Contractor shall deliver cost estimating information derived from the Model.

6.4.2. Project Completion. At Project completion, the Contractor shall provide an Micro Computer Aided Cost Estimating System Generation II (“MII”) Cost Estimate that follows the USACE Cost Engineering Military Work Breakdown System (“WBS”), a modified Uniformat, to at least the sub-systems level and uses quantity information supplied directly from Model output to the maximum extent possible, though other "gap" quantity information will be included by the contractor as necessary for a complete and accurate Cost Estimate. (See Paragraph 6.4.2.2).

6.4.2.1. Sub system level extracted quantities from the Model for use within the Estimate shall be provided according to how detailed line items or tasks should be installed/built so that accurate costs can be developed and/or reflected. When developing a Model, the contractor shall be cognizant of construction sequencing at the beginning stages of Model development, such as recognizing tasks performed on the first floor versus the same task on higher floors that will be more labor intensive and, therefore, need to have a separate quantity and be priced differently. Tasks and their extracted quantities from the Model shall be broken down by their location (proximity in the structure) as well as the complexity of installation.

6.4.2.2. At all design Stages it shall be acknowledged that BIM output will not generate all quantities that are necessary in order to develop a complete and accurate cost estimate of the Project based on the design alone. (An example of this would be plumbing that is less than 1.5" diameter and, therefore, not expected to be modeled due to permitted level of design granularity; this information is commonly referred to as “The Gap”. Quantities addressing “The Gap” and their associated costs shall be included in the final Project actual Cost Estimates as well even though not derived directly from the Model data).

6.5. Other Analyses and Reports. Structural, energy and efficiency, EPACT 2005 & EISA 2007, lighting design, daylighting, electrical power, psychrometric processing, shading, programming, LEED, fire protection, code compliance, Life Cycle Cost, acoustic, plumbing and other analyses that may be generated from the Model or reports summarizing the data compiled from these analyses shall be submitted in the form established by contractor in its accepted PxP.

7.0 Definitions

7.1. The following definitions apply specifically in the context of this attachment only.

7.2. “Model”: An electronic, three-dimensional representation of facility elements with associated intelligent attribute data (“Facility Data”).

7.3. “Facility Data”: The non-graphical information attached to objects in the Model that defines various characteristics of the object. Facility Data can include properties such as parametric values that drive physical sizes, material definitions and characteristics (e.g. wood, metal), manufacturer data, industry standards (e.g. AISC steel properties), and project identification numbers. Facility Data can also

define supplementary physical entities that are not shown graphically in the Model, such as insulation around a duct, or hardware on a door.

7.4. "Workspace": A collection of content libraries and supporting files that define and embody a BIM standard. A workspace includes BIM libraries such as wall types, standard steel shapes, furniture, HVAC fittings, and sprinkler heads. It also contains sheet libraries such as print/plot configurations, font and text style libraries, and sheet borders and title blocks. The USACE has developed Workspaces specific to USACE BIM standards; these workspaces are dependent on specific versions of the BIM applications they serve. All USACE BIM Workspaces can be downloaded from the CAD/BIM Technology Center (https://cadbim.usace.army.mil). In some cases, there is a specific Workspace for a given CoS Facility Standard Design.

7.5. "IFC": Industry Foundation Class, a standard and file format used for the exchange of BIM data; see www.iai-tech.org. Note: In the context of this attachment, IFC does not mean "Issued For Construction."

ATTACHMENT G
DESIGN SUBMITTAL DIRECTORY AND SUBDIRECTORY FILE ARRANGEMENT

Organize electronic design submittal files in a subdirectory/file structure in accordance with the following table.

The Contractor may suggest a slightly different structure, subject to the discretion of the government.

Design Submittal Directory and Subdirectory File Arrangement.

Directory	Sub-Directory	Sub-Directory or Files	Files
Submittal/Package Name	Narratives	PDF file or files with updated design narrative for each applicable design discipline	
	Drawings	PDF (subdirectory)	Single PDF file with all applicable drawing sheets - bookmarked by sheet number and name
		BIM (subdirectory) See Attachment F.	BIM project folder (with files) per the USACE Workspace. Include an Excel drawing index file with each drawing sheet listed by sheet #, name and corresponding dgn file name (Final Design & Design Complete only)
	Design Analysis & Calculations	Individual PDF files containing design analysis and calculations for each discipline applicable to the submittal	
		PDF file with Fire Protection and Life Safety Code Review checklist	
	LEED	PDF file with updated Leed Check List	
		PDF file or files with LEED Templates for each point with applicable documentation included in each file.	
		LEED SUBMITTALS	
	Energy Analysis	PDF with baseline energy consumption analysis	
		PDF with actual building energy consumption analysis	
	Specifications	Single PDF file with table of contents and all applicable specifications sections.	
		Submittal Register (Final Design & Design Complete submittal only)	
	Design Quality Control	PDF file or files with DQC checklist(s) and/or statements	
	Building Rendering(s)	PDF file of rendering for each building type included in contract (Final Design & Design Complete).	

ATTACHMENT H
USACE BIM Project Execution Plan (PxP) Template Version 1.0

This template is a tool that is provided to assist in the development of a USACE BIM Project Execution Plan as required per contract. The template provides a standard format for organizations to establish their general means and methods for meeting the scope and deliverable requirements in Attachment F. It was adapted from the buildingSMART alliance™ (bSa) Project "BIM Project Execution Planning" as developed by The Computer Integrated Construction (CIC) Research Group of The Pennsylvania State University. The bSa project is sponsored by The Charles Pankow Foundation, Construction Industry Institute (CII), Penn State Office of Physical Plant (OPP), and The Partnership for Achieving Construction Excellence (PACE). The template can be found at the following link:

https://mrsi.usace.army.mil/rfp/Shared%20Documents/USACE_BIM_PXP_TEMPLATE_V1.0.pdf

Please note: Instructions and examples to assist with the completion of this template are currently in grey. The text can and should be modified to suit the needs of the organization filling out the template. If modified, the format of the text should be changed to match the rest of the document. This can be completed, in most cases, by selecting the normal style in the template styles.

SECTION 01 45 04.00 10
CONTRACTOR QUALITY CONTROL

1.0 GENERAL

1.1. REFERENCES

1.2. PAYMENT

2.0 PRODUCTS (NOT APPLICABLE)

3.0 EXECUTION

3.1. GENERAL REQUIREMENTS

3.2. QUALITY CONTROL PLAN

3.3. COORDINATION MEETING

3.4. QUALITY CONTROL ORGANIZATION

3.5. SUBMITTALS AND DELIVERABLES

3.6. CONTROL

3.7. TESTS

3.8. COMPLETION INSPECTION

3.9. DOCUMENTATION

3.10. NOTIFICATION OF NONCOMPLIANCE

1.0 GENERAL

1.1. REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Refer to the latest edition, as of the date of the contract solicitation.

- ASTM INTERNATIONAL (ASTM)
- ASTM D 3740 Minimum Requirements for Agencies

  Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
- ASTM E 329 Agencies Engaged in the Testing

  and/or Inspection of Materials Used in Construction
- U.S. ARMY CORPS OF ENGINEERS (USACE)

  ER 1110-1-12 Quality Management

1.2. PAYMENT

There will be no separate payment for providing and maintaining an effective Quality Control program. Include all costs associated therewith in the applicable unit prices or lump-sum prices contained in the Contract Line Item Schedule.

2.0 PRODUCTS (Not Applicable)

3.0 EXECUTION

3.1. GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause titled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product, which complies with the contract requirements. The system shall cover all design and construction operations, both onsite and offsite, and shall be keyed to the proposed design and construction sequence. The site project superintendent is responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager at the site, responsible for the overall site activities, including but not limited to quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Contracting Officer, and shall be responsible for all construction and construction related activities at the site. Different contractors have different names for the on-site overall project supervisor. For clarification, the term “site project superintendent” refers to the Contractor’s senior site representative or “on-site manager”, or other similar title, as those terms are used in contract Clause 52.236-7, “Superintendence by the Contractor” and in the Division 00 Section(s) of the solicitation for this contract or task order,.or elsewhere in the contract. It does not refer to a construction superintendent, unless that person is also the Contractor’s permanently assigned senior site representative in charge of all on-site activities.

3.2. QUALITY CONTROL PLAN

Furnish for Government review, not later than 30 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 30 days of operation. Design and construction may begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. The Government will not permit work outside of the features of work included in an accepted interim plan to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started. Where the applicable Code issued by the International Code Council calls for an inspection by the Building Official, the Contractor shall include the inspections in the Quality Control Plan and shall perform the inspections. The Designer of Record shall develop a program for any special inspections required by the applicable International Codes and the Contractor shall perform these inspections, using qualified inspectors. Include the special inspection plan in the QC Plan.

3.2.1. Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all design and construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents subcontractors, designers of record, consultants, architect/engineers (AE), fabricators, suppliers, and purchasing agents:

3.2.1.1. A description of the quality control organization. Include a chart showing lines of authority and an acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. A CQC System Manager shall report to the project superintendent or someone higher in the contractor's organization.

3.2.1.2. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function. Also include those responsible for performing and documenting the inspections required by the International Codes and the special inspection program developed by the designer of record.

3.2.1.3. A copy of the letter to the CQC System Manager, signed by an authorized official of the firm, which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Furnish copies of these letters.

3.2.1.4. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents subcontractors, designers of record, consultants, architect engineers (AE), offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

3.2.1.5. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. Use only Government approved Laboratory facilities.

3.2.1.6. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

3.2.1.7. Procedures for tracking design and construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

3.2.1.8. Reporting procedures, including proposed reporting formats.

3.2.1.9. A list of the definable features of work. A definable feature of work is a task, which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable feature under a particular section. This list will be agreed upon during the coordination meeting.

3.2.1.10. A list of all inspections required by the International Codes and the special inspection program required by the code and this contract.

3.2.2. Additional Requirements for Design Quality Control (DQC) Plan

The following additional requirements apply to the Design Quality Control (DQC) plan:

3.2.2.1. The Contractor's QCP Plan shall provide and maintain a Design Quality Control (DQC) Plan as an effective quality control program which will assure that all services required by this design-build contract are performed and provided in a manner that meets professional architectural and engineering quality standards. As a minimum, competent, independent reviewers identified in the DQC Plan shall review all documents. Use personnel who were not involved in the design effort to produce the design to perform the independent technical review (ITR). The ITR is intended as a quality control check of the design. Include, at least, but not necessarily limited to, a review of the contract requirements (the accepted contract or task order proposal and amended RFP), the basis of design, design calculations, the design configuration management documentation and check the design documents for errors, omissions, and for coordination and design integration. The ITR team is not required to examine, compare or comment concerning alternate design solutions but should concentrate on ensuring that the design meets the contract requirements. Correct errors and deficiencies in the design documents prior to submitting them to the Government.

3.2.2.2. Include in the DQC Plan the discipline-specific checklists to be used during the design and quality control of each submittal. Submit these completed checklists at each design phase as part of the project documentation.

3.2.2.3. A Design Quality Control Manager, who has the responsibility of being cognizant of and assuring that all documents on the project have been coordinated, shall implement the DQC Plan This individual shall be a person who has verifiable engineering or architectural design experience and is a registered professional engineer or architect. Notify the Government, in writing, of the name of the individual, and the name of an alternate person assigned to the position.

3.2.2.4. Develop and maintain effective, acceptable design configuration management (DCM) procedures to control and track all revisions to the design documents after the Interim Design Submission through submission of the As-Built documents. Include the DCM plan as a subset of the DQC Plan. See Section ‘Design After Award’.

3.2.3. Acceptance of Plan

Government acceptance of the Contractor's plan is required prior to the start of design and construction. Acceptance is conditional and will be predicated on satisfactory performance during the design and construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.4. Notification of Changes

After acceptance of the CQC Plan, notify the Government in writing of any proposed change. Proposed changes are subject to Government acceptance.

3.3. COORDINATION MEETING

After the Postaward Conference, before start of design or construction, and prior to acceptance by the Government of the CQC Plan, the Contractor and the Government shall meet and discuss the Contractor's quality control system. Submit the CQC Plan for review a minimum of 7 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, design activities, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. The Government will prepare minutes of the meeting for signature by both parties. . The minutes shall become a part of the contract file. There may be occasions when either party will call for subsequent conferences to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

3.4. QUALITY CONTROL ORGANIZATION

3.4.1. Personnel Requirements

The requirements for the CQC organization are a CQC System Manager, a Design Quality Manager, and sufficient number of additional qualified personnel to ensure contract compliance. The CQC organization shall also include personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly. The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Contracting Officer. Provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly furnish complete records of all letters, material submittals, shop drawing submittals, schedules and all other project documentation to the CQC organization. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.4.2. CQC System Manager

Identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, graduate architect, or a BA/BS graduate of an ACCE accredited construction management college program. The CQC system Manager may alternately be an engineering technician with at least 2 years of college and an ICC certification as a Commercial Building Inspector (Residential Building Inspector certification will be required for Military Family Housing projects). In addition, the CQC system manager shall have a minimum of 5 years construction experience on construction similar to this contract. The CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. Assign the CQC System Manager no other duties (except may also serve as Safety and Health Officer, if qualified and if allowed by Section 00 73 00). Identify an alternate for the CQC System Manager in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager but the alternate may have other duties in addition to serving in a temporary capacity as the acting QC manager.

3.4.3. CQC Personnel

3.4.3.1. In addition to CQC personnel specified elsewhere in the contract provide specialized CQC personnel to assist the CQC System Manager in accordance with paragraph titled Area Qualifications.

3.4.3.2. These individuals may be employees of the prime or subcontractor; be responsible to the CQC System Manager; **are not intended to be full time, but must be physically present at the construction site during work on their areas of responsibility**; have the necessary education and/or

experience in accordance with the experience matrix listed herein. These individuals may perform other duties but must be allowed sufficient time to perform their assigned quality control duties as described in the Quality Control Plan. **One person may cover more than one area, provided that they are qualified to perform QC activities for the designated areas below and provided that they have adequate time to perform their duties:**

3.4.4. Experience Matrix

3.4.4.1. Area Qualifications

3.4.4.1.1. Civil - Graduate Civil Engineer or (BA/BS) graduate in construction management with 4 years experience in the type of work being performed on this project or engineering technician with 5 yrs related experience.

3.4.4.1.2. Mechanical - Graduate Mechanical Engineer or (BA/BS) graduate in construction management with 4 yrs related experience or engineering technician with an ICC certification as a Commercial Mechanical Inspector with 5 yrs related experience.

3.4.4.1.3. Electrical - Graduate Electrical Engineer or (BA/BS) graduate in construction management with 4 yrs related experience or engineering technician with an ICC certification as a Commercial Electrical Inspector with 5 yrs related experience.

3.4.4.1.4. Structural - Graduate Structural Engineer or (BA/BS) graduate in construction management with 4 yrs related experience or person with an ICC certification as a Reinforced Concrete Special Inspector and Structural Steel and Bolting Special Inspector (as applicable to the type of construction involved) with 5 yrs related experience.

3.4.4.1.5. Plumbing - Graduate Mechanical Engineer or (BA/BS) graduate in construction management with 4 yrs related experience, or person with an ICC certification as a Commercial Plumbing Inspector with 5 yrs related experience.

3.4.4.1.6. Concrete, Pavements and Soils Materials Technician (present while performing tests) with 2 yrs experience for the appropriate area

3.4.4.1.7. Testing, Adjusting and Balancing Specialist must be a member (TAB) Personnel of AABC or an experienced technician of the firm certified by the NEBB (present while testing, adjusting, balancing).

3.4.4.1.8. Design Quality Control Manager Registered Architect or Professional Engineer (not required on the construction site)

3.4.4.1.9. Registered Fire Protection Engineer with 4 years related experience or engineering technician with 5 yrs related experience (but see requirements for Fire Protection Engineer of Record to witness final testing in Section 01 10 00, paragraph 5.10, Fire Protection).

3.4.4.1.10. QC personnel assigned to the installation of the telecommunication system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification. In lieu of BICSI certification, QC personnel shall have a minimum of 5 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. QC personnel shall witness and certify the testing of telecommunications cabling and equipment.

3.4.5. Additional Requirement

In addition to the above experience and/or education requirements the CQC System Manager shall have completed the course entitled "Construction Quality Management for Contractors". This course is periodically offered at http://www.usace.army.mil/CECW/Pages/cecwe_index.aspx. Inquire of the District or Division sponsoring the course for fees and other expenses involved, if any, for attendance at this course.

3.4.6. Organizational Changes

When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

3.5. SUBMITTALS AND DELIVERABLES

Make submittals as specified in Section 01 33 00 ***SUBMITTAL PROCEDURES***. The CQC organization shall certify that all submittals and deliverables are in compliance with the contract requirements.

3.6. CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. The CQC organization shall conduct at least three phases of control for each definable feature of the construction work as follows:

3.6.1. Preparatory Phase

Perform this phase prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

3.6.1.1. A review of each paragraph of applicable specifications, reference codes, and standards. Make a copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field at the preparatory inspection. Maintain these copies in the field, available for use by Government personnel until final acceptance of the work.

3.6.1.2. A review of the contract drawings.

3.6.1.3. A check to assure that all materials and/or equipment have been tested, submitted, and approved.

3.6.1.4. Review of provisions that have been made to provide required control inspection and testing.

3.6.1.5. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

3.6.1.6. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

3.6.1.7. A review of the appropriate activity hazard analysis to assure safety requirements are met.

3.6.1.8. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

3.6.1.9. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

3.6.1.10. Discussion of the initial control phase.

3.6.1.11. Notify the Government at least 24 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. Document the results of the preparatory phase actions by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.6.2. Initial Phase

Accomplish this phase at the beginning of a definable feature of work. Include the following actions:

3.6.2.1. Check work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

3.6.2.2. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

3.6.2.3. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

3.6.2.4. Resolve all differences.

3.6.2.5. Check safety to include compliance with and upgrading of the Accident Prevention plan and activity hazard analysis. Review the activity analysis with each worker.

3.6.2.6. Notify the Government at least 24 hours in advance of beginning the initial phase. The CQC System Manager shall prepare and attach to the daily CQC report separate minutes of this phase. Indicate exact location of initial phase for future reference and comparison with follow-up phases.

3.6.2.7. Repeat the initial phase any time acceptable specified quality standards are not being met.

3.6.3. Follow-up Phase

Perform daily checks to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Conduct final follow-up checks and correct deficiencies prior to the start of additional features of work which may be affected by the deficient work. Do not build upon nor conceal non-conforming work.

3.6.4. Additional Preparatory and Initial Phases

Conduct additional preparatory and initial phases on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.7. TESTS

3.7.1. Testing Procedure

Perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements and project design documents. Upon request, furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing

includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers approved testing laboratory, or establish an approved testing laboratory at the project site. The Contractor may elect to use a laboratory certified and accredited by the Concrete and cement Reference Laboratory (CCRL) or by AASHTO Materials Reference Laboratory (AMRL) for testing procedures that those organizations certify. The Contractor shall perform the following activities and record and provide the following data:

3.7.1.1. Verify that testing procedures comply with contract requirements and project design documents.

3.7.1.2. Verify that facilities and testing equipment are available and comply with testing standards.

3.7.1.3. Check test instrument calibration data against certified standards.

3.7.1.4. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

3.7.1.5. Include results of all tests taken, both passing and failing tests, recorded on the CQC report for the date taken. Include specification paragraph reference, location where tests were taken, and the sequential control number identifying the test. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. Provide an information copy of tests performed by an offsite or commercial test facility directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.7.2. Testing Laboratories

3.7.2.1. Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

3.7.2.2. Capability Recheck

If the selected laboratory fails the capability check, the Government will assess the Contractor a charge of $1,375 to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the contract amount due the Contractor.

3.7.3. Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.7.4. Furnishing or Transportation of Samples for Government Quality Assurance Testing

The Contractor is responsible for costs incidental to the transportation of samples or materials. Deliver samples of materials for test verification and acceptance testing by the Government to the Corps of Engineers Laboratory, f.o.b., at the following address:

- For delivery by mail:

  Contractor shall coordinate with Government and use a validated lab.

  N/A

N/A

N/A

- For other deliveries:

  Contractor shall coordinate with Government and use a validated lab.

  N/A

  N/A

  N/A

The area or resident office will coordinate, exact delivery location, and dates for each specific test.

3.8. COMPLETION INSPECTION

3.8.1. Punch-Out Inspection

Near the end of the work, or any increment of the work established by a time stated in the SPECIAL CONTRACT REQUIREMENTS Clause, "Commencement, Prosecution, and Completion of Work", or by the specifications, the CQC Manager shall conduct an inspection of the work. Prepare a punch list of items which do not conform to the approved drawings and specifications and include in the CQC documentation, as required by paragraph DOCUMENTATION. The list of deficiencies shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

3.8.2. Pre-Final Inspection

As soon as practicable after the notification above, the Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Correct any items noted on the Pre-Final inspection in a timely manner. Accomplish these inspections and any deficiency corrections required by this paragraph within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

3.8.3. Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall attend the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups and major commands may also attend. The Government will formally schedule the final acceptance inspection based upon results of the Pre-Final inspection. Provide notice to the Government at least 14 days prior to the final acceptance inspection and include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

3.9. DOCUMENTATION

3.9.1. Maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers using

government-provided software, QCS (see Section 01 45 01.10). The report includes, as a minimum, the following information:

3.9.1.1. Contractor/subcontractor and their area of responsibility.

3.9.1.2. Operating plant/equipment with hours worked, idle, or down for repair.

3.9.1.3. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

3.9.1.4. Test and/or control activities performed with results and references to specifications/drawings requirements. Identify the applicable control phase (Preparatory, Initial, Follow-up). List deficiencies noted, along with corrective action.

3.9.1.5. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

3.9.1.6. Submittals and deliverables reviewed, with contract reference, by whom, and action taken.

3.9.1.7. Offsite surveillance activities, including actions taken.

3.9.1.8. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

3.9.1.9. Instructions given/received and conflicts in plans and/or specifications.

3.9.1.10. Provide documentation of design quality control activities. For independent design reviews, provide, as a minimum, identity of the ITR team, the ITR review comments, responses and the record of resolution of the comments.

3.9.2. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. Furnish the original and one copy of these records in report form to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, submit one report for every 7 days of no work and on the last day of a no work period. Account for all calendar days throughout the life of the contract. The first report following a day of no work shall be for that day only. The CQC System Manager shall sign and date reports. The report shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel. The Contractor may submit these forms electronically, in lieu of hard copy.

3.10. NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

End of Section 01 45 04.00 10

SECTION 01 50 02.TBD
TEMPORARY CONSTRUCTION FACILITIES

1.0 OVERVIEW

1.1. GENERAL REQUIREMENTS

1.3. BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

1.0 OVERVIEW

1.1. GENERAL REQUIREMENTS

1.1.1. This section contains requirements specifically applicable to this task order. The requirements of Base ID/IQ contract Section 01 50 02 apply to this task order, except as otherwise specified herein.

1.3. BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

1.3.1. Bulletin Board (As Specified in Base contract)

1.3.2. Project and Safety Signs (Added to Stress standardization of signs, in the event that the Base ID/IQ Section 01 50 02 does not contain this information)

Erect a project sign and a site safety sign with informational details as provided by the Government at the Post award conference, within 15 days prior to any work activity on project site. Update the safety sign data daily, with light colored metallic or non-metallic numerals. Remove the signs from the site upon completion of the project. Engineer Pamphlet EP 310-1-6a contains the standardized layout and construction details for the signs. It can be found through a GOOGLE Search or try http://www.usace.army.mil/publications/eng-pamphlets/ep310-1-6a/s-16.pdf.

End of Section 01 50 02.TBD

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04/08

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SECTION 01 57 23

TEMPORARY STORM WATER POLLUTION CONTROL
04/08

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM D 4439	(2004) Geosynthetics
ASTM D 4491	(1999a; R 2004e1) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(2004) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(2008) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(2004) Determining Apparent Opening Size of a Geotextile
ASTM D 4873	(2002) Identification, Storage, and Handling of Geosynthetic Rolls and Samples

1.2 SYSTEM DESCRIPTION

The work consists of implementing the storm water pollution prevention measures to prevent sediment from entering streams or water bodies as specified in this Section in conformance with the requirements of Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION, and the requirements of the National Pollution Discharge Elimination System (NPDES) permit.

1.3 EROSION AND SEDIMENT CONTROLS

The controls and measures required of the Contractor are described below.

1.3.1 Stabilization Practices

The stabilization practices to be implemented include temporary seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, erosion control matts, protection of trees, preservation of mature vegetation. On the daily CQC Report, record the dates when the major grading activities occur, (e.g., clearing and grubbing, excavation, embankment, and grading); when construction activities temporarily or permanently cease on a portion of the site; and when stabilization practices are initiated. Except as provided in paragraphs UNSUITABLE CONDITIONS and NO ACTIVITY FOR LESS THAN 21 DAYS, initiate stabilization practices as soon as practicable, but no more than 14 days, in any portion of the site where construction activities

have temporarily or permanently ceased.

1.3.1.1 Unsuitable Conditions

Where the initiation of stabilization measures by the fourteenth day after construction activity temporarily or permanently ceases or is precluded by unsuitable conditions caused by the weather, initiate stabilization practices as soon as practicable after conditions become suitable.

1.3.1.2 No Activity for Less Than 21 Days

When the total time period in which construction activity is temporarily ceased on a portion of the site is 21 days minimum, stabilization practices do not have to be initiated on that portion of the site until 14 days have elapsed after construction activity temporarily ceased.

1.3.1.3 Burnoff

Burnoff of the ground cover is not permitted.

1.3.1.4 Protection of Erodible Soils

Immediately finish the earthwork brought to a final grade, as indicated or specified, and protect the side slopes and back slopes upon completion of rough grading. Plan and conduct earthwork to minimize the duration of exposure of unprotected soils.

1.3.2 Erosion, Sediment and Stormwater Control

a. Submit "Erosion and Sediment Controls" (E&S) (form provided at the pre-construction conference) and Storm Water Inspection Reports for General Permit to the Contracting Officer once every 7 calendar days and within 24 hours of a storm event that produces 0.5 inch or more of rain. Will be maintained on site and accessable for inspections by local, state, and federal inspectors.

b. Storm Water Notice of Intent for Construction Activities

Fort Campbell submits the Notice of Intent, at the beginning of the calendar year, for each state. This provides the permit coverage for construction projects on installation. The government will provide the contractor a Storm Water Pollution Prevention Plan Guidance Document for the development of the Site Specific SWPPP by the Contractor for the project prior to the commencement of work. The SWPPP shall meet the requirements of the Fort Campbell Tennessee Individual NPDES Permit TN0080314 for storm water discharges from construction sites. The Fort Campbell Policy is available on the Environmental Division's website, at http://www.campbell.army.mil/envdiv/ under Water Programs. Maintain an approved copy of the SWPPP at the construction on-site office, and continually update as regulations require, to reflect current site conditions. Include within the SWPPP:

(1) Identify potential sources of pollution which may be reasonably expected to affect the quality of storm water discharge from the site.

(2) Describe and ensure implementation of practices which will be used to reduce the pollutants in storm water discharge from the

site.

(3) Ensure compliance with terms of the Tennessee Department of Environment and Conservation (TDEC) general permit for storm water discharge.

(4) Select applicable best management practices from EPA 832-R-92-005.

(5) Install, inspect, and maintain best management practices (BMPs) as required by the general permit.

(6) Once construction is complete and the site has been stabilized with a final, sustainable cover, a final walk through by the Contracting Officer and Environmental Division personnel will release the project and be documented for the purposes of the Notice of Termination submitted by the installation.

1.3.3 Structural Practices

Implement structural practices to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Implement structural practices in a timely manner, during the construction process, to minimize erosion and sediment runoff. Include the following devices; Location and details of installation and construction are shown on the drawings.

1.3.3.1 Silt Fences

Provide silt fences as a temporary structural practice to minimize erosion and sediment runoff. Properly install silt fences to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g. clearing and grubbing, excavation, embankment, and grading). Install silt fences in the locations indicated on the drawings. Obtain approval from the Contracting Officer prior to final removal of silt fence barriers.

1.3.3.2 Straw Bales

Not Used

1.3.3.3 Diversion Dikes

If used, build diversion dikes with a maximum channel slope of 2 percent and adequately compacted to prevent failure. The minimum height measured from the top of the dike to the bottom of the channel shall be 18 inches. The minimum base width shall be 6 feet and the minimum top width shall be 2 feet. Ensure that the diversion dikes are not damaged by construction operations or traffic. Locate diversion dikes where shown on the drawings.

1.3.4 Sediment Basins

Trap sediment in temporary sediment basins. Basins shall be sized to match the size of the proposed bioretention basins. Sediment Basins shall be excavated to the proposed elevation of washed stone as shown on the Bioretention Areas (Typical Section) detail. Install 4-inch perforated drain pipe completely encased in geo fabric and washed stone, and tie into Catch Basin boxes at location of future 4-inch french drain. Pump dry and remove the accumulated sediment, after each storm. Use proposed catch

basin grate for overflow. Remove collected sediment from the site. Install, inspect, and maintain best management practices (BMPs) as required by the general permit. Prepare BMP Inspection Reports as required by the general permit. If required by the permit, include those inspection reports. Biorention basin media should be retrofitted in the sediment basins at the end of the construction phase. The biobasin design and maintenance procedures must be provided to the Fort Campbell Environmental Division.

1.3.5 Vegetation and Mulch

a. Provide temporary protection on sides and back slopes as soon as rough grading is completed or sufficient soil is exposed to require erosion protection. Protect slopes by accelerated growth of permanent vegetation, temporary vegetation, mulching, or netting. Stabilize slopes by hydroseeding, anchoring mulch in place, covering with anchored netting, sodding, or such combination of these and other methods necessary for effective erosion control.

b. Seeding: Provide new seeding where ground is disturbed. Include topsoil or nutriment during the seeding operation necessary to establish or reestablish a suitable stand of grass. The seeding operation will be as specified in Section 32 92 19 SEEDING.

1.3.5.1 Stone Silt Checks

Excavate a cutoff trench into the creek banks, and extend it a minimum of 18 inches into the abutments. Place the rock in the cutoff trench and channel. The maximum height of the dam is 2 feet with a minimum of 9 inches between the top of dam and top of banks. If more than one dam is used in the drainage way, then place riprap downstream of the lower most dam a distance of 6 feet.

1.3.5.2 Inlet Protection (Fabric, FIP)

The Contractor shall provide fabric inlet protection as a temporary structural practice to minimize erosion and sediment runoff. Fabric inlet protection shall be properly installed to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g. clearing and grubbing, excavation, embankment, and grading). Fabric inlet protection shall be installed in the locations indicated on the drawings. Final removal of inlet protection shall be upon approval by the Contracting Officer.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Storm Water Pollution Prevention Plan; G, RO

Pollution prevention plan and Notice of intent for NPDES coverage under the general permit for construction activities

Environmental Protection Plan; G, RO

Environmental protection plan to include Spill Protection, Waste Diversion, and Air Quality data forms (forms to be provided by the Government).

SD-06 Test Reports

Storm Water Inspection Reports for General Permit; G, RO
Erosion and Sediment Controls

SD-07 Certificates

Mill Certificate or Affidavit

Certificate attesting that the Contractor has met all specified requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

Identify, store and handle filter fabric in accordance with ASTM D 4873.

PART 2 PRODUCTS

2.1 COMPONENTS FOR SILT FENCES

2.1.1 Filter Fabric

Provide geotextile that complies with the requirements of ASTM D 4439, and consists of polymeric filaments which are formed into a stable network such that filaments retain their relative positions. The filament shall consist of a long-chain synthetic polymer composed of at least 85 percent by weight of ester, propylene, or amide, and contains stabilizers and/or inhibitors added to the base plastic to make the filaments resistent to deterioration due to ultraviolet and heat exposure. Provide synthetic filter fabric that contains ultraviolet ray inhibitors and stabilizers to assure a minimum of six months of expected usable construction life at a temperature range of 0 to 120 degrees F. The filter fabric shall meet the following requirements:

FILTER FABRIC FOR SILT SCREEN FENCE

PHYSICAL PROPERTY	TEST PROCEDURE	STRENGTH REQUIREMENT
Grab Tensile	ASTM D 4632	100 lbs. min.
Elongation (percent)		30 percent max.
Trapezoid Tear	ASTM D 4533	55 lbs. min.
Permittivity	ASTM D 4491	0.2 sec-1
AOS (U.S. Std Sieve)	ASTM D 4751	20-100

2.1.2 Silt Fence Stakes and Posts

Use either wooden stakes or steel posts for fence construction. Wooden stakes utilized for silt fence construction, shall have a minimum cross section of 2 by 2 inches when oak is used and 4 by 4 inches when pine is used, and have a minimum length of 5 feet. Steel posts (standard "U" or "T" section) utilized for silt fence construction, shall have a minimum weight of 1.33 pounds/linear foot and a minimum length of 5 feet.

2.1.3 Mill Certificate or Affidavit

Provide a mill certificate or affidavit attesting that the fabric and factory seams meet chemical, physical, and manufacturing requirements specified above. Specify in the mill certificate or affidavit the actual Minimum Average Roll Values and identify the fabric supplied by roll identification numbers. Submit a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the filter fabric.

PART 3 EXECUTION

3.1 INSTALLATION OF SILT FENCES

Extend silt fences a minimum of 16 inches above the ground surface without exceeding 34 inches above the ground surface. Provide filter fabric from a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, splice together filter fabric at a support post, with a minimum 6 inch overlap, and securely sealed. Excavate trench approximately 4 inches wide and 4 inches deep on the upslope side of the location of the silt fence. The 4 by 4 inch trench shall be backfilled and the soil compacted over the filter fabric. Remove silt fences upon approval by the Contracting Officer.

3.2 INSTALLATION OF Fabric Inlet Protection

Fabric Inlet protection is used around catch basins located in non-pavement areas such as at toe of side slopes or in ditch locations. Construct a dike on the downslope side of the inlet to prevent runoff from bypassing. Dike should be 12 inches higher than the catch basin grate elevation. Cut fabric from a single roll to avoid joints (same fabric as used for the silt fence). Construct the fence as shown on the design detail sheet in the Stormwater Pollution Prevention Plan (SWPPP) and as shown in the contract drawings. Space the support posts evenly against the inlet perimeter a maximum of 3 feet apart, and drive them about 18-inches into the ground.

3.3 FIELD QUALITY CONTROL

Maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. Use the following procedures to maintain the protective measures.

3.3.1 Silt Fence Maintenance

Inspect the silt fences in accordance with paragraph, titled "Inspections," of this section. Any required repairs shall be made promptly. Pay close attention to the repair of damaged silt fence resulting from end runs and

undercutting. Should the fabric on a silt fence decompose or become ineffective, and the barrier is still necessary, replace the fabric promptly. Remove sediment deposits when deposits reach one-half or 50% of the height of the barrier. Remove a silt fence when it is no longer required. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall be seeded in accordance with 32 92 19 SEEDING, except that the coverage requirements in paragraph, titled "Establishment" of this section do not apply.

3.3.2 Straw Bale Maintenance

Not Used.

3.3.3 Diversion Dike Maintenance

Inspect diversion dikes in accordance with paragraph, titled "Inspections," of this section. Pay close attention to the repair of damaged diversion dikes and accomplish necessary repairs promptly. When diversion dikes are no longer required, shape to an acceptable grade. Seed the areas disturbed by this shaping in accordance with UFGS Guide Specification 32 92 19 SEEDING.

3.4 INSPECTIONS

3.4.1 General

Inspections are to be conducted by the Contractor's Tennessee certified inspector. Inspect disturbed areas of the construction site, areas that have not been finally stabilized used for storage of materials exposed to precipitation, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least twice weekly, 72 hours apart and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. The inspection occuring within 24 hours of the end of any storm producing 0.5 inches or more rainfall can be considered one of the twice weekly inspections. Conduct inspections at least once every month where sites have been finally stabilized.

3.4.2 Inspections Details

Inspect disturbed areas and areas used for material storage that are exposed to precipitation for evidence of, or the potential for, pollutants entering the drainage system. Observe erosion and sediment control measures identified in the Storm Water Pollution Prevention Plan to ensure that they are operating correctly. Inspect discharge locations or points to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Inspect locations where vehicles exit the site for evidence of offsite sediment tracking.

3.4.3 Inspection Reports

For each inspection conducted, prepare a report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the Storm Water Pollution Prevention Plan, maintenance performed, and actions taken. Furnish the report to the Contracting Officer within 24 hours of the inspection as a part of the Contractor's daily CQC REPORT. A copy of the inspection report shall be maintained on the job site.

-- End of Section --

APPENDIX A

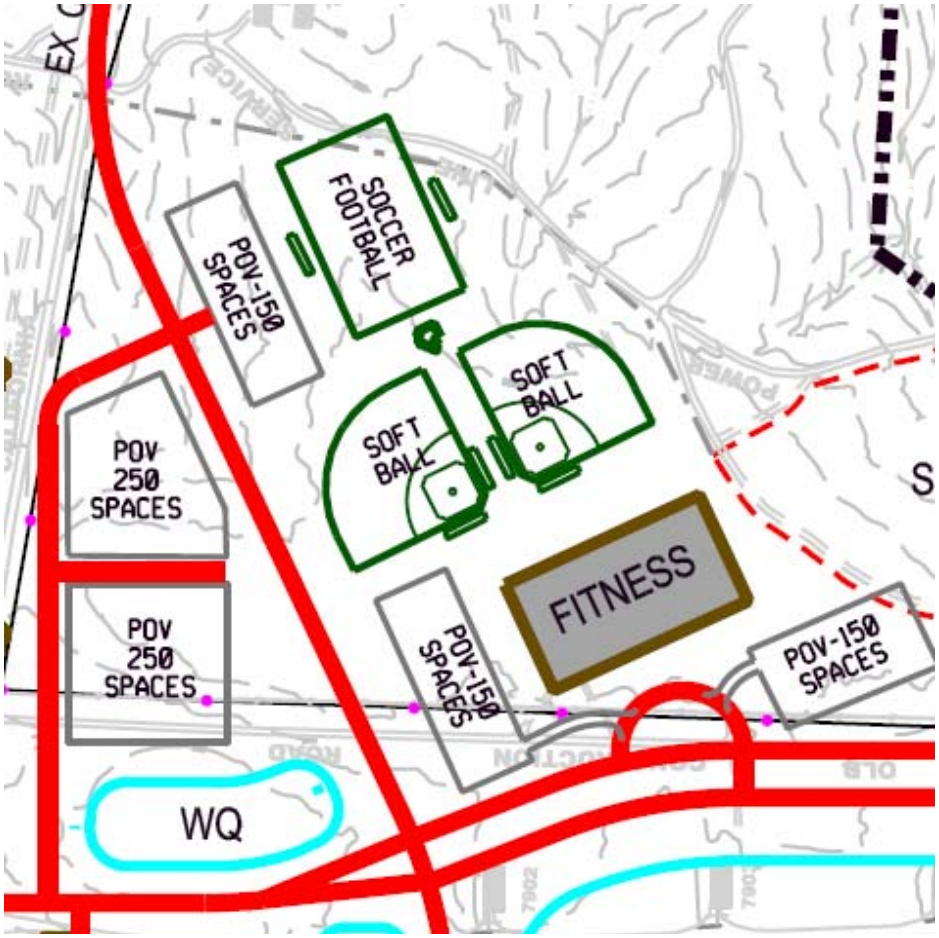
GEOTECHNICAL/GEOPHYSICAL
INFORMATION

US Army Corps of Engineers
Louisville District

PRELIMINARY SUBSURFACE CHARACTERIZATION REPORT

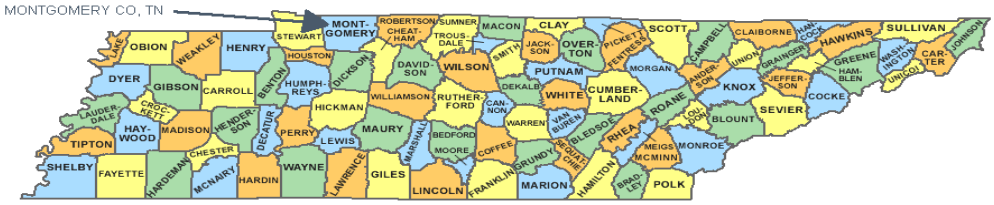
Physical Fitness Facility
Clarksville Base, Fort Campbell, TN

January 2008



Prepared by: I. Weilbaker
Reviewed by: R. Jeffries

Status: Final Submittal



DEPARTMENT OF THE ARMY
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CELRL-ED-T-G

3 January 2008

MEMORANDUM FOR CELRL-ED-D-A (PRIDE)

SUBJECT: Physical Fitness Facility, Clarksville Base, Fort Campbell, TN

1. CELRL-ED-T-G has completed the requested geotechnical exploration for the subject project. A report has been prepared to characterize the subsurface conditions at the project site. The report provides a general overview of the soil and geologic conditions with detailed descriptions at discrete boring locations. The Contractor's team shall include a licensed geotechnical engineer to interpret the report and develop earthwork and foundation recommendations and design parameters. If any additional subsurface investigation or laboratory analysis is required to better characterize the site conditions, it shall be performed under the direction of a licensed geotechnical engineer and shall be the full responsibility of the Contractor. A final geotechnical evaluation report shall be prepared by the licensed geotechnical engineer and submitted along with the first foundation design submittal.

2. The point of contact is Mr. Ryan Jeffries at (502) 315-6439 regarding the information presented in this report.

Encl

ISAIAH A. WEILBAKER
Project Engineer

RYAN K. JEFFRIES, P.E.
Project Checker

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1. BACKGROUND

1.1 PROJECT INFORMATION

General project information was provided by Brian Phelps of CELRL-ED-T-C. The proposed Physical Fitness Facility is located at Clarksville Base in Fort Campbell, TN. The site is located just east of the intersection of California Rd. and Old Construction Rd. The following documents were provided:

- Area Development Plan- Siteplan Concept, dated September 2007
- Quality Control Plan, prepared by R. Pride, dated 10/4/07.

Existing ground surface elevations range from 480 feet to 520 feet (USGS).

1.2 SITE GEOLOGY AND SEISMICITY

1.2.1 Geology

The bedrock foundation of Ft. Campbell is composed of Mississippian aged St. Genevieve and St. Louis Limestones. The St. Genevieve formation is a gray to white, slightly dark where weathered, thin to thick bedded, predominately oolitic, argillaceous and fossiliferous limestone which contains chert stringers. Native soils formed by the in-place solution weathering of this parent limestone formation typically consist of reddish brown clays that increase in plasticity from low to moderate with increasing depth. The soil/rock surface is typically erratic, and overburden thickness can vary.

The St. Louis Limestone is yellowish gray, light to olive gray, and dark gray to medium bluish gray, weathering to light gray to olive gray, very fine to medium grained, and is commonly bedded in layers less than 1 foot thick beds. This limestone is interbedded with dolomite and shale. The dolomite is medium dark gray to olive gray, weathering to yellowish gray, very fine to fine grained, 0.1 to 5.0 feet thick beds, commonly spalls on weathering, and contains crystalline calcite. Beds of carbonaceous shale, less than 0.3 ft thick, are present near the base of the unit. Chert occurs as irregular, spherical masses in a persistent zone near base and in limestone beds higher in the unit. The chert locally contains distinctive fossils. Experience with this geologic unit indicates the soil/rock surface is typically erratic, with soil-filled slots extending into the rock unit or with rock pinnacles extending up into the soil overburden. Because of the variability of the rock surface, the overburden thickness can vary from a few to tens of feet.

1.2.2 Seismicity

The project site is located on the periphery of the New Madrid seismic region which has the potential to influence ground motions. A site-specific study to determine ground motion was beyond the scope of this study.

For this study, the maximum considered earthquake (MCE) ground motions were represented by the spectral response accelerations for 2 percent probability of exceedance (PE) in 50 years, obtained from the National Seismic Hazard Maps published by the United States Geological Survey (USGS). Using the **USGS Java Ground Motion Parameter Calculator - Version 5.0.7**, the MCE, 5-percent-damped, spectral response acceleration parameter at short periods (S_S) is 0.581g. The MCE, 5-percent-damped, spectral response acceleration parameter at a period of one second (S_1) is 0.185g. Site classification for seismic design is discussed in a subsequent report section.

1.3 SITE CONDITIONS

A site reconnaissance was conducted on 01 November 2007 by Messers Matthew Whelan and Isaiah Weilbaker of CELRL-ED-T-G to observe and document surface conditions at the project site. The information gathered was used to help characterize the site.

The project site is located east of California Road and north of a new construction road at Fort Campbell Military Reserve in Fort Campbell, TN as shown Figure 2 in Appendix A. The project site was bounded to the west by a barracks facility project in the early stages of construction, by a wooded area to the east, by Ohio Road to the north, and by a new construction road to the south. At the time of the reconnaissance, the project site was idle.

The site is currently a partially cleared wooded area with rolling surface topography. The eastern portion of this site is open grassland (photos 1-3, 11-16). There has been some timber harvest and some clearing activities within the western portion of the site (photos 17-19, 21). Wooded areas consist of mature timber, dense evergreen cover and thick underbrush. Drainage included partially developed shallow seeded ditches on each side of the new construction road. Surface drainage in the vicinity of the proposed facilities flow to the south and southwest of the site. No streams or creeks were present. An east-west electric line and easement (photos 27-30) run approximately parallel to the Old Construction Road (photos 22, 25, 26) along the southern boundary of the site. Old stone remnants of possible small building foundations were noted within the southeast portion of the site (photo 4). No other existing structures were observed.

Rock outcrops were not observed on site. No rock excavation or indication of rock excavation was observed on the adjacent barracks facility site. Rock outcrops were observed at the base of the hillside slopes along Ohio Rd approximately ¼ mile north of the subject site.

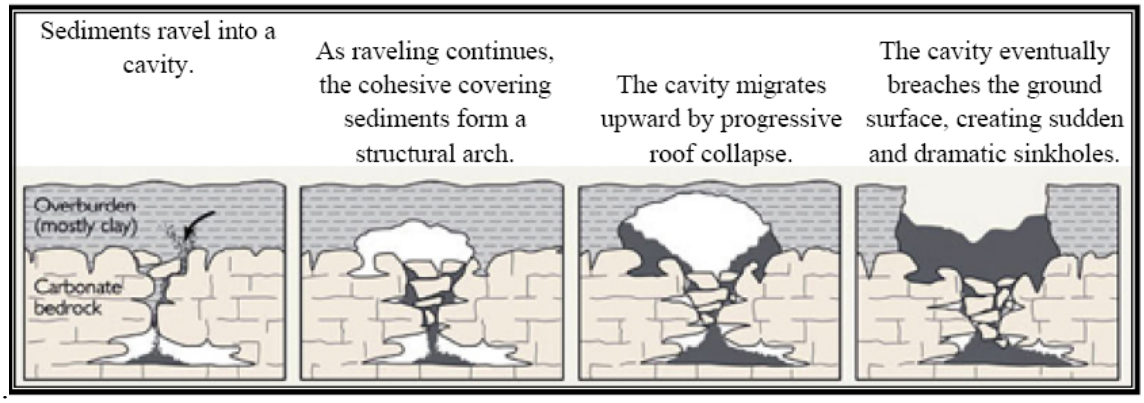
During the digging permit process it was discovered an old landfill exists to the eastern portion of the site. From the current site plan, part of the eastern parking lot may be located over this landfill. A map of the landfill area is included in Appendix A.

1.4 SINKHOLE DEVELOPMENT POTENTIAL

There were no visible open sinkholes as dense vegetative cover made identification difficult. There may be other low lying areas within the project site which may have sinkholes and have the potential for sinkhole development during construction. A review of the USGS topographic map indicates a high frequency of sinkholes and closed topographic depressions distributed throughout the Fort Campbell area. A large closed topographic depression is mapped along the southern site boundary (see Figure 2, Appendix A). The following sketches shown in Figure 1 provide a visual description of how sinkholes are formed and result in topographic depressions. Sinkhole development in areas underlain by limestone generally results from either a general raveling failure within the soil unit or by rock collapse. Either phenomenon typically results in depressions at the ground surface, which, if large enough, can be identified on topographic maps. Sinkholes begin at the rock surface and migrate toward the surface as raveling occurs. In many instances, sinkholes near the surface remain undetected by conventional exploration efforts.

Raveling failures are the most common of the subsidence phenomena that are associated with areas underlain by limestone formations. A typical scenario for sinkhole development caused by raveling begins with the natural rising and lowering of the groundwater table and is aggravated by surface water migration downward through the subsurface soils. The moving water typically mobilizes and transports soil particles from their original location into a lower lying strata. The movement of soil particles results in the formation of open voids in the overburden soil. With time, these resulting voids in the soil zone spall and collapse under the forces of gravity or increased loading such as construction activity. This spalling can lead to the development of large voids or cavities within the soil unit. Continued long term water movement causes the void or cavity to progressively expand until the soil arch is thin enough and near the ground surface such that the soil collapses into the cavity and a dropout results. Surface erosion then continues enlarge the dropout to a conical, rounded depression. This type of sinkhole development is most common to the Fort Campbell area.

Figure 1 - Progressive Development of Sinkholes



Additionally, as the water encounters the limestone bedrock, it continues to migrate downward into small fissures and bedding planes into the rock unit. With time, this migration of water may result in solution weathering of the limestone bedrock. The natural acidity in water migrating through the bedrock reacts with the calcium-based limestone rock. This chemical reaction dissolves the bedrock, resulting in the formation of voids and cavities in the rock unit. The resulting open voids and cavities in the bedrock act as a conduit for movement of water and suspended solids.

The second type of subsidence is due to rock collapse. The development of caves within limestone bedrock is the result of prolonged, concentrated solution activity. Voids are created through the introduction of surface water into the subsurface, as described above. The voids thus created are then enlarged by continued flow of water through the area. As the voids become larger and eventually interconnect, the quantity of water flowing through the area increases and results in more weakened rock below, the rock then collapses, resulting in a surface depression (i.e. a sinkhole). However, large scale dropouts due to rock collapses are rare in the Fort Campbell area. In addition to the natural causes of sinkhole development previously discussed, solution activity may also result from fluids leaking from subsurface piping and drainage systems such as buried water and sewer pipes and roof drains beneath the building and floor slabs.

1.5 TRAFFIC COMPOSITION FOR PAVEMENT DESIGN

Information regarding future traffic at the site was given by Fred Williams of Master Plans, Public Works Directorate, Fort Campbell, TN.

The planned Physical Fitness Facility parking lots and entrance road will experience mainly private operated vehicles (POV). At the time of this report, two (2) parking lots are planned, each sized for approximately 174 parking spaces. Each parking lot should expect 350 POV passes per day. The entrance road should expect 700 POV passes per day and should also expect occasional truck and tractor trailer traffic, such as garbage trucks and delivery vehicles.

2. EXPLORATORY FINDINGS

The subsurface conditions were explored with 4 soil test borings at the location shown on Figure 3 in Appendix A. The boring locations and depths were selected by CELRL-ED-T-G. The actual boring locations were determined by a geotechnical engineer using a hand-held GPS device. The boring elevations were determined by interpolation between contours on the site plan referenced in the project information section of this report.

Laboratory testing consisted of moisture content and Atterberg limits determinations on selected soil samples. A description of the subsurface conditions encountered with pertinent available physical properties is presented in the following sections.

2.1 FIELD SAMPLING AND TESTING

Field sampling and testing were performed in general accordance with USACE or ASTM procedures and established geotechnical engineering practice. The samples obtained during the exploration included driven (split-spoon samples). The samples were visually classified in the field by a geologist and returned to the Contractor's office for laboratory testing.

The standard penetration test (SPT) is one of the most widely used field tests in geotechnical engineering. At regular intervals, drilling tools are removed and soil samples obtained with a standard 1.4-inch-inside-diameter (I.D.), 2-inch-outside-diameter (O.D.), split-tube sampler. The sampler is first seated 6 inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer free-falling 30 inches. The number of hammer blows required to drive the sampler the final one foot is designated the "penetration resistance" or *N*-value. The penetration resistance when properly evaluated is an index to the soil's strength.

Measured standard penetration test (SPT) resistances (N_m-values) are dependent on many factors including overburden pressure, hammer efficiency, borehole diameter, length of drilling rods, and sampling method. To account for the variability associated with the field data, correction factors are applied to normalize N_m to an initial effective vertical overburden pressure (σ'_{v0}) of atmospheric pressure (P_a), approximately 100 kilopascals (kPa), and a hammer energy ratio (efficiency) of 60 percent. The SPT correction factors, summarized in the following table[1], were applied to the SPT N_m-values to normalize the measured blow counts to obtain an equivalent blow count or $(N_1)_{60}$-value.

[1] Youd, T. L., Idriss, I. M., et al. "Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils." *J. Geotech. and Geoenvir. Engrg.*, ASCE, Oct. 2001, 127(10), 820-821.

Table 1. Corrections to Measured SPT N_m-values

Factor	Equipment Variable	Term	Correction
Overburden pressure	N/A	C_N	$2.2/(1.2 + \sigma'_{v0}/P_a)$
Hammer efficiency	Donut hammer	C_E	0.5 to 1.0
	Safety hammer		0.7 to 1.2
	Automatic-trip donut-type hammer		0.8 to 1.3
Borehole diameter	65 to 115 millimeters	C_B	1.0
	150 millimeters		1.05
	200 millimeters		1.15
Rod length	Less than 3 meters	C_R	0.75
	3 to 4 meters		0.8
	4 to 6 meters		0.85
	6 to 10 meters		0.95
	10 to 30 meters		1.0
Sampling method	Standard sampler	C_S	1.0
	Standard sampler with liners	C_S	1.1 to 1.3

Automatic hammers are becoming more prevalent in practice for standard penetration testing for speed and safety. Since automatic hammers are more efficient and deliver more energy per blow, SPT *N*-values are generally lower than other hammer types. SPT *N*-values from automatic hammers have been found to be approximately 75 percent of those from safety hammers[2]. A C_E value of 1.25 was used to correct for hammer efficiency. The corrected blow count can be obtained from the following equation:

$$(N_1)_{60} = N_m C_N C_E C_B C_R C_S$$

where N_m is the "uncorrected" measured SPT resistance, and the other terms are as defined in the preceding table.

Plots of $(N_1)_{60}$ versus elevation are provided in Appendix B.

2.2 LABORATORY TESTING

The laboratory testing performed on selected soil samples for this study included natural moisture content determination and Atterberg limits tests. The laboratory testing program is summarized in the following table.

[2] Drumright E. E., Pfingsten, C. W., and Lukas, R. G. "Influence of Hammer Type on SPT Results." *J. Geotech. and Geoenvir. Engrg.*, ASCE, 122(7), 598-599.

Table 2. Laboratory Testing Program

Classification Tests	Qty.
Natural Moisture Content	26
Atterberg Limits	8

The results of the laboratory testing are provided in Appendix C.

2.3 SUBSURFACE CONDITIONS

The boring logs represent the geotechnical engineer's interpretation of the subsurface conditions based on the visual classification of field samples and laboratory tests of selected field samples. The interface between various strata on the boring logs represents the approximate interface location. Transitions between strata may be more gradual than shown. Water levels shown on the boring logs represent the conditions only at the time of exploration, unless otherwise indicated.

In general, the borings encountered one soil strata underlying a topsoil layer. The soil strata and pertinent available physical properties are described in the following paragraphs.

2.3.1 Topsoil

Topsoil thicknesses ranged from 1 to 2 inches thick on the boring logs. However, these values are not representative of appropriate stripping depths. Since a large portion of the site is wooded, organic material will exist well below the topsoil, and stripping depths will be greater than the noted topsoil and will vary greatly across the site. There are also ample small stockpiles of soil and organic debris on the site apparently left from previous clearing of the electric easement.

2.3.2 Soil Test Borings

Stratum I: The Stratum I soils generally consisted of reddish brown, lean clay with chert to a depth of 4 to 9 feet below the ground surface. We have interpreted the Stratum I soils to be native soils. Field-measured standard penetration test (SPT) resistances (N-values) ranged from 7 blows per foot (bpf) to 63 bpf. The corresponding corrected $(N_1)_{60}$-values are indicative of soils with stiff to hard consistency. The values in the upper 5.5 feet of Stratum I are indicative of soils with stiff to very stiff consistency, while the consistency was typically very stiff to hard below a depth of about 5.5 feet.

Soil plasticity tests (Atterberg limits) performed on selected samples indicated Liquid Limits ranging from 37 to 45, and Plasticity Indices ranging from 16 to 21. These values correspond to "CL" type soils, according to the Unified Soil Classification System (USCS). The moisture content of the samples tested ranged from 20.8 to 25.6 percent. These values are indicative of moist samples.

Stratum II: The Stratum II soils generally consisted of reddish brown fat clay with chert beginning at 4 to 9 feet below the ground surface and extending to the termination depth. We have interpreted the Stratum II soils to be native soils. SPT N-values ranged from 7 bpf to 41 bpf. The corresponding corrected $(N_1)_{60}$-values are indicative of soils with stiff to hard consistency.

Atterberg limits performed on selected samples indicated Liquid Limits ranging from 50 to 86, and Plasticity Indices ranging from 29 to 62. These values correspond to "CH" type soils, according to the USCS. The moisture content of the samples tested ranged from 23.6 to 38.6 percent. These values are indicative of moist to wet samples.

2.3.3 Termination

The borings within the proposed building footprint were terminated at the predetermined depth of 20.5 feet, and the borings within the proposed parking areas were terminated at the predetermined depth of 15.5 feet. Refusal material was not encountered at the termination depths.

2.4 GROUNDWATER CONDITIONS

Water was not detected in the borings at the time of drilling. Typically, water conditions affecting construction projects are related to trapped or perched water, which occurs in irregular, discontinuous locations within the soil overburden or existing fill material, or near the soil/rock interface. When these water bearing strata are exposed in excavations, such as cut slopes, utility or footing trenches, they can produce widely varying seepage durations and rates depending on recent rainfall activity and other hydrogeologic characteristics of the area. These perched water sources are often not linked to the more continuous relatively stable groundwater table that typically occurs at greater depths. Groundwater levels may vary from those measured at the time of the field operations.

3. LIMITATIONS

A report has been prepared to characterize the subsurface conditions at the project site. The report provides a general overview of the soil and geologic conditions with detailed descriptions at discrete boring locations. The Contractor's team shall include a licensed geotechnical engineer to interpret the report and develop earthwork and foundation recommendations and design parameters. If any additional subsurface investigation or laboratory analysis is required to better characterize the site conditions, it shall be performed under the direction of a licensed geotechnical engineer and shall be the full responsibility of the Contractor.

3.1 FINAL GEOTECHNICAL EVALUATION REPORT

A final geotechnical evaluation report shall be prepared by the licensed geotechnical engineer and submitted along with the first foundation design submittal. This evaluation report shall summarize the subsurface conditions, provide recommendations for the design of appropriate foundations, floor slabs, retaining walls, embankments, and pavements. The report shall include the recommended spectral accelerations and Site Class for seismic design along with an evaluation of any seismic hazards and recommendations for mitigation, if required. Calculations shall be included to support the recommendations for bearing capacity, settlement, and pavement sections. Supporting documentation shall be included for all recommended design parameters such as shear strength, earth pressure coefficients, friction factors, subgrade modulus, California Bearing Ratio (CBR), etc. In addition, the report shall provide earthwork recommendations, expected frost penetration, expected groundwater levels, recommendations for dewatering and groundwater control, possible presence of any surface or subsurface features that may affect the construction of the project such as sinkholes, boulders, shallow rock, old fill, old structures, soft areas, or unusual soil conditions.

3.2 QUALITY ASSURANCE DURING CONSTRUCTION

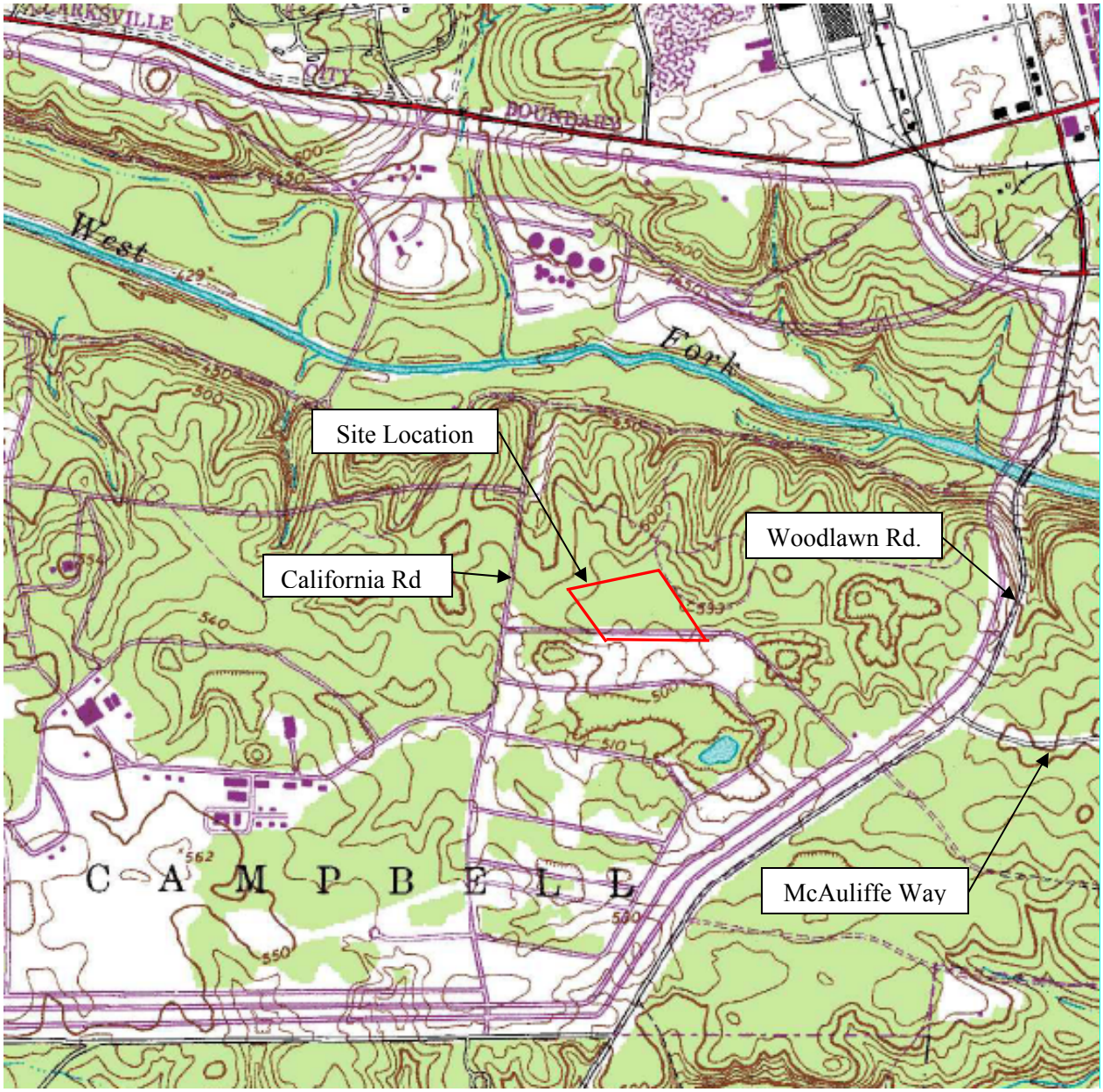
The fill placement and compaction operations shall be observed, documented, and tested on a full-time basis by a qualified independent testing agency. Compaction requirements shall be in accordance with ASTM D1557 (modified Proctor), not ASTM D698 (standard Proctor). During construction, all foundation excavations shall be inspected, evaluated, and approved prior to the placement of concrete by a licensed geotechnical engineer.

3.3 OFF-SITE SPOIL DISPOSAL

The project specifications shall not allow Contractors to dispose of materials outside a military installation without requiring it to go to a destination approved by the Contracting Officer's Representative (COR).

Appendix A – Drawings

Site Location Map
Boring Location Plan
Landfill Location Map



USGS Quadrangle (Topographic): New Providence, TN

Figure 2	Ft. Campbell, TN Clarksville Base Physical Fitness Facility	**SITE LOCATION MAP**	Designed by: I. Weilbaker Drawn by: I. Weilbaker Checked by: R. Jeffries Project Engineer/Architect:	Date: 8/20/07 Scale: NOT TO SCALE Drawing code: Date:	US Army Corps of Engineers Louisville District

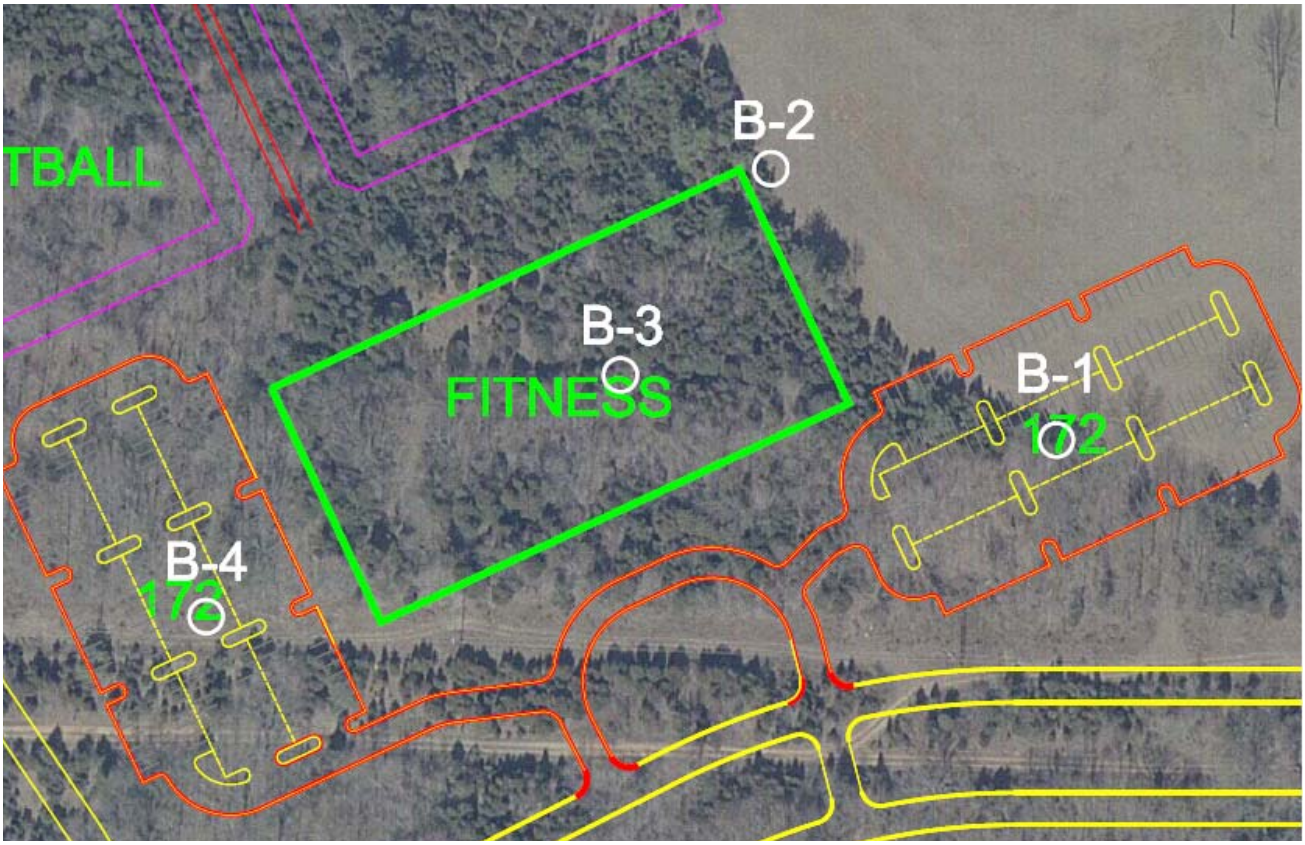
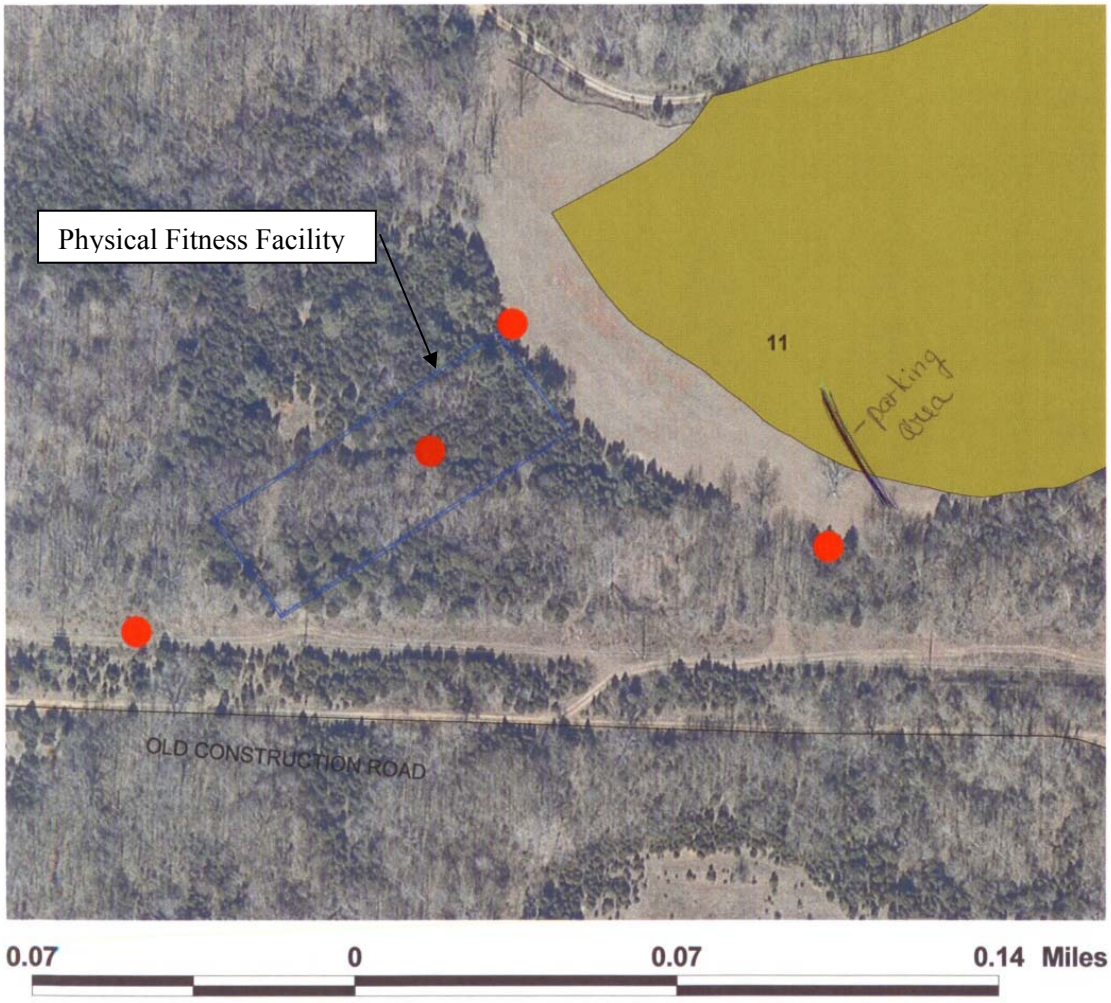


Figure 3	Ft. Campbell, TN Clarksville Base Physical Fitness Facility	**BORING LOCATION PLAN**	Designed by: I. Weilbaker Drawn by: I. Weilbaker Checked by: R. Jeffries Project Engineer/Architect:	Date: 8/20/07 Scale: NOT TO SCALE Drawing code: Date:	US Army Corps of Engineers Louisville District



SWMU Polygons
Existing Buildings
SWMU Points
Oil - Water Separator
Oil Pit
Landfill
Other
Lube Rack
Storage Tank
Groundwater Sampling Wells
SMUG Area
Installtion Boundary
Rear Area Roads
Cantonment Area Roads

Figure 4	Ft. Campbell, TN Clarksville Base Physical Fitness Facility	**LANDFILL LOCATION MAP**	Designed by: I. Weilbaker Drawn by: I. Weilbaker Checked by: R. Jeffries Project Engineer/Architect:	Date: 8/20/07 Scale: NOT TO SCALE Drawing code: Date:	US Army Corps of Engineers Louisville District

Appendix B – Field Testing

Field Procedures
Soil and Rock Classification Sheet
Boring Logs
Normalized SPT $(N_1)_{60}$ -Values
Statistical Analysis of SPT $(N_1)_{60}$ -Values
Plot of Normalized SPT $(N_1)_{60}$ –Values verses Elevation

FIELD PROCEDURES

Field Operations: The general field procedures employed by the United States Army Corps of Engineers (USACE), Louisville District, are summarized in ASTM D420 *Investigating and Sampling Soils and Rocks for Engineering Purposes*. This recommended practice lists recognized methods for determining soil and rock distribution and groundwater conditions. These methods include geophysical and in situ methods as well as borings.

Borings are drilled to obtain subsurface samples using one of several alternative techniques depending upon the subsurface conditions. These techniques are:

a. Continuous 2½ or 3¼ inch inside diameter (I.D.) hollow stem augers;
b. Wash borings using roller cone or drag bits (using drilling mud or water);
c. Continuous flight augers (ASTM D1425).

These drilling methods are not capable of penetrating through material designated as "refusal materials." Refusal, thus indicated, may result from hard cemented soil, soft weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound continuous rock. Core drilling procedures are required to determine the character and continuity of refusal materials.

The subsurface conditions encountered during drilling are reported on a field boring log by a geologist or geotechnical engineer. The boring log contains information concerning the boring method, samples attempted and recovered, indications of the presence of various materials such as coarse gravel, cobbles, etc., and observations between samples. Therefore, these boring logs contain both factual and interpretive information. The field boring logs are maintained in the District office.

The soil and rock samples plus the field boring logs are reviewed by a geologist or geotechnical engineer who classifies the soils in general accordance with the procedures outlined in ASTM D2488 and prepares the final boring logs which are the basis for all evaluations and recommendations.

The final boring logs represent the interpretation of the contents of the field logs based on the results of the engineering examinations and tests of the field samples. These logs depict subsurface conditions at the specific locations and at the particular time when drilled. Soil conditions at other locations may differ from conditions occurring at these boring locations. Also, the passage of time may result in a change in the subsurface soil and groundwater conditions at these boring locations. The lines designating the interface between soil or refusal materials on the logs and on profiles represent approximate boundaries. The transition between materials may be gradual. The final boring logs are included with this report.

Soil Test Borings: Soil test borings were made at the site at locations shown on the Boring Location Plan. Soil sampling and penetration testing were performed in accordance with ASTM D1586.

The borings were made by mechanically twisting a hollow stem steel auger into the soil. At regular intervals, soil samples were obtained with a standard 1.4 inch I.D., 2 inch outside diameter (O.D.), split tube sampler. The sampler was first seated 6 inches to penetrate any loose cuttings, then driven an additional foot with blows of a 140-pound hammer free falling 30 inches. The number of hammer blows required to drive the sampler the final foot was recorded and is designated the "penetration resistance." The penetration resistance, when properly evaluated, is an index to the soil strength and foundation supporting capability.

Representative portions of the soil samples, thus obtained, were placed in glass jars and transported to the contractor's laboratory. In the laboratory, the samples were examined to verify the driller's field classifications. The boring logs graphically show the soil descriptions and penetration resistances.

Water Level Readings: Water table readings are normally taken in conjunction with borings and are recorded on the boring logs. These readings indicate the approximate location of the hydrostatic water table at the time of the field investigation. Where impervious (more clayey) soils are encountered the amount of water seepage into the boring is small, and it is generally not possible to establish the location of the hydrostatic water table through water level readings. The groundwater table may also be dependent upon the amount of precipitation at the site during a particular period of time. Fluctuations in the water table should be expected with variations in precipitation, surface run-off, evaporation and other factors.

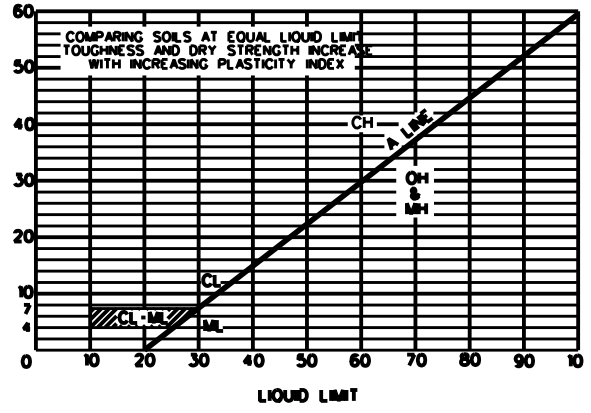
The time of boring, water level reported on the boring logs is determined by field crews as the drilling tools are advanced. The time of boring water level is detected by changes in the drilling rate, soil samples obtained, or by measurement after the drilling tools are withdrawn. Additional water table readings may be obtained after the borings are completed. A time lag of 24 hours may allow stabilization of the groundwater table which has been disrupted by the drilling operations. The readings are taken by dropping a weighted line down the boring or using an electrical probe to detect the water level surface.

Occasionally, the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the caved-in zone. The cave-in depth is also measured and recorded on the boring logs.

UNIFIED SOIL CLASSIFICATION
(INCLUDING IDENTIFICATION AND DESCRIPTION)

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES	FIELD IDENTIFICATION PROCEDURES (EXCLUDING PARTICLES LARGER THAN 3 INCHES AND BASING FRACTIONS ON ESTIMATED WEIGHTS)			LABORATORY CLASSIFICATION CRITERIA
1	2		3	4	5			6
COARSE-GRAINED SOILS MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE. THE NO. 200 SIEVE SIZE IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE.	GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO.4 SIEVE SIZE. (FOR VISUAL CLASSIFICATION, THE 1/4 IN. SIZE MAY BE USED AS EQUIVALENT TO THE NO. 4 SIEVE SIZE)	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES.	WIDE RANGE IN GRAIN SIZES AND SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZES.			DETERMINE PERCENTAGES OF GRAVEL AND SAND FROM GRAIN-SIZE CURVE. DEPENDING ON PERCENTAGE OF FINES (FRACTION SMALLER THAN NO. 200 SIEVE SIZE) COARSE-GRAINED SOILS ARE CLASSIFIED AS FOLLOWS: LESS THAN 5% GW, GP, SW, SP. MORE THAN 12% GM, GC, SM, SC. 5% TO 12% BORDERLINE CASES REQUIRING USE OF DUAL SYMBOLS. $C_U = \frac{D_{60}}{D_{10}}$ GREATER THAN 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ BETWEEN ONE AND 3; NOT MEETING ALL GRADATION REQUIREMENTS FOR GW. ATTERBERG LIMITS BELOW "A" LINE WITH PI LESS THAN 4; ATTERBERG LIMITS ABOVE "A" LINE WITH PI GREATER THAN 7; ABOVE "A" LINE WITH PI BETWEEN 4 AND 7 ARE BORDERLINE CASES REQUIRING USE OF DUAL SYMBOLS.
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES.	PREDOMINANTLY ONE SIZE OR A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING.			
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES.	NONPLASTIC FINES OF FINES WITH LOW PLASTICITY (FOR IDENTIFICATION PROCEDURES SEE ML BELOW)			
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES.	PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW).			
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO.4 SIEVE SIZE.	CLEAN SANDS (LITTLE OR NO FINES)	SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.	WIDE RANGE IN GRAIN SIZE AND SUBSTANTIAL AMOUNTS OF ALL INTERMEDIATE PARTICLE SIZES.			
			SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.	PREDOMINANTLY ONE SIZE OR A RANGE OF SIZES WITH SOME INTERMEDIATE SIZES MISSING.			
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM	SILTY SANDS, SAND-SILT MIXTURES.	NONPLASTIC FINES OR FINES WITH PLASTICITY (FOR IDENTIFICATION PROCEDURES SEE ML BELOW).			
			SC	CLAYEY SANDS, AND-CLAY MIXTURES.	PLASTIC FINES (FOR IDENTIFICATION PROCEDURES SEE CL BELOW).			
FINE-GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE. THE NO. 200 SIEVE SIZE IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE.	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50				IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN NO. 40 SIEVE SIZE.			USE GRAIN-SIZE CURVE IN IDENTIFYING THE FRACTIONS AS GIVEN UNDER FIELD IDENTIFICATION.
					DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PL)	
			ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY.	NONE TO SLIGHT	QUICK TO SLOW	NONE	
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS.	MEDIUM TO HIGH	NONE TO VERY SLOW	MEDIUM	
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY.	SLIGHT TO MEDIUM	SLOW	SLIGHT	
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS.	SLIGHT TO MEDIUM	SLOW TO NONE	SLIGHT TO MEDIUM	
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS.	HIGH TO VERY HIGH	NONE	HIGH	
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASITICITY, ORGANIC SILTS.	MEDIUM TO HIGH	NONE TO VERY SLOW	SLIGHT TO MEDIUM	
HIGHLY ORGANIC SOILS			PT	PEAT AND OTHER HIGHLY ORGANIC SOILS.	READILY IDENTIFIED BY COLOR, ODOR, SPONGY FEEL AND FREQUENTLY BY FIBROUS TEXTURE.			

$C_U = \frac{D_{60}}{D_{10}}$ GREATER THAN 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ BETWEEN ONE AND 3; NOT MEETING ALL GRADATION REQUIREMENTS FOR SW. ATTERBERG LIMITS BELOW "A" LINE WITH PI LESS THAN 4; ATTERBERG LIMITS ABOVE "A" LINE WITH PI GREATER THAN 7; LIMITS PLOTTING IN HTCHED ZONE WITH PI BETWEEN 4 AND 7 ARE BORDERLINE CASES REQUIRING USE OF DUAL SYMBOLS.



PLASTICITY CHART

FOR LABORATORY CLASSIFICATION OF FINE-GRAINED SOILS

Soil and Rock Classification Sheets

Figure 5

GENERAL NOTES

1. REFUSAL IS DEFINED AS THE POINT BEYOND WHICH FURTHER PENETRATION WAS IMPRACTICAL WITH THE EXPLORATION METHOD USED. SEE "METHODS OF EXPLORATION" THIS SHEET INDICATING MEANS BY WHICH THE BORINGS WERE ADVANCED.

2. WATER ELEVATIONS INDICATED (▽) IN CORE (C), STANDARD PENETRATION (SPT), FISHTAIL (F), DENISON (U) AND WASH (W) BORINGS MAY HAVE BEEN INFLUENCED BY DRILLING OPERATIONS AND SHOULD NOT BE CONSTRUED AS INDICATING THE TRUE GROUND WATER LEVEL.

3. GROUND WATER LEVELS WILL VARY IN ACCORDANCE WITH RAINFALL AND STREAM STAGES, THEREFORE, ACTUAL LEVEL OF GROUND WATER ON ANY DATE OTHER THAN THAT SHOWN ON THE LOGS MUST BE DETERMINED BY SEPARATE OBSERVATIONS. THE OMISSION OF GROUND WATER ELEVATIONS SHALL NOT NECESSARILY BE CONSTRUED AS INDICATING THE ABSENCE OF GROUND WATER AT A PARTICULAR BORING LOCATION.

4. WHEREVER THE METHOD OF EXPLORATION PRECLUDED THE POSSIBILITY OF RECOVERING SAMPLES ABOVE ROCK, SUITABLE FOR EXAMINATION OR TESTS, THE MATERIAL IS DENOTED AS OVERBURDEN.

5. CLASSIFICATIONS AND PHYSICAL CHARACTERISTICS OF SOIL AND ROCK AS SHOWN ON THE LOGS WERE DETERMINED IN THE FIELD AND LATER SUPPLEMENTED BY ANALYSIS MADE BY THE DISTRICT GEOLOGIST AND THE LABORATORY TECHNICANS.

6. SUPPLEMENTAL INFORMATION SUCH AS FIELD BOOKS, FIELD LOGS, LABORATORY LOGS (PRESENTING THE RESULTS OF LABORATORY TESTS FOR SHEAR, CONSOLIDATION, PERMEABILITY, ETC. WHEN PERFORMED) AND EDITED LOGS LOGS MAY BE VIEWED IN THE OFFICE OF THE DISTRICT ENGINEER, U.S. ARMY ENGINEER DISTRICT, LOUISVILLE, CORPS OF ENGINEERS, FEDERAL OFFICE BUILDING, LOUVILLE, KY. FAILURE OF THE CONTRACTOR TO AVAIL HIMSELF OF THE INFORMATION REPRESENTED BY THE BORING LOGS, INCLUDING LABORATORY TEST RESULTS, SHALL NOT BE GROUNDS FOR A CLAIM THAT THE GOVERNMENT WITHELD INFORMATION ON SUBSURFACE CONDITIONS.

7. THE TERM "LOST WATER" AS SHOWN ON THE LOGS INDICATES A QUANTITY OF DRILLING WATER LOST IN THE DRILL HOLE.

8. DRIVE SAMPLES WERE TAKEN WITH A 1 3/8" I.D.-2" O.D. X 2'-8" SPLIT SPOON SAMPLER USING A 140# HAMMER WITH A 30" DROP, UNLESS OTHERWISE INDICATED ON GRAPHIC LOGS.

9. CORE HOLES WERE COMPLETED BY AN NXM OR NQ WIRE LINE SIZE CORE BARREL WITH DIAMOND BIT, UNLESS OTHERWISEINDICATED ON THE GRAPHIC LOG.

10. WATER CONTENT (WC) AS SHOWN ON GRAPHIC LOG REPRESENTS THE MOISTURE CONTENT OF MATERIAL ON DATE MADE.

11. TOP OF GROUND SHOWN ON THE GRAPHIC LOGS IS THE ELEVATION AT THE TIME OF DRILLING. THE ELEVATION MAY HAVE CHANGED SINCE THAT TIME.

12. OPTIMUM MOISTURE WAS OBTAINED BY STANDARD PROCTOR OR CE 55 COMPACTION TESTS IN ACCORDANCE WITH EM 1110-2-1906, APP. VI OR MIL. STD. 621 A METHOD 100: RESPECTIVELY, AS NOTED ON BORING LOG.

13. THE LETTER DESIGNATION USED BEFORE BORING NUMBER INDICATES THE METHOD OF EXPLORATION FOR EXAMPLE: DC-DRIVE SAMPLER AND CORE BORING.

$\frac{\text{DC-10}}{\text{7-26-56}}$ -BORING NO. & DATE MADE

14. GENERAL NOTES 5 AND 6 MAY NOT BE APPLICABLE WHEN EXPLORATION AND TESTING IS PERFORMED BY OTHERS.

METHODS OF EXPLORATION

VEL	-	SEISMIC
S	-	SHELBY TUBE OR PISTON SAMPLER
HA	-	HAND AUGER
A	-	POWER AUGER
C	-	CORE BORING
D	-	DRIVE SAMPLER
F	-	FISHTAIL
U	-	UNDISTURBED DENSION
W	-	WASH BORING
T	-	TRENCH
TP	-	TEST PIT
R	-	ROCK BIT
P	-	PROBE ROD

SOIL DESCRIPTIVE TERMS

	SIZE
BOULDER	> 8 INCHES
COBBLE	3 INCHES TO 8 INCHES
COARSE GRAVEL	3/4 INCH TO 3 INCH
FINE GRAVEL	1/4 INCH TO3/4 INCH
COARSE SAND	2 MM TO 1/4 INCH
MEDIUM SAND	0.4 MM TO 2 MM
FINE SAND	0.075 MM TO 0.4 MM
TRACE	1 TO 10%
OCCASIONAL	11 TO 35%
AND	36 TO 50%
LAMINAE	0 TO 10 MM
LENSE	10 MM TO 50 MM
BAND	50 MM TO 2.5 INCH
LAYER	2.5 INCH TO 6 INCH.

SAMPLE TYPE

P	-	DRIVE SAMPLE (STANDARD PENETRATION TEST)
S	-	UNDISTURBED SHELBY TUBE
A	-	AUGER
F	-	FISHTAIL
U	-	UNDISTURBED DENISON
CU	-	UNDISTURBED CUBE
C	-	CORE
J	-	JAR
BX	-	BOX (CORE)

LEGEND

F	-	FILL
T	-	TOP SOIL
OB (SEE GEN. NOTE 4)	-	OVERBURDEN
SS	-	SANDSTONE
SH	-	SHALE
SLS	-	SILTSTONE
LS	-	LIMESTONE
CO	-	COAL
UC	-	UNDERCLAY
IC	-	INDURATED CLAY
DOL	-	DOLOMITE
CON	-	CONGLOMERATE
OTZ	-	QUARTZ
ROD	-	ROCK QUALITY DESIGNATION
NOD	-	NODULES
GRAV	-	GRAVEL OR GRAVELLY
LT	-	LIGHT
DK	-	DARK
SL	-	SLIGHTLY
MOD	-	MODERATELY
MED	-	MEDIUM
TR	-	TRACE
HD	-	HARD
NUM	-	NUMEROUS
WOR	-	WEIGHT OF RODS
WOH	-	WEIGHT OF HAMMER
WT	-	WEIGHT
VIS	-	VISCOSITY (MARSH)
WP	-	WELL POINT
(W)	-	WEATHERED
W/	-	WITH
GR	-	GRAIN
OCC	-	OCCASIONAL
BD	-	BEDDED OR BEDS
INTBD	-	INTERBEDDED
LAM	-	LAMINAE
XLYN	-	CRYSTALLINE
ARGIL	-	ARGILLACEOUS
V	-	VERY
BLK	-	BLACK
BR	-	BROWN
GRY	-	GRAY
BLU	-	BLUE
GRN	-	GREEN
YEL	-	YELLOW
OB/P	-	OPEN BEDDING PLANE
CAL	-	CALCAREOUS
CARBO	-	CARBONACEOUS
FREQ	-	FREQUENT
FOS	-	FOSSILIFEROUS
CMTD	-	CEMENTED
MOT	-	MOTTLED
FRAG	-	FRAGMENTS
B	-	BENTONITE
DIAG	-	DIAGONAL
ALT	-	ALTERNATING
VERT	-	VERTICAL
HOR	-	HORIZONTAL
FRAC	-	FRACTURE
X-BD	-	CROSSBEDDING
SP	-	SHEAR PLANE
V/J	-	VERTICAL JOINT
JT	-	JOINT
SOL	-	SOLUTION
	-	CAVITY (OPEN OR FILLED)
MICA	-	MICACEOUS
STY	-	STYLOLITIC
B/P	-	BEDDING PLANE
F/W	-	FREE WATER
H/A	-	HIGH ANGLE
PIEZ	-	PIEZOMETER
BOH	-	BOTTOM OF HOLE
TOR	-	TOP OF ROCK
ST	-	STAIN, STAINED
ANG	-	ANGULAR
RND	-	ROUNDED
##	-	X-RAY DIFFRACTION ANALYSIS (SEE GENERAL NOTE 11)

CORRELATION OF PENETRATION RESISTANCE (ASTM D 1586) WITH RELATIVE DENSITY AND CONSISTENCY

PENETRATION RESISTANCE,N Blows per foot		RELATIVE DENSITY
0 - 4		Very Loose
5 - 10		Loose
SANDS AND 11 - 30		Med Dense
GRAVELS 31 - 50		Dense
Over 50		Very Dense

PENETRATION RESISTANCE,N Blows per foot		
0 - 2		Very Soft
3 - 4		Soft
SILTS AND 5 - 8		Med Stiff
CLAYS 9 - 15		Stiff
16 - 30		Very Stiff
31+		Hard

WEATHERING

SEVERE WEATHERING - LOSS OF ROCK COHERANCE, MATERIAL CAN BE REMOVED BY HAND TOOLS. RETAINES SOME EVIDENCE OF ROCK STRUCTURE

MODERATE WEATHERING MATERIAL MAY BE OXIDIZED BUT MOST PHYSICAL CHARACTERISTIC REMAIN. OCCASIONAL BLOCKS MAY BE REMOVED WITH HAND TOOLS.

SLIGHT WEATHERING - MATERIAL GENERALLY FRESH, WITH VARIOUS DEGREES OF WEATHERING ALONG JOINTS AND BEDDING.

TERMS FOR THICKNESS OF ROCK BEDDING

PARTING	< 0.02'
BAND	0.02'-0.2'
THIN BED	0.2'-0.5'
MEDIUM BED	0.5'-1.0'
THICK BED	1.0'-3.0'
MASSIVE	> 3.0'

BORING NO. **B-1**	SHEET 1 OF 1
1. PROJECT Clarksville Base Physical Fitness Facility	11. DATUM FOR ELEVATION SHOWN (TBM OR MSL) N/A
2. LOCATION N N/A E N/A	
3. DRILLING AGENCY FMSM Engineers, Inc.	12. DRILL METHOD HSA
4. NAME OF DRILLER Merle Wethington	13. ELEVATION TOP OF HOLE Approx. 520
5. DRILL TYPE CME 45B1	14. TOTAL NUMBER CORE BOXES N/A
6. THICKNESS OF OVERBURDEN N/A	15. ELEVATION GROUND WATER N/A
7. DEPTH DRILLED INTO ROCK N/A	16. DATE HOLE STARTED 12/11/07 COMPLETED 12/11/07
8. TOTAL DEPTH OF HOLE 15.5	
9. DIRECTION OF HOLE VERTICAL ☒ INCLINED ☐ _____ DEG. FROM VERT	17. INSPECTOR Melanie Morguson

ELEVATION	CLASSIFICATION OF MATERIALS	LEGEND	USCS CLASS	SAMPLE #	SAMPLE TYPE	BLOWS PER 6-INCH	MOISTURE (%)	PENETRATION	RECOVERY	RQD	REMARKS	DEPTH SCALE
	Overburden-Topsoil 1"		T									0
	Lean Clay, red, moist, soft to very stiff, w/chert gravels		CL	1	P	4 5 6	23.5	1.5	0.9			1
				2		9 10 22	21.8	1.5	1.5		LL = 38 PL = 20 PI = 18	2
												3
	Fat Clay, red, moist, very stiff to hard, w/ chert gravels		CH	3		10 15 17	23.6	1.5	1.5		LL = 50 PL = 21 PI = 29	4
												5
				4		29 14 15	24.0	1.5	0.8			6
												7
				5		20 15 20	25.5	1.5	1.3			8
												9
												10
												11
												12
												13
												14
	Boring Terminated @ 15.5'; No Refusal			6		12 13 10	34.5	1.5	1.2			15
												16
												17
												18
												19
												20

LRL FORM 1202 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT Clarksville Base Physical Fitness Facility SHEET 2
JUNE 2000 SYMBOLS: V - WATER LEVEL AT COMPLETION > - PARTIAL LOSS OF DRILL FLUID B-1

BORING NO. **B-2** SHEET **1** OF **1**

1. PROJECT Clarksville Base Physical Fitness Facility	11. DATUM FOR ELEVATION SHOWN (TBM OR MSL) N/A
2. LOCATION N N/A E N/A	
3. DRILLING AGENCY FMSM Engineers, Inc.	12. DRILL METHOD HSA
4. NAME OF DRILLER Merle Wethington	13. ELEVATION TOP OF HOLE Approx. 520
5. DRILL TYPE CME 45B1	14. TOTAL NUMBER CORE BOXES N/A
6. THICKNESS OF OVERBURDEN N/A	15. ELEVATION GROUND WATER N/A
7. DEPTH DRILLED INTO ROCK N/A	16. DATE HOLE STARTED 12/11/07 COMPLETED 12/11/07
8. TOTAL DEPTH OF HOLE 20.5	
9. DIRECTION OF HOLE VERTICAL ☒ INCLINED ☐ _____ DEG. FROM VERT	17. INSPECTOR Melanie Morguson

ELEVATION	CLASSIFICATION OF MATERIALS	LEGEND	USCS CLASS	SAMPLE #	SAMPLE TYPE	BLOWS PER 6-INCH	MOISTURE (%)	PENETRATION	RECOVERY	RQD	REMARKS	DEPTH SCALE
	Overburden-Topsoil 2"		T									0
	Fat Clay w/chert gravel, red and brown, moist, soft to very stiff w/some mottling		CH	1	P	2 3 4	25.5	1.5	1.0			1
				2		5 6 15	21.8	1.5	1.5			2
												3
				3		9 11 14	25.9	1.5	1.5			4
												5
				4		17 18 17	24.3	1.5	1.1			6
												7
				5		9 11 16	38.6	1.5	1.5			8
												9
												10
												11
												12
												13
				6		20 19 22	27.6	1.5	0.4			14
												15
												16
												17
												18
												19
				7		13 10 11	34.0	1.5	1.5			20
	Boring Terminated @ 20.5'; No Refusal											

LRL FORM 1202 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT Clarksville Base Physical Fitness Facility SHEET 2 of 2
JUNE 2000 SYMBOLS: V - WATER LEVEL AT COMPLETION > - PARTIAL LOSS OF DRILL FLUID **B-2**

BORING NO. **B-3**	SHEET **1** OF **1**
1. PROJECT Clarksville Base Physical Fitness Facility	11. DATUM FOR ELEVATION SHOWN (TBM OR MSL) N/A
2. LOCATION N N/A E N/A	
3. DRILLING AGENCY FMSM Engineers, Inc.	12. DRILL METHOD HSA
4. NAME OF DRILLER Merle Wethington	13. ELEVATION TOP OF HOLE Approx. 520
5. DRILL TYPE CME 45B1	14. TOTAL NUMBER CORE BOXES N/A
6. THICKNESS OF OVERBURDEN N/A	15. ELEVATION GROUND WATER N/A
7. DEPTH DRILLED INTO ROCK N/A	16. DATE HOLE STARTED 12/11/07 COMPLETED 12/11/07
8. TOTAL DEPTH OF HOLE 20.5	
9. DIRECTION OF HOLE VERTICAL ☒ INCLINED ☐ _____ DEG. FROM VERT	17. INSPECTOR Melanie Morguson

ELEVATION	CLASSIFICATION OF MATERIALS	LEGEND	USCS CLASS	SAMPLE #	SAMPLE TYPE	BLOWS PER 6-INCH	MOISTURE (%)	PENETRATION	RECOVERY	RQD	REMARKS	DEPTH SCALE
	Overburden-Topsoil 2"		T									0
	Lean Clay w/chert gravel, red, moist, soft to very stiff		CL	1	P	4 13 4	21.0	1.5	1.0			1
				2		4 3 4	24.4	1.5	1.1		LL = 40 PL = 20 PI = 20	2
												3
				3		11 18 22	20.8	1.5	1.5		LL = 45 PL = 24 PI = 21	4
												5
				4		11 33 30	21.7	1.5	1.5			6
												7
	Fat Clay w/ chert gravel, red, moist, stiff to very stiff		CH	5		7 14 18	32.7	1.5	1.3		LL = 86 PL = 24 PI = 62	8
												9
												10
												11
												12
												13
				6		7 11 15	31.3	1.5	1.5		LL = 83 PL = 22 PI = 61	14
												15
												16
												17
												18
												19
				7		9 8 9	36.5	1.5	1.5			20
	Boring Terminated @ 20.5'; No Refusal											

LRL FORM 1202 JUNE 2000 PREVIOUS EDITIONS ARE OBSOLETE.

SYMBOLS: V - WATER LEVEL AT COMPLETION > - PARTIAL LOSS OF DRILL FLUID

PROJECT Clarksville Base Physical Fitness Facility LOCATION

B-3

BORING NO. **B-4** SHEET **1** OF **1**

1. PROJECT Clarksville Base Physical Fitness Facility	11. DATUM FOR ELEVATION SHOWN (TBM OR MSL) N/A
2. LOCATION N N/A E N/A	
3. DRILLING AGENCY FMSM Engineers, Inc.	12. DRILL METHOD HSA
4. NAME OF DRILLER Merle Wethington	13. ELEVATION TOP OF HOLE Approx. 518
5. DRILL TYPE CME 45B1	14. TOTAL NUMBER CORE BOXES N/A
6. THICKNESS OF OVERBURDEN N/A	15. ELEVATION GROUND WATER N/A
7. DEPTH DRILLED INTO ROCK N/A	16. DATE HOLE STARTED 12/11/07 COMPLETED 12/11/07
8. TOTAL DEPTH OF HOLE 15.5	
9. DIRECTION OF HOLE VERTICAL ☒ INCLINED ☐ _____ DEG. FROM VERT	17. INSPECTOR Melanie Morguson

ELEVATION	CLASSIFICATION OF MATERIALS	LEGEND	USCS CLASS	SAMPLE #	SAMPLE TYPE	BLOWS PER 6-INCH	MOISTURE (%)	PENETRATION	RECOVERY	RQD	REMARKS	DEPTH SCALE
	Overburden-Topsoil 2"		T									0
	Lean Clay w/chert gravel, red and brown, moist, soft to stiff, some mottling w/silty lenses		CL	1	P	3 3 4	25.6	1.5	1.5			1
				2		4 5 4	20.8	1.5	1.5		LL = 37 PL = 21 PI = 19	2
												3
	Fat Clay w/ chert gravel, red and brown, moist, very stiff to hard, some mottling w/ silty lenses.		CH	3		8 12 20	30.6	1.5	1.2		LL = 52 PL = 20 PI = 32	4
												5
				4		17 18 22	28.8	1.5	1.1			6
												7
				5		7 11 15	34.6	1.5	1.0			8
												9
												10
												11
												12
												13
												14
	Boring Terminated @ 15.5'; No Refusal			6		12 17 24	31.1	1.5	1.1			15
												16
												17
												18
												19
												20

US Army Corps of Engineers
Louisville District

Project:	Fort Campbell Physical Fitness Facility	Prepared By:	I. Weilbaker	Date:	18 Dec 2007
Subject:	B-1	Checked By:	R. Jeffries	Date:	27 Dec 2007
		Reviewed By:		Date:	
		Approved By:		Date:	

Normalized Standard Penetration Test (SPT) Resistances, $(N_1)_{60}$-values

Ref: Youd, T.L. and Idriss, I.M. et al. "Liquefaction Resistance of Soils: Summary Report from the 1996 and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," *J. Geotech. and Geoenvir. Engrg.* , ASCE, Oct. 2001, 127(10), 817-833.

Boring and Ground Water Location

Top of Hole Elevation	520.000	feet
Depth to Ground Water	40.0	feet
Ground Water Elevation	480.000	feet
Unit Weight of Ground Water	62.4	pcf
Borehole Diameter	7.000	inches

Corrections to SPT $(N_1)_{60} = N_m \cdot C_N \cdot C_E \cdot C_B \cdot C_R \cdot C_S$

Overburden Pressure, C_N — *See Table*

$C_N = 2.2 / (1.2 + \sigma'_{vo}/2000)$

Energy Ratio, C_E — 1.00

C_E = 0.5-1.0 (donut hammer);
C_E = 0.7-1.2 (safety hammer);
C_E = 0.8-1.3 (automatic-trip donut-type hammer)

Borehole Diameter, C_B — 1.11

C_B = 1.0 (65-115 mm);
C_B = 1.05 (150 mm);
C_B = 1.15 (200 mm)

Rod Length, C_R

Assumed Rod Stickup — 5.0 feet

C_R = 0.75 (< 3 m); 0.8 (3-4 m);
C_R = 0.85 (4-6 m); 0.95 (6-10 m);
C_R = 1.0 (10-30 m)

Sampling Method, C_S — 1.00

C_S = 1.0 (standard sampler);
C_S = 1.1-1.3 (sampler without liners)

SPT Measured Blow Counts, N_m-values, Normalized to Equivalent Blow Counts, $(N_1)_{60}$-values

z_{top} (feet)	z_{bot} (feet)	N_m (bpf)	γ_{wet} (pcf)	z_{mid} (feet)	EL_{mid} (ft)	H (feet)	σ_{vo} (psf)	u (psf)	σ'_{vo} (psf)	C_N	C_R	$(N_1)_{60}$ (bpf)	EL_{mid} (ft)
0.0	1.5	11	120.0	0.75	519.25	1.50	90	0	90	1.77	0.75	16	519.25
1.5	3.0	32	120.0	2.25	517.75	1.50	270	0	270	1.65	0.75	44	517.75
4.0	5.5	32	120.0	4.75	515.25	1.50	570	0	570	1.48	0.75	39	515.25
6.5	8.0	29	120.0	7.25	512.75	1.50	870	0	870	1.35	0.80	35	512.75
9.0	10.5	35	120.0	9.75	510.25	1.50	1,170	0	1,170	1.23	0.85	41	510.25
14.0	15.5	23	120.0	14.75	505.25	1.50	1,770	0	1,770	1.06	0.95	25	505.25

US Army Corps of Engineers
Louisville District

Project:	Fort Campbell Physical Fitness Facility	Prepared By:	I. Weilbaker	Date:	18 Dec 2007
Subject:	B-2	Checked By:	R. Jeffries	Date:	27 Dec 2007
		Reviewed By:		Date:	
		Approved By:		Date:	

Normalized Standard Penetration Test (SPT) Resistances, $(N_1)_{60}$-values

Ref: Youd, T.L. and Idriss, I.M. et al. "Liquefaction Resistance of Soils: Summary Report from the 1996 and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," *J. Geotech. and Geoenvir. Engrg.* , ASCE, Oct. 2001, 127(10), 817-833.

Boring and Ground Water Location

Top of Hole Elevation	520.000	feet
Depth to Ground Water	40.0	feet
Ground Water Elevation	480.000	feet
Unit Weight of Ground Water	62.4	pcf
Borehole Diameter	7.000	inches

Corrections to SPT $(N_1)_{60} = N_m \cdot C_N \cdot C_E \cdot C_B \cdot C_R \cdot C_S$

Overburden Pressure, C_N — *See Table*

$C_N = 2.2 / (1.2 + \sigma'_{vo}/2000)$

Energy Ratio, C_E — 1.00

C_E = 0.5-1.0 (donut hammer);
C_E = 0.7-1.2 (safety hammer);
C_E = 0.8-1.3 (automatic-trip donut-type hammer)

Borehole Diameter, C_B — 1.11

C_B = 1.0 (65-115 mm);
C_B = 1.05 (150 mm);
C_B = 1.15 (200 mm)

Rod Length, C_R

Assumed Rod Stickup — 5.0 feet

C_R = 0.75 (< 3 m); 0.8 (3-4 m);
C_R = 0.85 (4-6 m); 0.95 (6-10 m);
C_R = 1.0 (10-30 m)

Sampling Method, C_S — 1.00

C_S = 1.0 (standard sampler);
C_S = 1.1-1.3 (sampler without liners)

SPT Measured Blow Counts, N_m-values, Normalized to Equivalent Blow Counts, $(N_1)_{60}$-values

z_{top} (feet)	z_{bot} (feet)	N_m (bpf)	γ_{wet} (pcf)	z_{mid} (feet)	EL_{mid} (ft)	H (feet)	σ_{vo} (psf)	u (psf)	σ'_{vo} (psf)	C_N	C_R	$(N_1)_{60}$ (bpf)	EL_{mid} (ft)
0.0	1.5	7	120.0	0.75	519.25	1.50	90	0	90	1.77	0.75	10	519.25
1.5	3.0	21	120.0	2.25	517.75	1.50	270	0	270	1.65	0.75	29	517.75
4.0	5.5	25	120.0	4.75	515.25	1.50	570	0	570	1.48	0.75	31	515.25
6.5	8.0	35	120.0	7.25	512.75	1.50	870	0	870	1.35	0.80	42	512.75
9.0	10.5	27	120.0	9.75	510.25	1.50	1,170	0	1,170	1.23	0.85	41	510.25
14.0	15.5	41	120.0	14.75	505.25	1.50	1,770	0	1,770	1.06	0.95	30	505.25
19.0	20.5	21	120.0	19.75	500.25	1.50	2,370	0	2,370	0.92	0.95	40	500.25

US Army Corps of Engineers
Louisville District

Project:	Fort Campbell Physical Fitness Facility	Prepared By:	I. Weilbaker	Date:	18 Dec 2007
Subject:	B-3	Checked By:	R. Jeffries	Date:	27 Dec 2007
		Reviewed By:		Date:	
		Approved By:		Date:	

Normalized Standard Penetration Test (SPT) Resistances, $(N_1)_{60}$-values

Ref: Youd, T.L. and Idriss, I.M. et al. "Liquefaction Resistance of Soils: Summary Report from the 1996 and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," *J. Geotech. and Geoenvir. Engrg.* , ASCE, Oct. 2001, 127(10), 817-833.

Boring and Ground Water Location

Top of Hole Elevation	520.000	feet
Depth to Ground Water	40.0	feet
Ground Water Elevation	480.000	feet
Unit Weight of Ground Water	62.4	pcf
Borehole Diameter	7.000	inches

Corrections to SPT $(N_1)_{60} = N_m \cdot C_N \cdot C_E \cdot C_B \cdot C_R \cdot C_S$

Overburden Pressure, C_N — *See Table*

$C_N = 2.2 / (1.2 + \sigma'_{vo}/2000)$

Energy Ratio, C_E — 1.00

C_E = 0.5-1.0 (donut hammer);
C_E = 0.7-1.2 (safety hammer);
C_E = 0.8-1.3 (automatic-trip donut-type hammer)

Borehole Diameter, C_B — 1.11

C_B = 1.0 (65-115 mm);
C_B = 1.05 (150 mm);
C_B = 1.15 (200 mm)

Rod Length, C_R

Assumed Rod Stickup — 5.0 feet

C_R = 0.75 (< 3 m); 0.8 (3-4 m);
C_R = 0.85 (4-6 m); 0.95 (6-10 m);
C_R = 1.0 (10-30 m)

Sampling Method, C_S — 1.00

C_S = 1.0 (standard sampler);
C_S = 1.1-1.3 (sampler without liners)

SPT Measured Blow Counts, N_m-values, Normalized to Equivalent Blow Counts, $(N_1)_{60}$-values

z_{top} (feet)	z_{bot} (feet)	N_m (bpf)	γ_{wet} (pcf)	z_{mid} (feet)	EL_{mid} (ft)	H (feet)	σ_{vo} (psf)	u (psf)	σ'_{vo} (psf)	C_N	C_R	$(N_1)_{60}$ (bpf)	EL_{mid} (ft)
0.0	1.5	17	120.0	0.75	519.25	1.50	90	0	90	1.77	0.75	25	519.25
1.5	3.0	7	120.0	2.25	517.75	1.50	270	0	270	1.65	0.75	10	517.75
4.0	5.5	40	120.0	4.75	515.25	1.50	570	0	570	1.48	0.75	49	515.25
6.5	8.0	63	120.0	7.25	512.75	1.50	870	0	870	1.35	0.80	75	512.75
9.0	10.5	32	120.0	9.75	510.25	1.50	1,170	0	1,170	1.23	0.85	37	510.25
14.0	15.5	26	120.0	14.75	505.25	1.50	1,770	0	1,770	1.06	0.95	29	505.25
19.0	20.5	17	120.0	19.75	500.25	1.50	2,370	0	2,370	0.92	0.95	16	500.25

US Army Corps of Engineers
Louisville District

Project:	Fort Campbell Physical Fitness Facility	Prepared By:	I. Weilbaker	Date:	18 Dec 2007
Subject:	B-4	Checked By:	R. Jeffries	Date:	27 Dec 2007
		Reviewed By:		Date:	
		Approved By:		Date:	

Normalized Standard Penetration Test (SPT) Resistances, $(N_1)_{60}$-values

Ref: Youd, T.L. and Idriss, I.M. et al. "Liquefaction Resistance of Soils: Summary Report from the 1996 and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," *J. Geotech. and Geoenvir. Engrg.* , ASCE, Oct. 2001, 127(10), 817-833.

Boring and Ground Water Location

Top of Hole Elevation	518.000	feet
Depth to Ground Water	40.0	feet
Ground Water Elevation	478.000	feet
Unit Weight of Ground Water	62.4	pcf
Borehole Diameter	7.000	inches

Corrections to SPT $(N_1)_{60} = N_m \cdot C_N \cdot C_E \cdot C_B \cdot C_R \cdot C_S$

Overburden Pressure, C_N — *See Table*

$C_N = 2.2 / (1.2 + \sigma'_{vo}/2000)$

Energy Ratio, C_E — 1.00

C_E = 0.5-1.0 (donut hammer);
C_E = 0.7-1.2 (safety hammer);
C_E = 0.8-1.3 (automatic-trip donut-type hammer)

Borehole Diameter, C_B — 1.11

C_B = 1.0 (65-115 mm);
C_B = 1.05 (150 mm);
C_B = 1.15 (200 mm)

Rod Length, C_R

Assumed Rod Stickup — 5.0 feet

C_R = 0.75 (< 3 m); 0.8 (3-4 m);
C_R = 0.85 (4-6 m); 0.95 (6-10 m);
C_R = 1.0 (10-30 m)

Sampling Method, C_S — 1.00

C_S = 1.0 (standard sampler);
C_S = 1.1-1.3 (sampler without liners)

SPT Measured Blow Counts, N_m-values, Normalized to Equivalent Blow Counts, $(N_1)_{60}$-values

z_{top} (feet)	z_{bot} (feet)	N_m (bpf)	γ_{wet} (pcf)	z_{mid} (feet)	EL_{mid} (ft)	H (feet)	σ_{vo} (psf)	u (psf)	σ'_{vo} (psf)	C_N	C_R	$(N_1)_{60}$ (bpf)	EL_{mid} (ft)
0.0	1.5	7	120.0	0.75	517.25	1.50	90	0	90	1.77	0.75	10	517.25
1.5	3.0	9	120.0	2.25	515.75	1.50	270	0	270	1.65	0.75	12	515.75
4.0	5.5	32	120.0	4.75	513.25	1.50	570	0	570	1.48	0.75	39	513.25
6.5	8.0	40	120.0	7.25	510.75	1.50	870	0	870	1.35	0.80	48	510.75
9.0	10.5	26	120.0	9.75	508.25	1.50	1,170	0	1,170	1.23	0.85	30	508.25
14.0	15.5	41	120.0	14.75	503.25	1.50	1,770	0	1,770	1.06	0.95	45	503.25

US Army Corps of Engineers
Louisville District

Project:	Fort Campbell Physical Fitness Facility	Prepared By:	I. Weilbaker	Date:	18 Dec 2007
Subject:	B-1 through B-4	Checked By:	R. Jeffries	Date:	27 Dec 2007
		Reviewed By:		Date:	
		Approved By:		Date:	

Statistical Analysis of Normalized Standard Penetration Test (SPT) Resistances, $(N_1)_{60}$-values

Ref: Youd, T.L. and Idriss, I.M. et al. "Liquefaction Resistance of Soils: Summary Report from the 1996 and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," *J. Geotech. and Geoenvir. Engrg.* , ASCE, Oct. 2001, 127(10), 817-833.

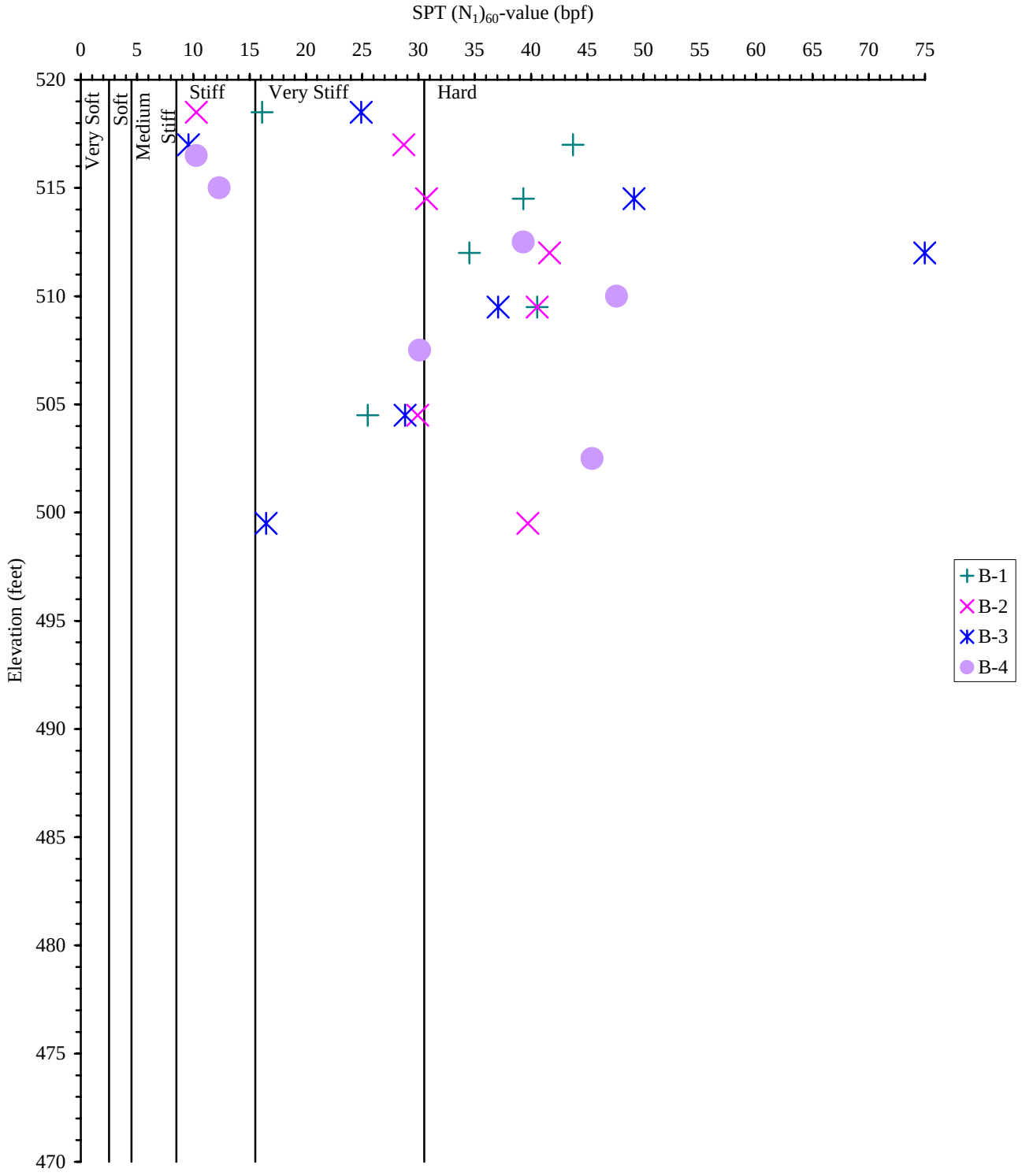
Depth (feet)	SPT $(N_1)_{60}$-values (bpf)																Statistical Analysis				
	B-1	B-2	B-3	B-4													Min.	Max.	Std. Dev.	Var.	Avg.
1.5	16	10	25	10													10	25	6	47	15
3.0	44	29	10	12													10	44	15	251	23
5.5	39	31	49	39													31	49	7	56	39
8.0	35	42	75	48													35	75	17	312	49
10.5	41	41	37	30													30	41	4	24	37
15.5	25	30	29	45													25	45	8	78	32
20.5		40	16														16	40	16	270	28
																Summary	10	75	14	223	32

US Army Corps of Engineers
Louisville District

Project:	Fort Campbell Physical Fitness Facility		
Subject:	B-1 through B-4		
Prepared By:	I. Weilbaker	Date:	18 Dec 2007
Checked By:	R. Jeffries	Date:	27 Dec 2007

Normalized Standard Penetration Test (SPT) Resistances, $(N_1)_{60}$-values

Ref: Youd, T.L. and Idriss, I.M. et al. "Liquefaction Resistance of Soils: Summary Report from the 1996 and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils," *J. Geotech. and Geoenvir. Engrg.* , ASCE, Oct. 2001, 127(10), 817-833. EM 1110-1-1804, *Geotechnical Investigations* , 1 January 2001.



Appendix C – Laboratory Testing

Laboratory Procedures
Moisture Content of Soil
Atterberg Limits

LABORATORY PROCEDURES

Soil Classification: Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply past experience to current situations. In the explorations, samples obtained during drilling operations are examined in the contractor's laboratory and visually classified by an engineer. The soils are classified according to consistency (based on number of blows from standard penetration tests), color and texture. These classification descriptions are included on the test boring records.

The classification system discussed above is primarily qualitative. A detailed soil classification requires two laboratory tests: grain size tests and plasticity tests. Using these test results the soil can be classified according to the AASHTO or Unified Classification Systems (ASTM D2487). Each of these classification systems and the in-place physical soil properties provide an index for estimating the soil's behavior. The soil classification and physical properties determined are presented in this report.

Atterberg Limits: Portions of the samples are taken for Atterberg limits testing to determine the plasticity characteristics of the soil. The plasticity index (PI) is the range of moisture content over which the soil deforms as a plastic material. It is bracketed by the liquid limit (LL) and the plastic limit (PL). The liquid limit is the moisture content at which the soil becomes sufficiently "wet" to flow as a heavy viscous fluid. The plastic limit is the lowest moisture content at which the soil is sufficiently plastic to be manually rolled into tiny threads. The liquid limit and plastic limit are determined in accordance with ASTM D4318.

Moisture Content: The Moisture Content is determined according to ASTM D2216.

Fuller Mossbarger Scott & May ENGINEERS

Moisture Content of Soil

ASTM D 2216

Project Name Clarksville Base Physical Fitness Facility

Project Number LX2007274

Tested By RJ/CSM

Test Method ASTM

Maximum Particle Size in Sample	No. 10	No. 4	3/8"	3/4"	1 1/2"	3"
Recommended Minimum Mass (g)	20	100	500	2,500	10,000	50,000

Material Type: Stratified, Laminated, Lensed, Homogeneous

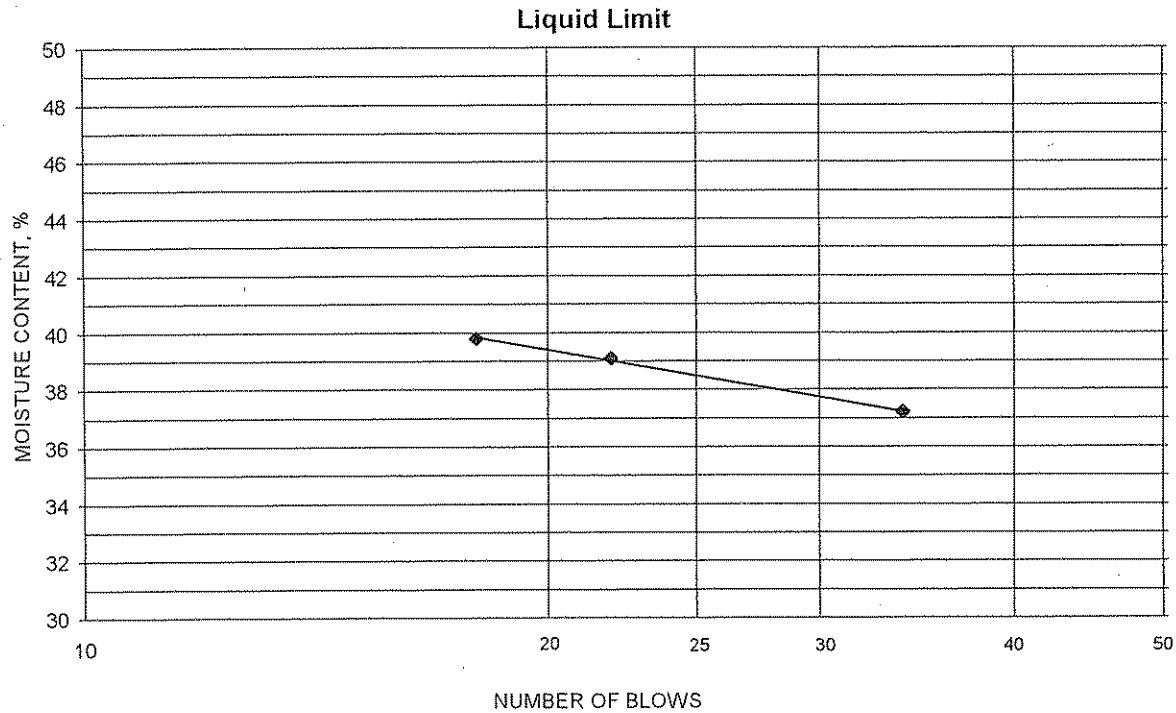
Source	Lab ID	Date Tested	Material Type	Maximum Particle Size	Material Excluded Amount	Material Excluded Size	Pass Min. Mass? (Y/N)	Can Weight (g)	Wet Soil & Can Weight (g)	Dry Soil & CanWeight (g)	Moisture Content (%)
B-1, 0.0'-1.5'	1	12/14/07	Hom	No. 10			Yes	21.01	101.44	86.12	23.5
B-1, 1.5'-3.0'	2	12/14/07	Hom	1 1/2"			No	21.10	96.15	82.70	21.8
B-1, 4.0'-5.5'	3	12/14/07	Len	No. 10			Yes	21.21	91.93	78.42	23.6
B-1, 6.5'-8.0'	4	12/14/07	Len	No. 4			No	20.75	86.76	74.00	24.0
B-1, 9.0'-10.5'	5	12/14/07	Len	1 1/2"			No	20.60	85.38	72.23	25.5
B-1, 14.0'-15.5'	6	12/14/07	Hom	3"	1	3"	No	20.78	94.29	75.44	34.5
B-2, 0.0'-1.5'	7	12/14/07	Hom	No. 10			Yes	20.79	93.13	78.43	25.5
B-2, 1.5'-3.0'	8	12/14/07	Hom	No. 4			No	20.08	110.80	94.55	21.8
B-2, 4.0'-5.5'	9	12/14/07	Hom	3/4"			No	20.99	101.30	84.79	25.9
B-2, 6.5'-8.0'	10	12/14/07	Len	3"			No	20.77	91.72	77.84	24.3
B-2, 9.0'-10.5'	11	12/14/07	Len	3"			No	20.76	97.84	76.38	38.6
B-2, 14.0'-15.5'	12	12/14/07	Str	3/4"			No	21.06	96.85	80.45	27.6
B-2, 19.0'-20.5'	13	12/14/07	Hom	3/4"			No	20.67	93.51	75.04	34.0
B-3, 0.0'-1.5'	14	12/14/07	Hom	No. 10			Yes	20.85	100.34	86.52	21.0
B-3, 1.5'-3.0'	15	12/14/07	Hom	No. 10			Yes	20.86	120.36	100.86	24.4
B-3, 4.0'-5.5'	16	12/14/07	Hom	3"			No	20.92	93.39	80.92	20.8
B-3, 6.5'-8.0'	17	12/14/07	Hom	3"	2	3"	No	20.74	98.42	84.56	21.7
B-3, 9.0'-10.5'	18	12/14/07	Hom	3"			No	21.78	85.08	69.47	32.7
B-3, 14.0'-15.5'	19	12/14/07	Len	No. 10			Yes	20.84	85.00	69.70	31.3
B-3, 19.0'-20.5'	20	12/14/07	Len	3"	1	3"	No	20.90	91.93	72.95	36.5
B-4, 0.0'-1.5'	21	12/14/07	Hom	No. 10			Yes	21.02	121.94	101.34	25.6
B-4, 1.5'-3.0'	22	12/14/07	Hom	3"	3	3"	No	20.27	97.46	84.18	20.8
B-4, 4.0'-5.5'	23	12/14/07	Len	1 1/2"	3	1 1/2"	No	18.90	86.59	70.73	30.6
B-4, 6.5'-8.0'	24	12/14/07	Hom	1 1/2"			No	20.30	74.61	62.45	28.8
B-4, 9.0'-10.5'	25	12/14/07	Hom	1 1/2"			No	20.37	80.65	65.15	34.6
B-4, 14.0'-15.5'	26	12/14/07	Str	1 1/2"			No	19.61	85.02	69.49	31.1

Fuller Mossbarger Scott & May ENGINEERS

ATTERBERG LIMITS

Project	Clarksville Base Physical Fitness Facility			Project No.	LX2007274
Source	B-1, 1.5'-3.0'			Lab ID	2
Tested By	KDG	Test Method	ASTM D 4318 Method A	% + No. 40	15
Test Date	12-17-2007	Prepared	Dry	Date Received	12-12-2007

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
21.93	19.00	11.12	34	37.2	38
22.38	19.18	10.99	22	39.1	
21.61	18.58	10.96	18	39.8	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
17.44	16.40	11.12	19.7	20	18
20.65	19.12	11.31	19.6		

Remarks: _____

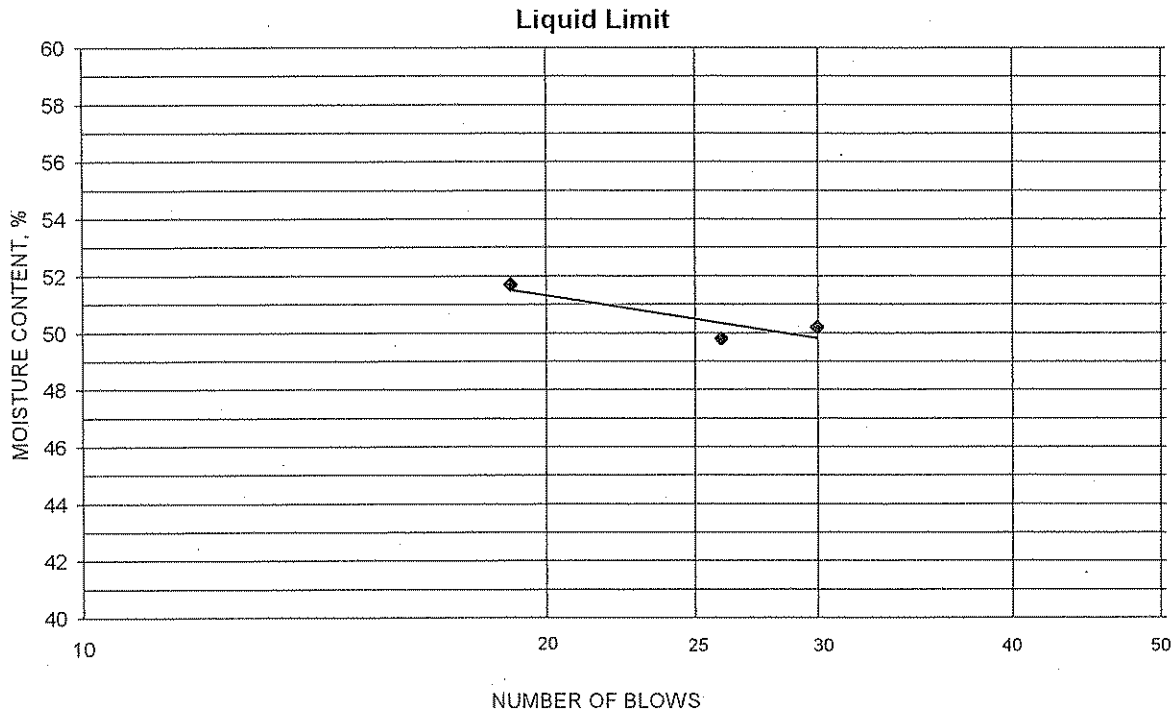
Reviewed By _____

Fuller Mossbarger Scott & May ENGINEERS

ATTERBERG LIMITS

Project	Clarksville Base Physical Fitness Facility			Project No.	LX2007274
Source	B-1, 4.0'-5.5'			Lab ID	3
Tested By	RC	Test Method	ASTM D 4318 Method A	% + No. 40	5
Test Date	12-17-2007	Prepared	Dry	Date Received	12-12-2007

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
23.62	19.35	10.84	30	50.2	
22.95	18.94	11.18	19	51.7	
20.71	17.50	11.05	26	49.8	50



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
18.01	16.84	11.40	21.5	21	29
18.22	17.05	11.52	21.2		

Remarks: _____

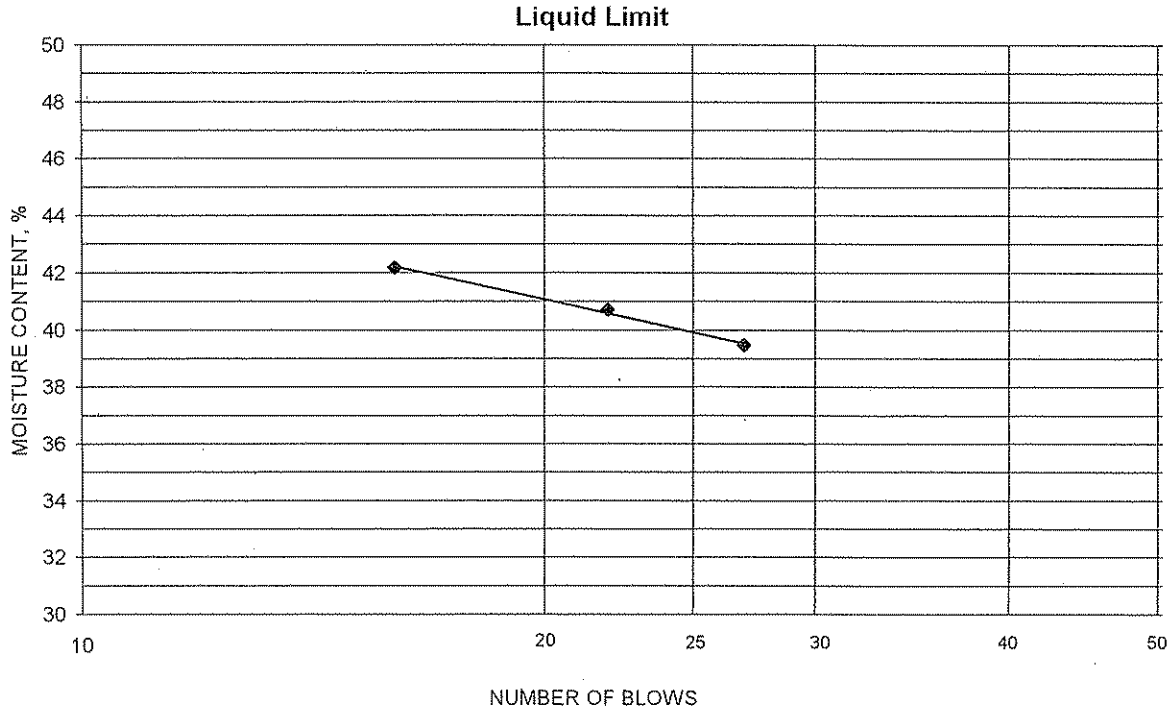
Reviewed By _____

Fuller Mossbarger Scott & May ENGINEERS

ATTERBERG LIMITS

Project	Clarksville Base Physical Fitness Facility			Project No.	LX2007274
Source	B-3, 1.5'-3.0'			Lab ID	15
Tested By	KDG	Test Method	ASTM D 4318 Method A	% + No. 40	5
Test Date	12-17-2007	Prepared	Dry	Date Received	12-12-2007

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.65	17.98	11.21	27	39.4	
20.52	17.79	11.08	22	40.7	
20.45	17.68	11.11	16	42.2	40



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
16.65	15.77	11.25	19.5	20	20
17.44	16.43	11.26	19.5		

Remarks: _____

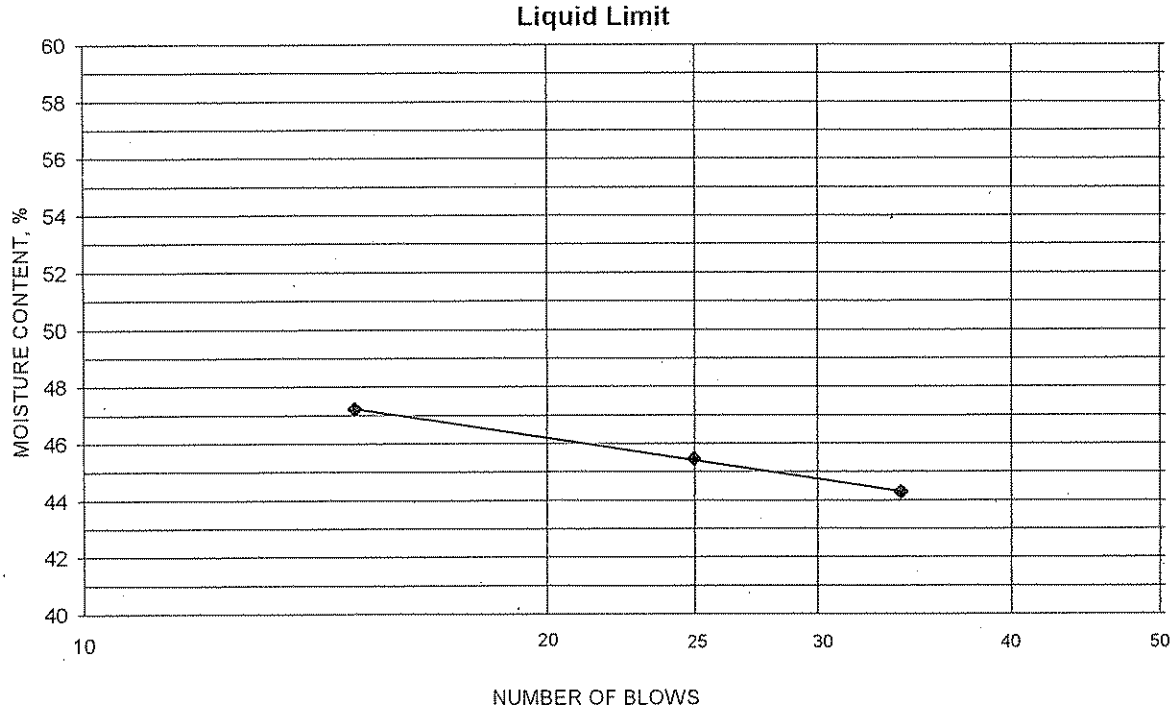
Reviewed By _____

Fuller Mossbarger Scott & May ENGINEERS

ATTERBERG LIMITS

Project	Clarksville Base Physical Fitness Facility			Project No.	LX2007274
Source	B-3, 4.0'-5.5'			Lab ID	16
Tested By	KDG	Test Method	ASTM D 4318 Method A	% + No. 40	65
Test Date	12-17-2007	Prepared	Dry	Date Received	12-12-2007

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.33	17.39	10.92	25	45.4	
20.24	17.39	10.95	34	44.3	
20.53	17.58	11.33	15	47.2	45



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
19.29	17.72	11.22	24.2	24	21
19.10	17.58	11.27	24.1		

Remarks: _____

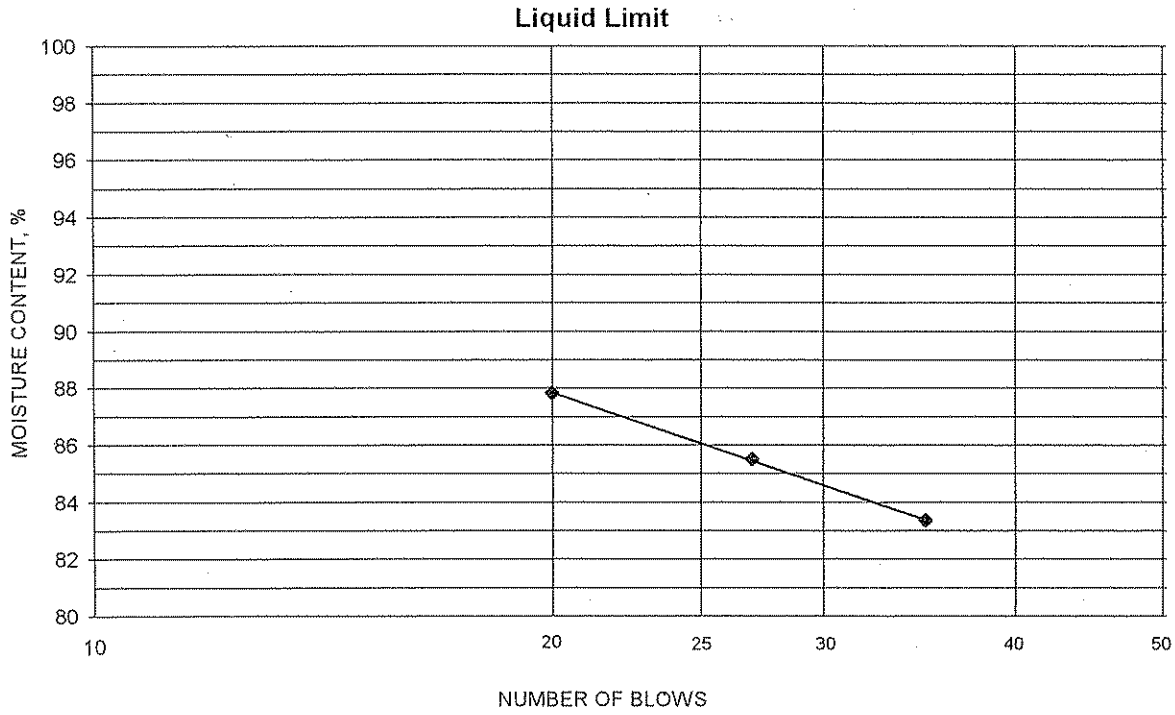
Reviewed By _____

Fuller Mossbarger Scott & May ENGINEERS

ATTERBERG LIMITS

Project	Clarksville Base Physical Fitness Facility			Project No.	LX2007274
Source	B-3, 9.0'-10.5'			Lab ID	18
Tested By	KDG	Test Method	ASTM D 4318 Method A	% + No. 40	50
Test Date	12-17-2007	Prepared	Dry	Date Received	12-12-2007

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.25	16.15	11.23	35	83.3	
21.20	16.67	11.37	27	85.5	
20.60	16.14	11.06	20	87.8	86



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
16.99	15.96	11.54	23.3	24	62
17.12	16.10	11.82	23.8		

Remarks: _____

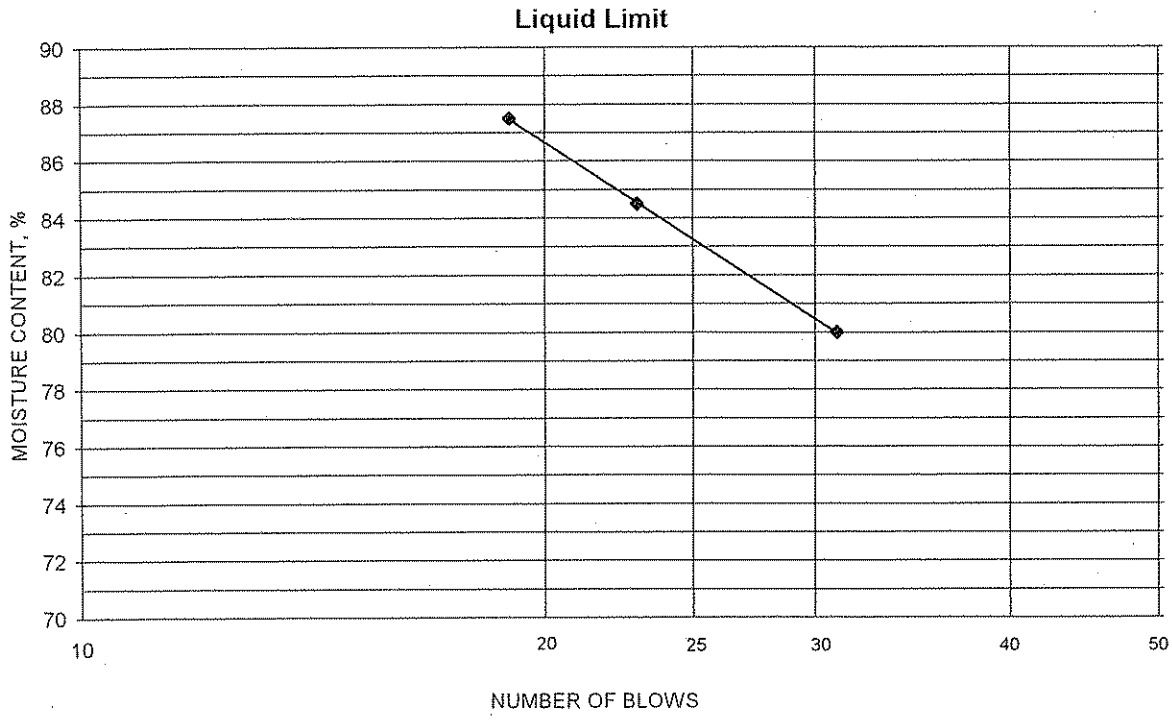
Reviewed By _____

Fuller Mossbarger Scott & May ENGINEERS

ATTERBERG LIMITS

Project	Clarksville Base Physical Fitness Facility			Project No.	LX2007274
Source	B-3, 14.0'-15.5'			Lab ID	19
Tested By	RJ	Test Method	ASTM D 4318 Method A	% + No. 40	5
Test Date	12-17-2007	Prepared	Dry	Date Received	12-12-2007

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
22.83	17.56	10.97	31	80.0	
21.85	17.01	11.28	23	84.5	
21.96	16.93	11.18	19	87.5	83



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
20.32	18.71	11.26	21.6	22	61
20.52	18.86	11.24	21.8		

Remarks: _____

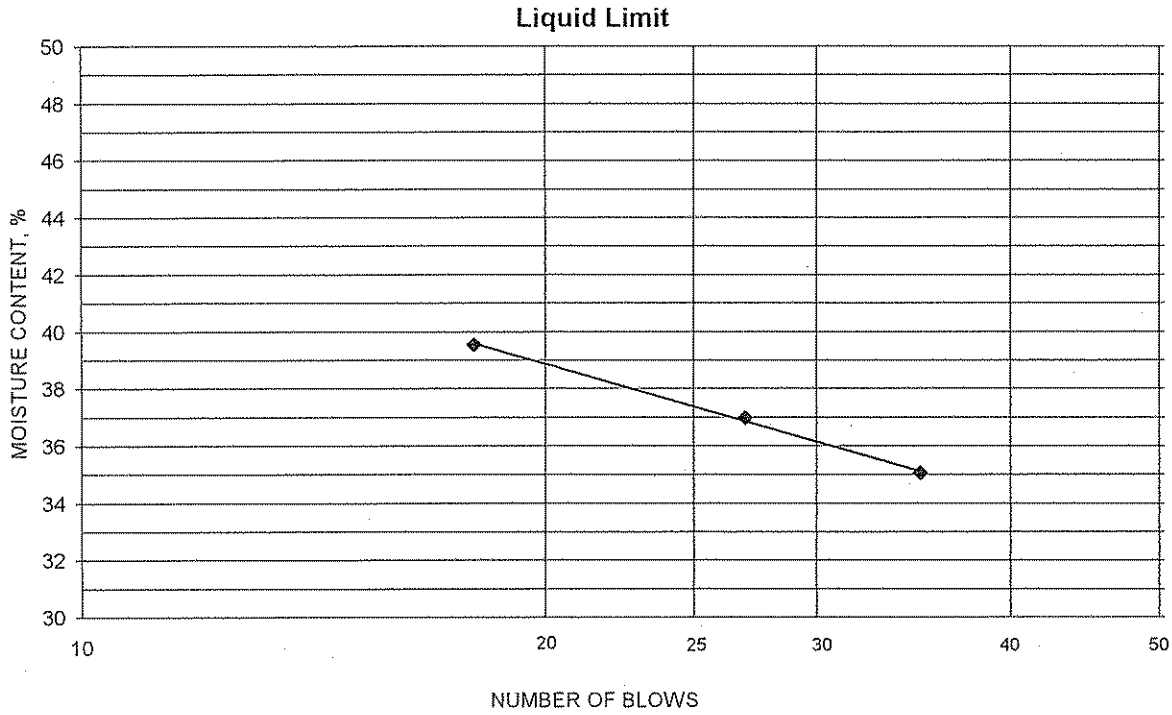
Reviewed By _____

Fuller Mossbarger Scott & May ENGINEERS

ATTERBERG LIMITS

Project	Clarksville Base Physical Fitness Facility			Project No.	LX2007274
Source	B-4, 1.5'-3.0'			Lab ID	22
Tested By	RJ	Test Method	ASTM D 4318 Method A	% + No. 40	25
Test Date	12-17-2007	Prepared	Dry	Date Received	12-12-2007

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
22.86	19.84	11.22	35	35.0	
23.38	20.10	11.22	27	36.9	
26.59	22.25	11.27	18	39.5	37



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
21.80	20.06	11.66	20.7	21	16
21.43	19.73	11.48	20.6		

Remarks: _____

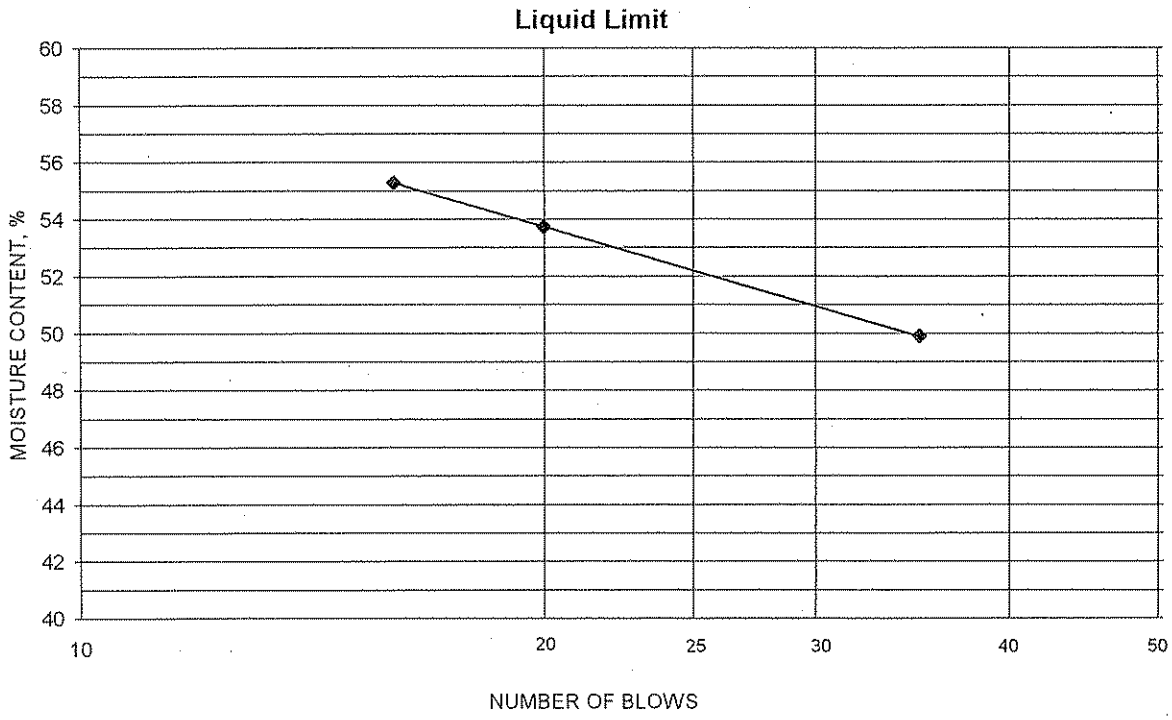
Reviewed By _____

Fuller, Mossbarger, Scott & May ENGINEERS

ATTERBERG LIMITS

Project	Clarksville Base Physical Fitness Facility			Project No.	LX2007274
Source	B-4, 4.0'-5.5'			Lab ID	23
Tested By	RC	Test Method	ASTM D 4318 Method A	% + No. 40	25
Test Date	12-17-2007	Prepared	Dry	Date Received	12-12-2007

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
22.87	19.01	11.27	35	49.9	
20.60	17.20	10.87	20	53.7	
21.45	17.73	11.00	16	55.3	52



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
19.56	18.21	11.52	20.2	20	32
19.05	17.79	11.49	20.0		

Remarks: _____

Reviewed By _____

Appendix D – Site Photos

Site Photos Location Plan
Site Photos (30)

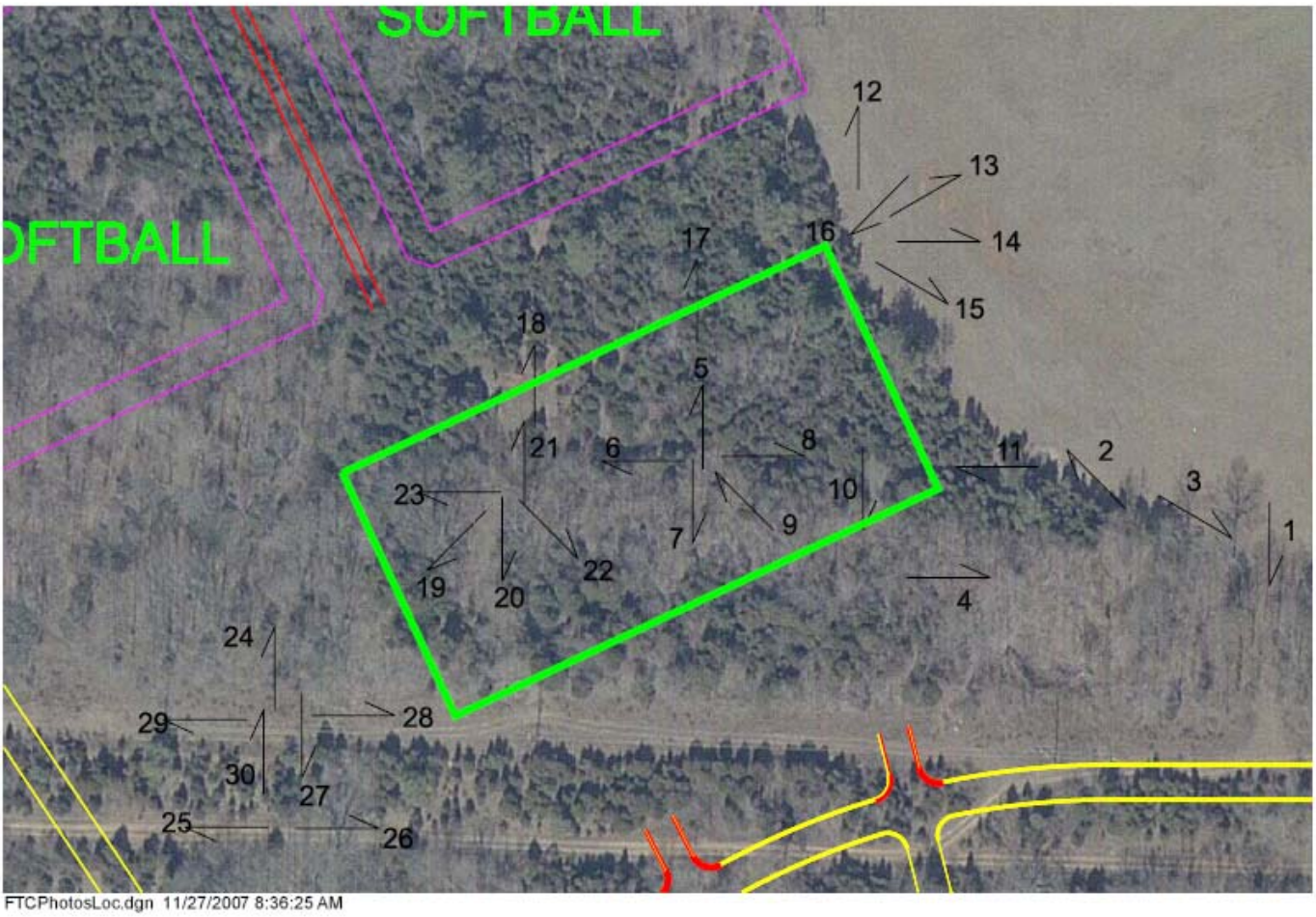


Figure 5	**Ft. Campbell, TN** Clarksville Base Physical Fitness Facility	**SITE PHOTOS LOCATION PLAN**	Designed by: I. Weilbaker Drawn by: I. Weilbaker Checked by: R. Jeffries Project Engineer/Architect: Date:	Date: 8/20/07 Scale: NOT TO SCALE Drawing code:	US Army Corps of Engineers Louisville District

Photo 1: At southeast portion of site, looking south through access path.

Photo 2: At "B-1" looking northwest.

Photo 3: At "B-1" looking southeast.

Photo 4: Southern portion of site, old foundation stones.

Photo 5: Center of old logging road at "B-3", looking north.

Photo 6: Center of logging road at "B-3", looking west.

Photo 7: At "B-3", center of logging road, looking south at eroded ditch.

Photo 8: At "B-3", center of logging road, looking east.

Photo 9: Center of old logging road at "B-3".

Photo 10: Unidentified test pit along old logging road.

Photo 11: Edge of clearing, looking west through old logging road.

Photo 12: At "B-2" looking north.

Photo 13: At "B-2" looking northeast.

Photo 14: At "B-2" looking east.

Photo 15: At "B-2" looking southeast.

Photo 16: At "B-2".

Photo 17: Unidentified test pit north of old logging road.

Photo 18: Unidentified test pit north of old logging road.

Photo 19: Center of site, south of logging road, looking southwest.

Photo 20: Center of site, south of logging road, looking south.

Photo 21: Partially cleared area, south of logging road, center of site, looking north.

Photo 22: Near "B-4", looking southeast.

Photo 23: Approximate center of site, looking west.

Photo 24: At "B-4", overhead utility easement, looking north.

Photo 25: Center of old construction road, southern portion of site, looking west.

Photo 26: Center of old construction road, southern portion of site, looking east.

Photo 27: At "B-4", overhead utility easement, looking south.

Photo 28: At "B-4", overhead utility easement, looking east.

Photo 29: At "B-4", overhead utility easement, looking west.

Photo 30: At "B-4", edge of utility easement.

GEO/11-283
Final

U.S. Army Corps of Engineers
Louisville District

Survey Results for
Fort Campbell Physical Fitness Facility
Geophysical Investigation
Fort Campbell, Kentucky

Prepared for
U.S. Army Corps of Engineers
Louisville District Contract No. W912QR-08-D-0014
Delivery Order No. 0017

Prepared by

GEO Consultants, LLC
325 Kentucky Avenue
Kevil, Kentucky 42053

Battelle-Oak Ridge Operations

March 2011

Survey Results for the Fort Campbell Physical Fitness Facility Geophysical Investigation Fort Campbell, Kentucky

March 2011

Prepared for GEO Consultants, LLC by Battelle-Oak Ridge Operations

LIST OF FIGURES

Figure 1. Interpretation overlain on map of the differential of the top and bottom coils for the third time gate
Figure 2. Map of the first time gate response of bottom coil.
Figure 3. Map of the second time gate response of bottom coil.
Figure 4. Map of the third time gate response of bottom coil.
Figure 5. Map of the differential of the top and bottom coils for the third time gate.
Figure 6. Map of the line path of the EM-61 survey.
Figure 7. Map of differential of the top and bottom coils of the third time gate superimposed on aerial image showing important site features.

FEATURE INTERPRETATION

The following are the results of a geophysical investigation (in graphic form) performed for the proposed location of the Fort Campbell Physical Fitness Center from March 15 – 16, 2011 by GEO Consultants, LLC and Battelle utilizing EM-61 instrumentation.

Figure 1 identifies anomalous features of interest. The table below provides the interpretation of the anomalies based on the differential drawing (Figure 5). Figure 2 shows the TEM first time gate response, Bin 1, of the EM-61 lower coil for the BCT Complex. Figure 3 shows the TEM second time gate response, Bin 2, of the lower coil. The third time gate response, Bin 3, for the bottom coil is mapped on Figure 4. Figure 5 shows the differential of the TEM third time gate response, Bin 3. The differential is calculated by taking the third time gate response of the top coil minus the third time gate response of the bottom coil, thereby eliminating some of the surface anomalies allowing for deeper detection within the subsurface of the survey area. Figure 6 illustrates the line path of the EM-61 survey. Figure 7 depicts the differential (from Figure 5) superimposed on an aerial image identifying important site features.

Anomalous features in the interpretation map (Figure 1) have been identified and a probable source has been attributed to them.

Interpretation summary of Figure 1.

Feature Identification	Attribution and Characteristics
A	Known landfill site.
B	Metal warning sign.
C	Surface or near surface debris.
D	Deeper anomalies that do not appear in the bin1, bin2, and bin3 maps; however, they become prevalent in the deep differential map. They may be due to a change in soil type or moisture content. It should be possible to resolve the origin of these features through shallow excavation.

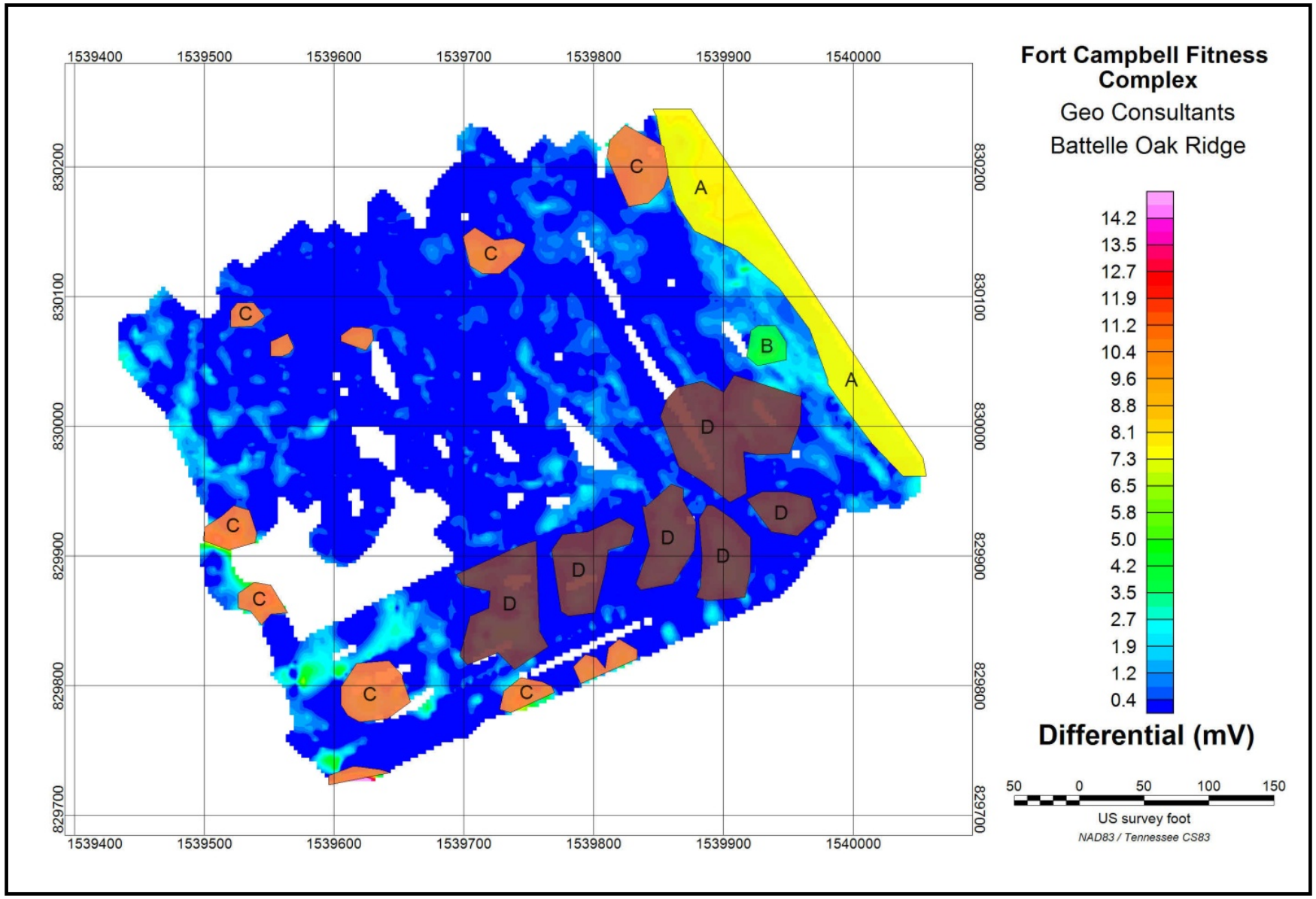


Figure 1. Interpretation overlain on map of the differential of the top and bottom coils for the third time gate.

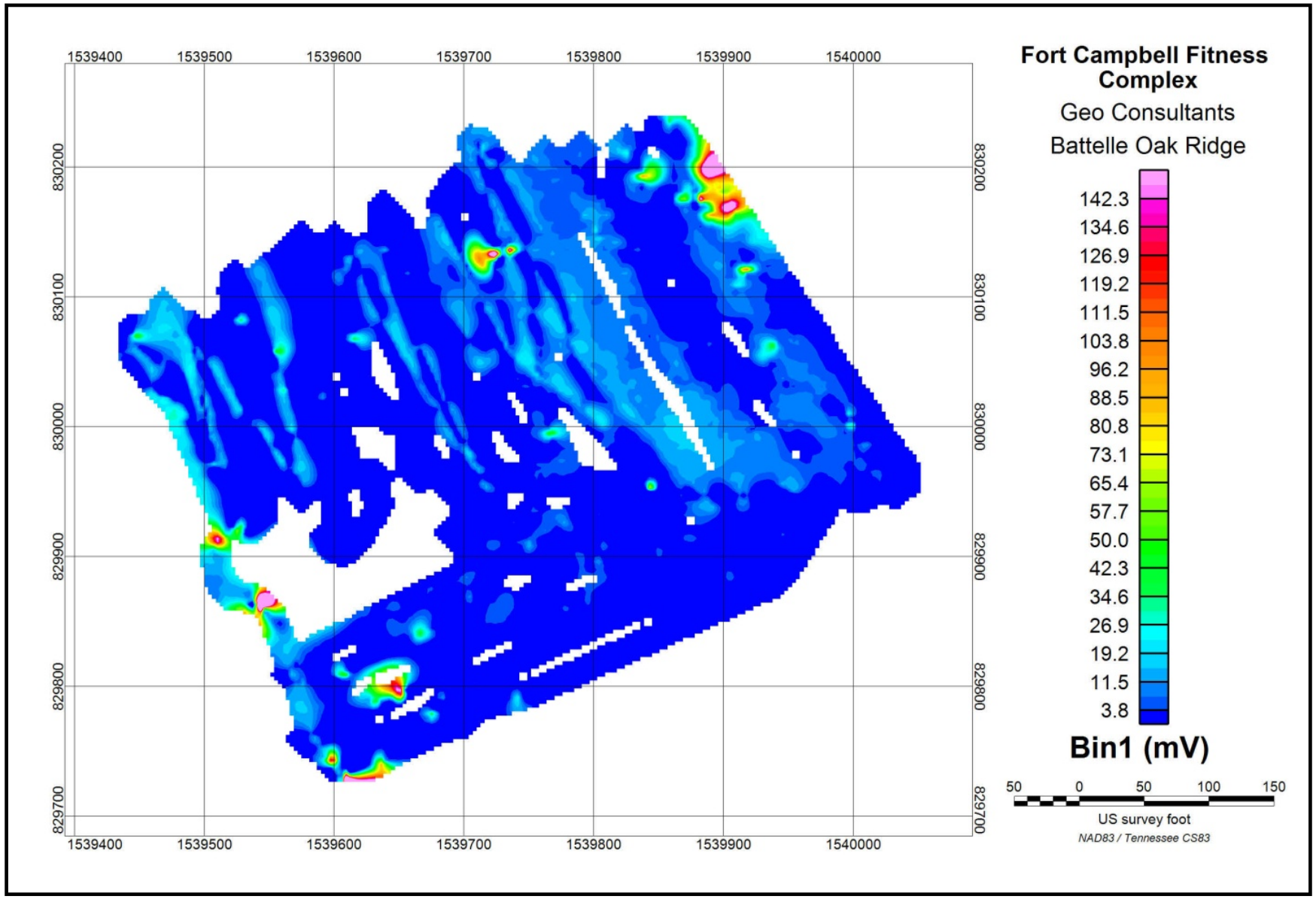


Figure 2. Map of the first time gate response of bottom coil.

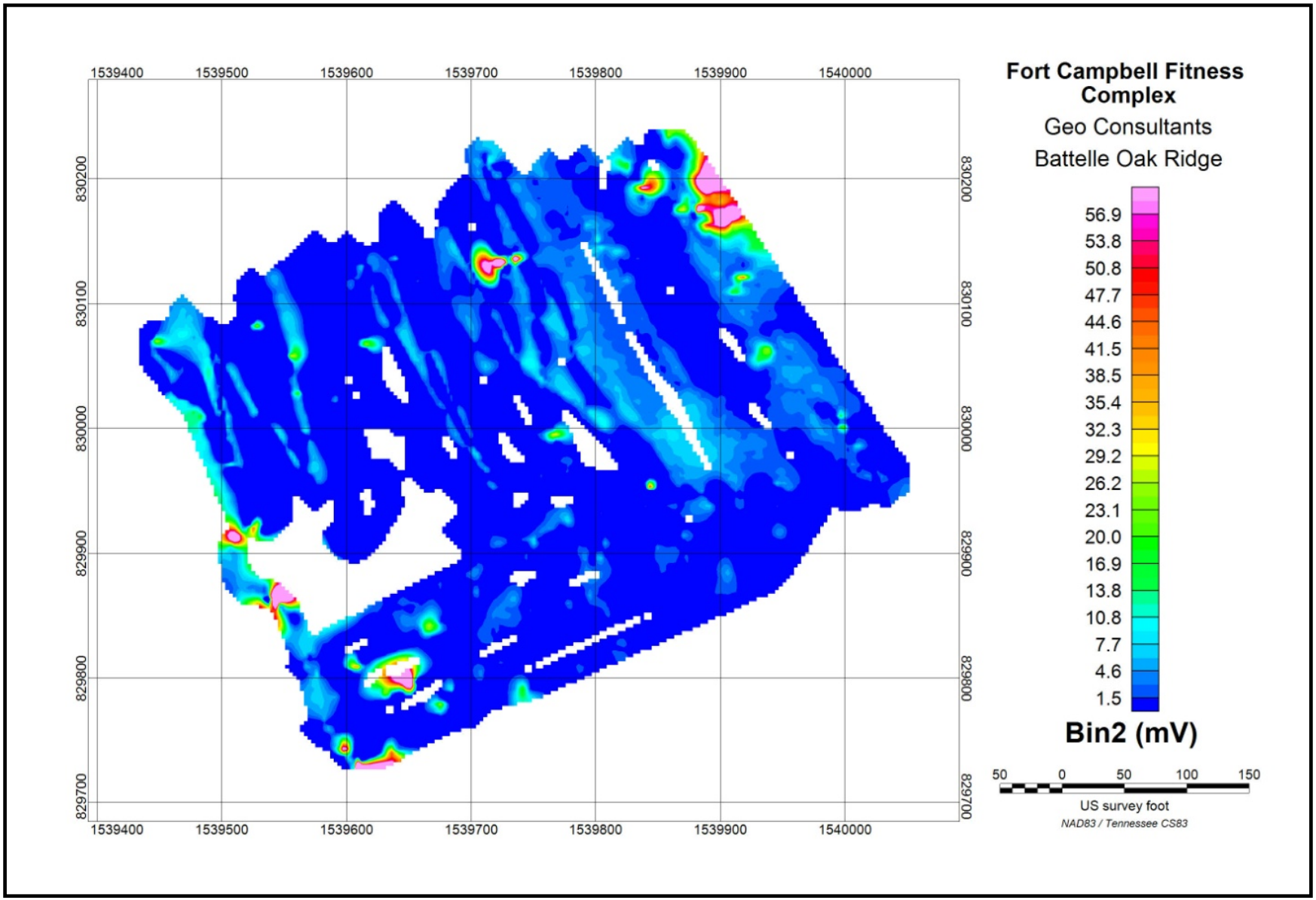


Figure 3. Map of the second time gate response of bottom coil.

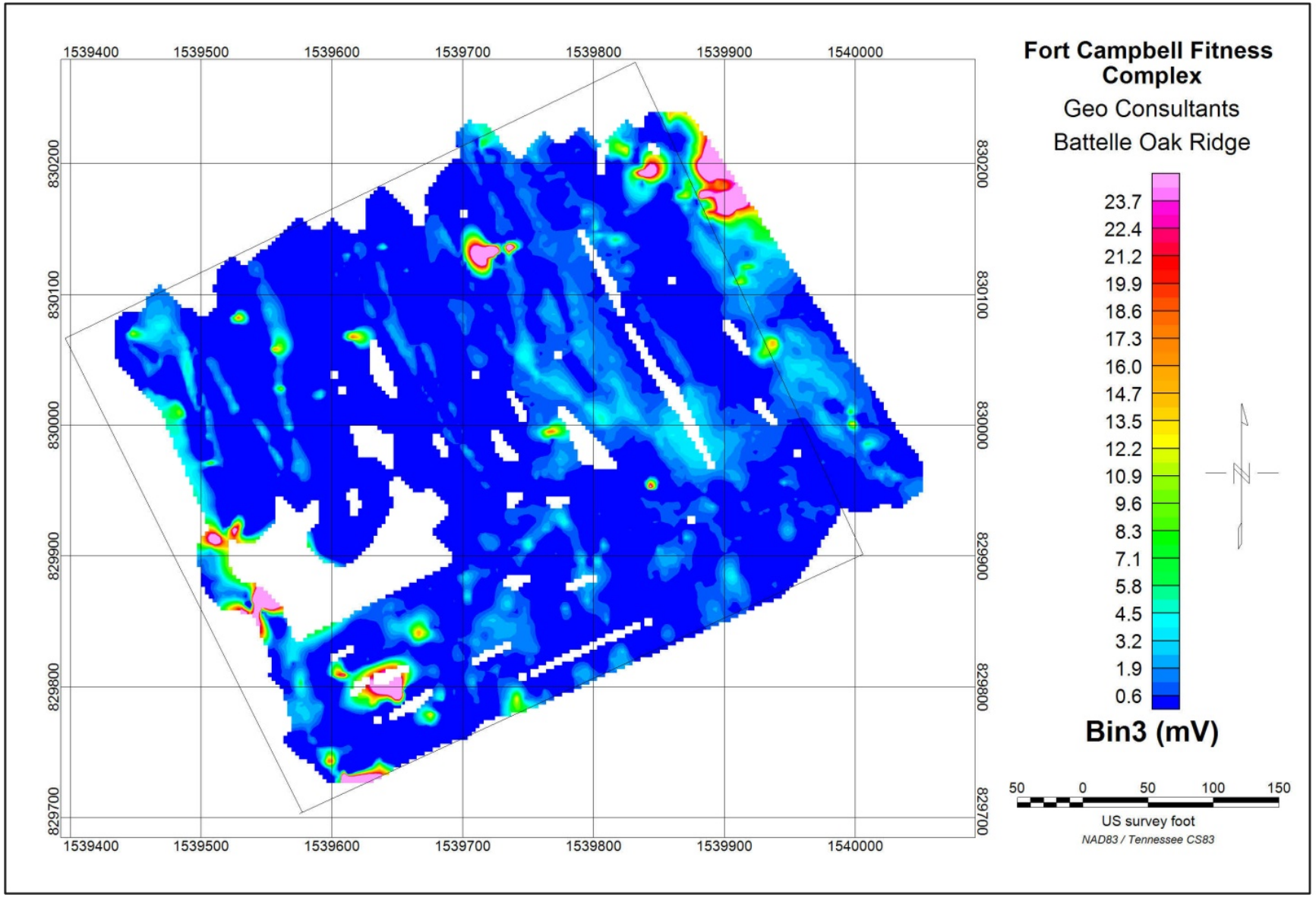


Figure 4. Map of the third time gate response of bottom coil.

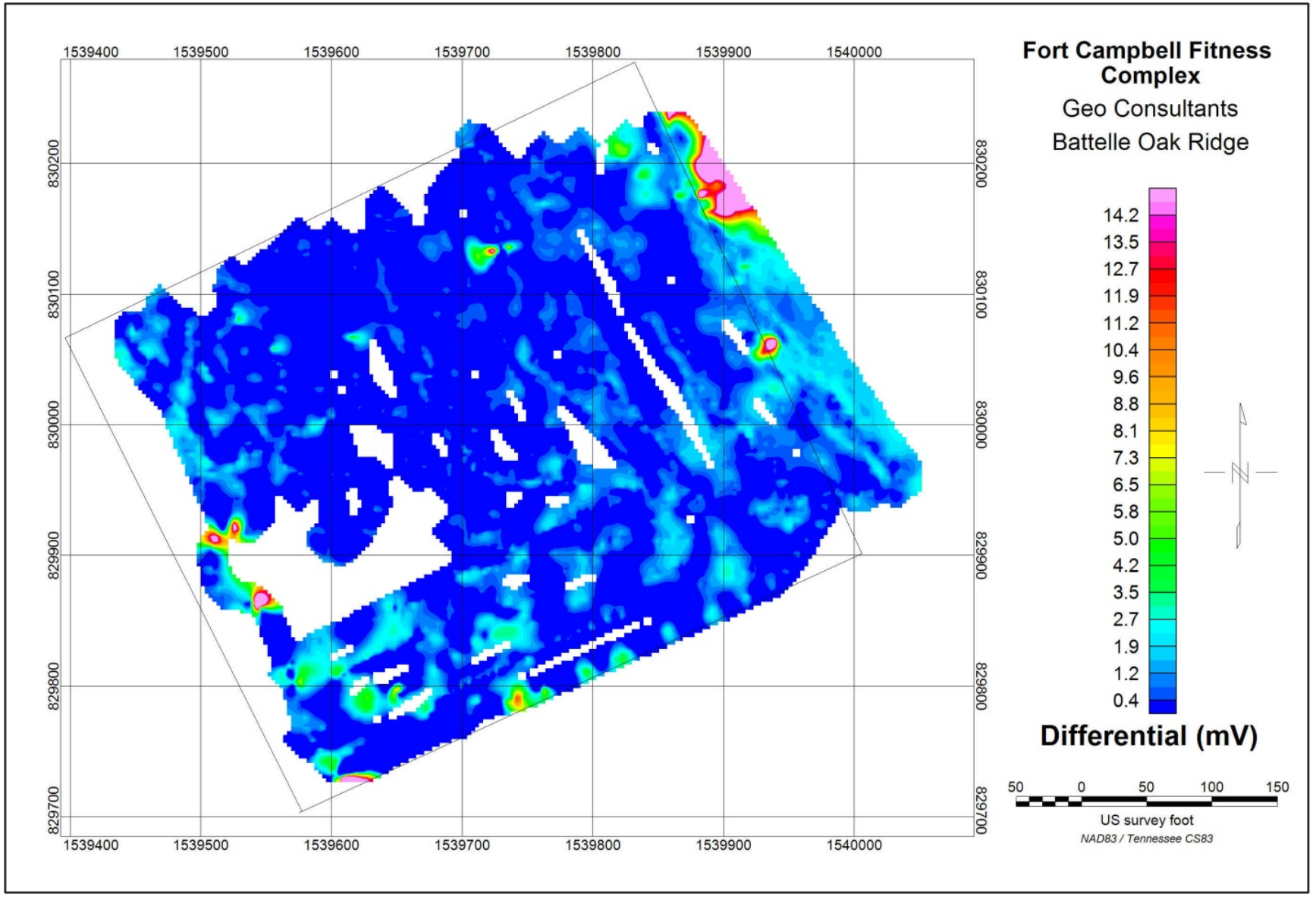


Figure 5. Map of the differential of the top and bottom coils for the third time gate.

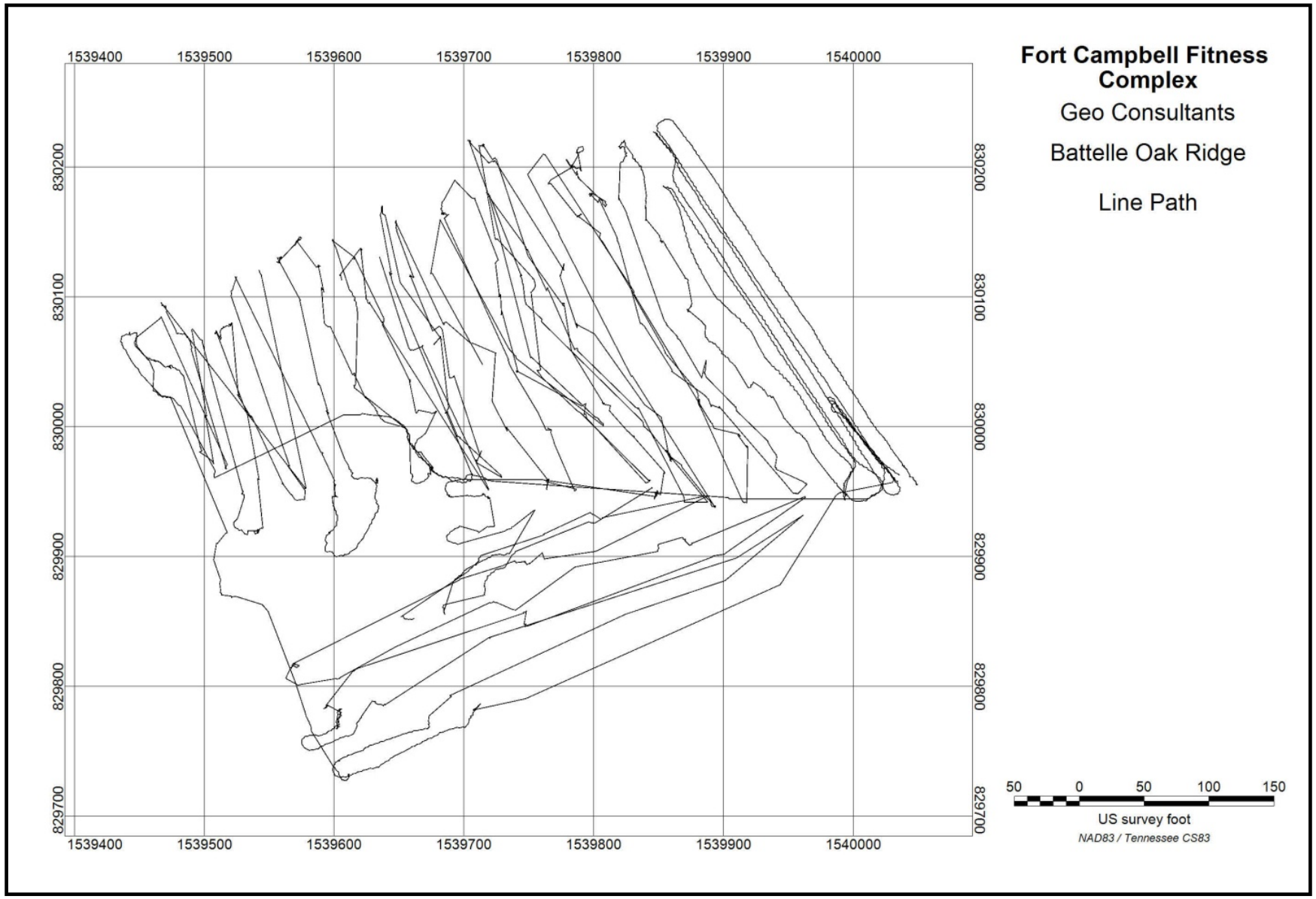
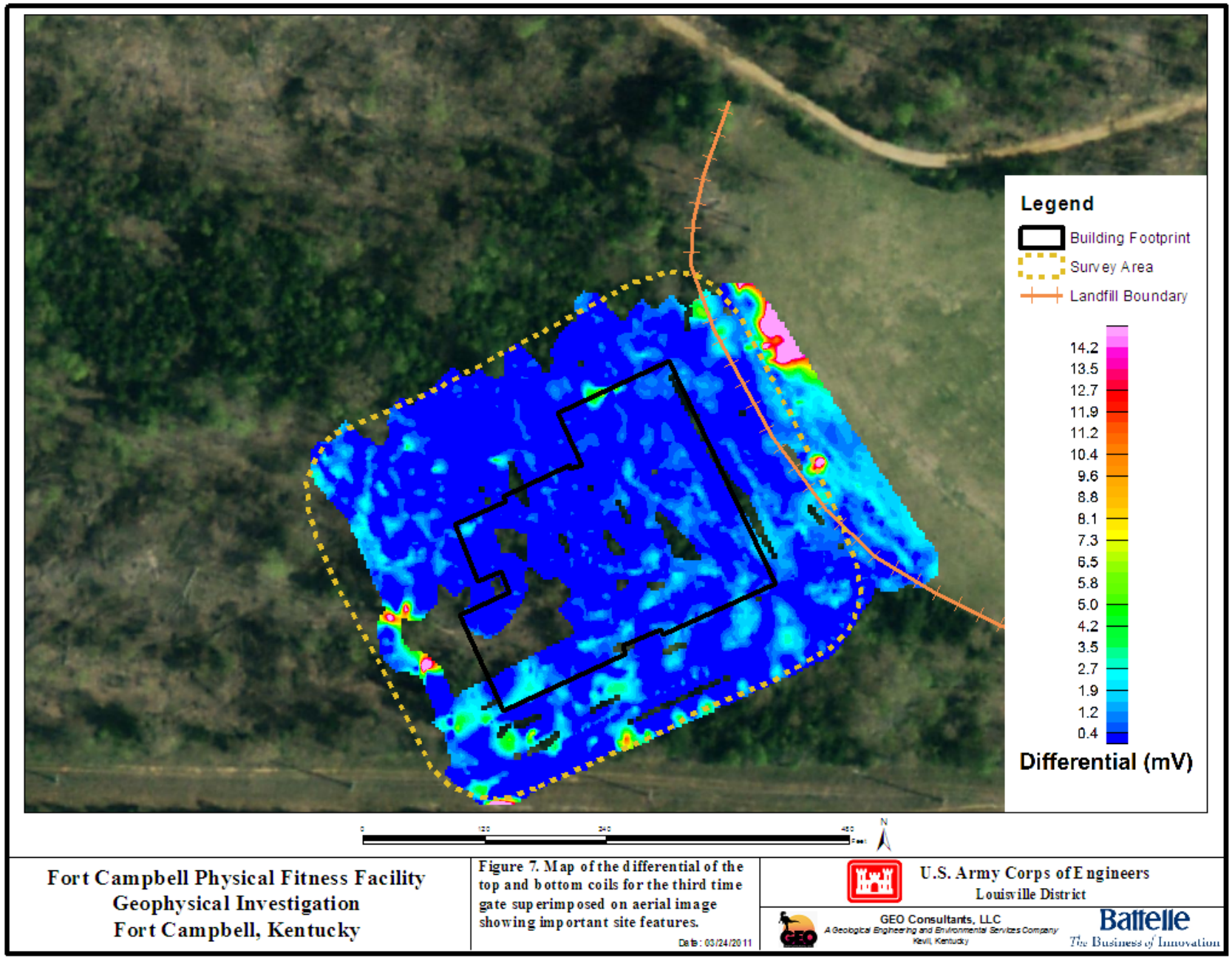


Figure 6. Map of the line path of the EM-61 survey.


Legend
Building Footprint
Survey Area
Landfill Boundary
14.2
13.5
12.7
11.9
11.2
10.4
9.6
8.8
8.1
7.3
6.5
5.8
5.0
4.2
3.5
2.7
1.9
1.2
0.4
Differential (mV)
0
120
240
480
Feet
N
Fort Campbell Physical Fitness Facility
Geophysical Investigation
Fort Campbell, Kentucky
Figure 7. Map of the differential of the top and bottom coils for the third time gate superimposed on aerial image showing important site features.
Date: 03/24/2011
U.S. Army Corps of Engineers
Louisville District
GEO Consultants, LLC
A Geological Engineering and Environmental Services Company
Kevil, Kentucky
Battelle
The Business of Innovation

APPENDIX B

LIST OF DRAWINGS
(NOT USED – SEE APPENDIX J)

APPENDIX C

UTILITY CONNECTIONS

HOW TO OBTAIN STATE PERMITS FOR WATER AND SEWER LINE EXTENSIONS

After you have submitted an application to CH2M HILL to build a water or sewer line on Fort Campbell, CH2M HILL will provide an "Approval to Begin Design". However, before "Approval to Begin Construction" is granted, we may need to obtain State permits for water and/or sewer. If your project is more than just simple services, then State permits are required. See Chris Semler (ph 931-431-2015, csemler@ch2m.com) for questions and assistance.

KENTUCKY DRINKING WATER:

- Requires a form, fee (usually $150), drawings, and some additional information. The design engineer-of-record should provide this information.
- See http://www.water.ky.gov/permitting/plansrev/ for the form (includes a checklist), and instructions.
- Once you have completed the form, including state fee, and obtained the items on the checklist, send the entire package to CH2M HILL (attn: Chris Semler). CH2M HILL will provide for item 6 on the checklist, a letter of acceptance from the utility, and CH2M HILL will submit the package to the KY Division of Water on your behalf.

KENTUCKY WASTEWATER:

- Requires a form, fee (usually $200), drawings, specifications, and some additional information. The design engineer-of-record should provide this information.
- The form (includes a checklist) and instructions are available from: http://www.water.ky.gov/homepage_repository/kpdes_permit_aps.htm (second from the bottom).
- More information is available at: http://www.water.ky.gov/permitting/wastewaterpermitting/construction/
- Once you have completed the form and obtained the items on the checklist including the State fee, please send the entire package to CH2M HILL (attn: Chris Semler). CH2M HILL will provide items 7, 8 and 9 on the checklist, and CH2M HILL will submit the package to the KY Water Infrastructure Branch on your behalf.

TENNESSEE DRINKING WATER:

- Requires a fee worksheet, fee ($100 plus 1 cent per foot over 1000' of main), 4 sets of drawings, specifications, and additional information to be provided by the engineer-of-record:
  - Project description: number and type (offices or motor pools, for example) of buildings served, construction timeframe, etc.
  - Sizes & lengths of pipe, pipe material
  - Number of fire hydrants
  - Design flow rate
  - Technical contact person (name, address, phone, fax and e-mail).

HOW TO OBTAIN STATE PERMITS FOR WATER AND SEWER LINE EXTENSIONS

- See http://tn.gov/environment/permits/pubh2o.shtml for the fee worksheet (4th from the bottom).
- Once you have gathered the above information, send the entire package to CH2M HILL (attn: Chris Semler). CH2M HILL will provide a letter of acceptance from the utility, and CH2M HILL will submit the package to the Tennessee Division of Water.

TENNESSEE WASTEWATER:

- Requires a fee ($25 per 250 feet or portion thereof), 3 sets of drawings, specifications, calculations, and additional information to be provided by the engineer-of-record:
  - Project description: number and type (offices or motor pools, for example) of buildings served, construction timeframe, etc.
  - Sizes & lengths of pipe, pipe material
  - Number of manholes
  - Design flow rate
  - Technical contact person (name, address, phone, fax and e-mail)
- Regulations and a fee worksheet are available at: http://www.state.tn.us/environment/wpc/publications/ (3rd block from the bottom)
- Once you have gathered the above information, send the entire package, including fee, to CH2M HILL (attn: Chris Semler). CH2M HILL will provide a letter of acceptance from the utility, and CH2M HILL will submit the package to the Tennessee Division of Water Pollution Control on your behalf.

Tips and General Information:

- Please provide one extra copy of your drawings, 11x17, for our records.
- Bind your drawings (staples and paper are fine). Loose sheets get lost!
- Expect approval in 4-5 weeks. You cannot construct without the right permit.
- Use the right PE stamp. Tennessee requires a Tennessee Stamp. Kentucky requires a Kentucky Stamp. Put an original PE Stamp on the cover page and any utility plans and profiles.
- Do not combine fees. Please keep wastewater packages and water packages separate. Make checks payable to the “State of Tennessee” or the “Kentucky State Treasurer”.
- If you are using CH2M HILL’s “Fort Campbell Water and Wastewater Design Guide and Construction Standards” as your specifications, you will not need to submit these in hard copy form. You still must include these in your CD /DVD submittal to Kentucky.
- Please do not call the States for information unless they contact you directly. CH2M HILL will gladly do this for you.
- CH2M HILL’s Fort Campbell office is located at:

  BLDG 5101 Tennessee Ave
  Fort Campbell KY 42223
- For more information, please contact Chris Semler PE, at 931-431-2015 or csemler@ch2m.com.

CH2MHILL

FORT CAMPBELL ARMY POST

Application for Water and Wastewater Connection

To be completed by CH2M HILL

Application date: _____
Application number: _____

Requestor

Firm Name_____

Technical Representative _____

Address_____

Phone No._____

Representative to Sign Agreement_____

Address_____

Phone No._____

Federal Contract Information

Contract Number_____

Contract Date_____

Project Title_____

Government Project Number_____

Contracting Agency_____

Contract Officer _____

Address_____

Phone Number_____

Service Requested

☐ Water ☐ Wastewater

Date final service is required _____

Will construction be phased? YES NO (circle one)

If phased, provide dates:

_____

_____

Structure Description

Name of structure or complex _____

Single structure or multiple structures _____

Describe function of structure(s) _____

Permanent or Temporary_____

Location (Street Address) _____

Site Plan – Provide site plan with streets and layout of structures (attach drawing)

Capacity Requirements

Anticipated water demand per structure (attach worksheet) _____

Anticipated irrigation demand (attach worksheet) _____

Anticipated fire demand (attach worksheet) _____

Anticipated sewer demand (attach worksheet) _____

Will a lift station be required? If so, what is the anticipated capacity of the lift station?
_____

Will the existing water and wastewater systems support this required demand? Yes or No (circle one)

Wastewater Characteristics

Is the wastewater discharged to the sewer likely to have characteristics that would differ from that of normal domestic wastewater (this includes structures that contain food preparation facilities larger than single family kitchens) or exceed any of the limits in the Fort Campbell Sewer Use Policy?

YES NO (circle one)

If the answer to the above question is yes, fill in supplemental data form to indicate the nature of the facility for the purpose of determining potential wastewater service requirements.

Application Fee (Design Review and Inspection)

An Application Fee of $600 is due and payable with this application for all connection up to 5,000 linear feet. The fee is calculated by adding the estimated _____ linear feet of water line to the estimated _____ linear feet of sewer line.

- 0 – 5,000 feet, $600
- > 5,000 feet, further review required for special fees

Additionally, special fees may be imposed for design reviews of large lift stations, storage tanks, or any other structure that is determined to be out of the ordinary and will be calculated separately with payment due before approval to construct is granted.

The fee for this project is: $_____. Additional fees will/will not (circle one) be required.

Impact Fee

An Impact Fee may be due and payable for any infrastructure required outside the footprint of this project but required to support this project, whether the infrastructure exists or is to be constructed, and may be imposed against the project or the Customer to recover the cost of said infrastructure. Such fees will be calculated apart from any other fees discussed in this document. Impact fees will be calculated based on the portion of available capacity (existing or to be constructed) required to support the project.

The impact fee for this project is: $_____.

Disputes

In the event of any dispute, question, or disagreement arising from or relating to this process and/or the Fort Campbell Water and Wastewater Design and Construction Standards, the parties hereto shall use their best efforts to settle the dispute, question, or disagreement. To this effect, they shall consult and negotiate with each other in good faith and, recognizing their mutual interests, attempt to reach a resolution satisfactory to both parties. If they do not reach such resolution within a period of 60 days after a party has notified the other of the dispute, then the parties shall submit the dispute to a mutually acceptable neutral third party before resorting to arbitration. If the parties do not reach resolution of the dispute within 60 days after submitting the dispute to a neutral third party, either party may, upon written notice to the other party, submit the dispute to binding arbitration in accordance with rules comparable to the Construction Industry Arbitration Rules of the American Arbitration Association then in effect. The location of any mediation or arbitration shall be the location of the Project, or as otherwise mutually agreed between the parties. The prevailing party in any dispute arising out of or relating to this Agreement or its breach that is resolved by arbitration or other litigation shall be entitled to recover from the other party reasonable attorney's fees, costs and expenses incurred by the prevailing party in connection with such arbitration or litigation.

I hereby acknowledge receipt and acceptance of this application for further review and processing.

CH2M HILL CONSTRUCTORS, INC.

Sign Name:
_____

Print Name:
_____

Print Title:
_____

I hereby certify that the information contained herein is accurate and complete to the best of my ability.

CUSTOMER/REQUESTOR

Sign Name:
_____

Print Name:
_____

Print Title:
_____

APPENDIX D

RESULTS OF FIRE FLOW TESTS

Test Location	23ct
Date of Test	3/10/11
Time of Test	1030
CH2M HILL Staff	Hill / Lozano's

System Information

Tank Elevations

WTP Clearwell	ft		
ET2 (Parade Field)	ft	Destiny Tank	ft
ET4 (Sommers)	ft	Sabre Tank	ft

Pump Stations	Time	ON/ OFF	Pressure (psi)	How Many Pumps Are Running?	Flow (gpm)
WTP Pumps					
Morgan Road PS					
Destiny PS					
Sabre PS					

Flow Test Information

Flow Hydrant # (file by this hydrant number)	H112-10
Size of Hydrant Opening	2.5
No. of Openings Flowed	1
Hydrant Opening Coefficient	.90
Discharge Flow Rate (gpm)	1300

Residual Hydrant #	H112-11
Static Pressure (psi)	68
Flow Pressure (psi)	62
Post Flow Static Pressure (psi)	68

Theoretical Calculated Hydrant Flow at 20 psi
$Q_R = Q_F \times (h_R{}^{0.54})/h_F{}^{0.54}$ = flow at 20 psi

Q_F = observed flow at measured residual pressure.

h_R = difference between normal pressure and 20 psi

h_F = difference between normal pressure and observed residual pressure during test

Color Codes:

- ☐ BLUE >= 1500 GPM
- ☐ GREEN 1000-1499 GPM
- ☐ ORANGE 500-999 GPM
- ☐ RED <500 GPM

CHECK ALL THAT APPLY:

- ☐ Hydrant needs work order to fix: _____
- ☑ Hydrant has isolation valve
- ☐ Hydrant has dog tag
- ☑ Hydrant in GIS (in map book)
- ☐ No test due to traffic concerns
- ☐ No test due to restricted access
- ☐ No test due to erosion concerns
- ☐ Other (frost free hydrant, hydrant removed, washrack, etc. Explain: _____

The information provided on this data sheet represents performance for the referenced fire hydrant at the date and time of day, and under the conditions indicated. Guarantees of fire hydrant performance at other times and conditions are not stated or implied.

Appendix A field testing sheet_Nov2010.xls

Fort Campbell
Flow Test Data Sheet

Test Location	2BCT
Date of Test	3/10/11
Time of Test	0945
CH2M HILL Staff	Hill / Richardson / Olsen

System Information

Tank Elevations

			WTP Clearwell		ft
ET2 (Parade Field)		ft	Destiny Tank		ft
ET4 (Sommers)		ft	Sabre Tank		ft

Pump Stations	Time	ON/ OFF	Pressure (psi)	How Many Pumps Are Running?	Flow (gpm)
WTP Pumps					
Morgan Road PS					
Destiny PS					
Sabre PS					

Flow Test Information

Flow Hydrant # (file by this hydrant number)	H112-11
Size of Hydrant Opening	2.5
No. of Openings Flowed	1
Hydrant Opening Coefficient	.90
Discharge Flow Rate (gpm)	1325

Residual Hydrant #	H112-10
Static Pressure (psi)	68
Flow Pressure (psi)	58
Post Flow Static Pressure (psi)	68

Theoretical Calculated Hydrant Flow at 20 psi

$Q_R = Q_F \times (h_R^{0.54}) / h_F^{0.54}$ = flow at 20 psi

Q_F = observed flow at measured residual pressure.

h_R = difference between normal pressure and 20 psi

h_F = difference between normal pressure and observed residual pressure during test

Color Codes:

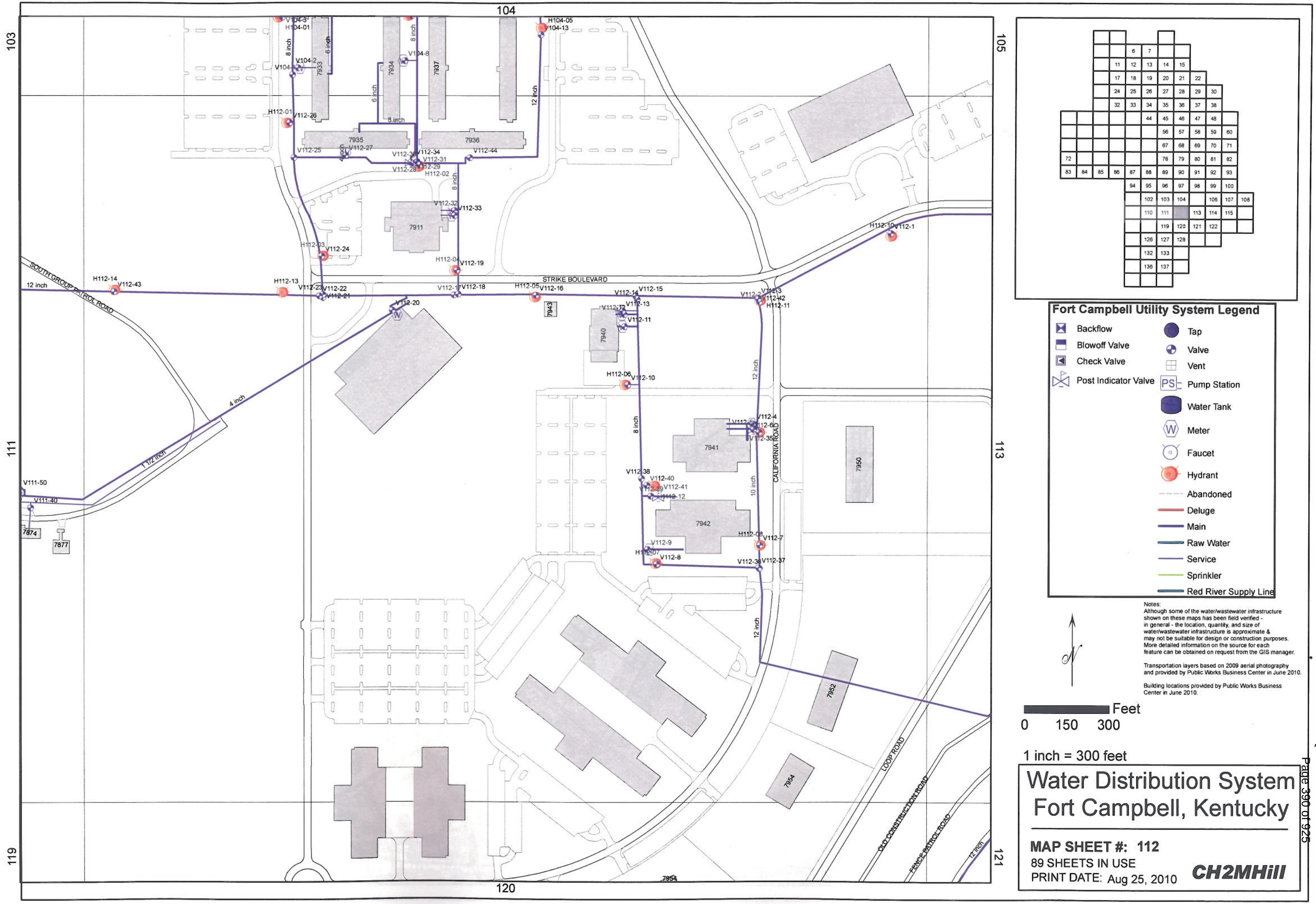
- ☐ BLUE >= 1500 GPM
- ☐ GREEN 1000-1499 GPM
- ☐ ORANGE 500-999 GPM
- ☐ RED <500 GPM

CHECK ALL THAT APPLY:

- ☐ Hydrant needs work order to fix: _____
- ☑ Hydrant has isolation valve
- ☐ Hydrant has dog tag
- ☑ Hydrant in GIS (in map book)
- ☐ No test due to traffic concerns
- ☐ No test due to restricted access
- ☐ No test due to erosion concerns
- ☐ Other (frost free hydrant, hydrant removed, washrack, etc. Explain: _____

The information provided on this data sheet represents performance for the referenced fire hydrant at the date and time of day, and under the conditions indicated. Guarantees of fire hydrant performance at other times and conditions are not stated or implied.

Appendix A field testing sheet_Nov2010.xls



Fort Campbell Utility System Legend

- Backflow
- Blowoff Valve
- Check Valve
- Post Indicator Valve
- Tap
- Valve
- Vent
- Pump Station
- Water Tank
- Meter
- Faucet
- Hydrant
- Abandoned
- Deluge
- Main
- Raw Water
- Service
- Sprinkler
- Red River Supply Line

Notes:
Although some of the water/wastewater infrastructure shown on these maps has been field verified - in general - the location, quantity, and size of water/wastewater infrastructure is approximate & may not be suitable for design or construction purposes. More detailed information on the source for each feature can be obtained on request from the GIS manager.

Transportation layers based on 2009 aerial photography and provided by Public Works Business Center in June 2010.

Building locations provided by Public Works Business Center in June 2010.

Feet
0 150 300

1 inch = 300 feet

Water Distribution System Fort Campbell, Kentucky

MAP SHEET #: 112
89 SHEETS IN USE
PRINT DATE: Aug 25, 2010

CH2MHill

APPENDIX E

ENVIRONMENTAL INFORMATION

SECTION 01560
Environmental Protection

Ft. Campbell Requirements:

Ft. Campbell specification Section 1560, Environment Protection shall be used instead of UFGS 01355 for all COE and DPW prepared projects.

Instructions to Designers:

Project specifications shall include the Ft. Campbell Specification:
Section 01560, Environment Protection.

Additional required guidance is found in **Appendix A.**

For electronic copies of the document, contact the PE/A for MILCON and OMA projects by the COE. A-E's directly serving the installation should contact the PM.

Return to Division Table of Contents

Ft. Campbell version:

Section 01560, Environment Protection.

SECTION C-01560

ENVIRONMENT PROTECTION
4/03

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 SUBMITTALS

The following shall be submitted in accordance with Section C-01300 SUBMITTAL PROCEDURES:

1.2.1 SD-8, Statements

Work Plans; GA.

1.2.1.1 Environment Protection

Prior to commencement of work at the site, the Contractor will submit within 10 calendar days after Notice to Proceed, his written detailed proposal for implementing the requirements for environmental pollution control specified herein. The contractor will then meet the representatives of the Contracting Officer upon their completion of review of his proposal as needed for compliance with the environmental pollution control program.

1.2.1.2 Preconstruction Survey

Prior to start of any onsite construction activities, the Contractor and the Contracting Officer shall make a joint condition survey, after which the Contractor shall prepare a brief report indicating on a layout plan the condition of trees, shrubs, and grassed areas immediately adjacent to the site of the work and adjacent to his assigned storage area and access routes(s) as applicable. This report will be signed by both the Contracting Officer and Contractor upon mutual agreement as to its accuracy and completeness.

1.2.1.3 Waste Disposal Scheme

As part of his proposed implementation under Paragraph 3.2, and prior to onsite construction, the Contractor shall submit a description of his scheme for disposing of waste materials resulting from the work under this contract. If any waste material is

dumped in unauthorized areas, the Contractor shall remove the material and restore the area to the condition of the adjacent undisturbed areas. Where directed, contaminated ground shall be excavated, disposed of as approved, and replaced with suitable fill material, all at the expense of the Contractor.

PART 2 POLLUTION PREVENTION PLANS

2.1 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with all Federal, State, and local regulations.

2.1.1 Environmental Protection Plan

The contractor will develop a site specific Environmental Protection Plan which will address in detail the following:

a. Hazardous materials (HM) to be brought onto the post

Any hazardous materials planned or used on the post by the contractor will be managed with the same intent and purpose as the Hazardous Materials Management Program (HMMP) maintained by the DPW Environmental Division Pollution Prevention Branch. Ft. Campbell's HMMP was established to maintain effective and regulatory compliant management of hazardous materials used on the post. The HMMP provides establishment of source reduction methods, recycling and reuse opportunities, modifications of processes and procedures, shelf life management, authorized HM use list, full visibility of all HM at any given time, the least toxic and least amount of HM acquired, stored, or used, and proper handling, storage, and disposal of all HM. A hazardous material as per 29 CFR 1910.1200 will be included. A hazardous material as per 29 CFR 1910.1200 is any material which is a physical or health hazard. The Contractor shall complete the **FTCKY HAZMAT INVENTORY FORM** , which appears as an appendix to this section. The inventory form requires a list (including quantities) of HM to be brought to the post and copies of the corresponding material safety sheets (MSDS). The completed form shall be submitted to the Contracting Office representative and to Fort Campbell Environmental Division - Pollution Prevention Branch. In the event the usage of additional Hazardous Materials are found necessary during the project, they will be included into the MSDS package of the Environmental Protection Plan. At project completion, any hazardous material brought onto the post shall be removed from the site by the Contractor. Ft. Campbell is required by Executive Order 12856, "Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements", to comply with the

requirements of the Emergency Planning and Community Right-to-Know Act (EPCRA). EPCRA requires Ft. Campbell to identify the amounts of chemicals present on, or released from its facilities, understand the potential problems that hazardous materials pose to the surrounding communities and environment, and provide information to the public and local emergency planning organizations. To comply with EPCRA requirements, Ft. Campbell must track and be accountable for hazardous materials (HM) used throughout the post. As required by the Emergency Planning and Community Right - to - Know Act (EPCRA), the Contractor will account for the quantity of HM brought to the post, the quantity used or expended during the job, and the leftover quantity which (1) may have additional useful life as HM and shall be removed by the Contractor, or (2) may be hazardous waste, which shall then be removed as specified herein. This information will be provided to the Environmental Division Pollution Prevention Branch on a calendar year basis or project basis if less than a single calendar year, and must be submitted by the end of January following the year reported.

b. Hazardous waste (HW) generated

The Environmental Protection Plan must list, quantify explain how any HW generated during the project will be disposed. Disposal of hazardous waste generated by the contractor shall be disposed off site according to applicable regulations at the contractor's expense. A report must be submitted annually of the generation of hazardous waste on post and must be provided to the Contracting Officer representative and to Environmental Division - Pollution Prevention Branch.

c. Storage of hazardous waste

In accordance with post regulations and 40 CFR 262, hazardous waste shall be stored near the point of generation up to a total quantity of (one quart) 1 L of acutely hazardous waste or (55 gallons) 200 L of hazardous waste (Satellite Accumulation Point). Any volume exceeding these quantities shall be moved to a HW permitted area within 3 days. Locations of hazardous waste storage areas must be approved by DPW-ED-PP. Containers must be labeled in accordance with 40 CFR 262 and must contain the words Hazardous Waste and other words which identify the contents of the container. Prior to shipment of hazardous waste on site or off, the waste must be placed into good condition Department of Transportation (DOT) specification containers for hazardous waste (49 CFR 172.101). Containers must be labeled with required labels for HW and for DOT shipping. The area selected for the storage of hazardous wastes must minimize the threat to human health or the environment in the event of a release.

d. Minimization of hazardous waste

In accordance with post regulations, the Contractor should substitute materials as necessary to reduce the generation of HW and include a statement to that effect in the Environmental Plan.

e. Environmental conditions likely to be encountered during this project

Contact the Contracting officer for conditions in the area of the project which may be subject to special environmental procedures. Include this information in the Preconstruction Survey. Describe in the Environmental Plan any permits required prior to working the area, and contingency plans in case an unexpected environmental condition is discovered.

f. Any Hazardous Waste removal or disposal must be manifested through Environmental Division's Pollution Prevention Branch, Hazardous Waste Program Manager and must be signed and numbered. Permitting plans for any transportation and disposal, excavation, or construction of hazardous waste that will require an environmental permit from an issuing agency

The Contractor is responsible for generating the permits and delivering the completed documents to the Contracting Officer. The Contracting Officer will review the permits and the Contractor shall file the documents with the appropriate agency and complete disposal with the approval of the Contracting Officer. The Contracting Officer shall advise Environmental Plan of any Hazardous Waste generated and shall send contractor to Environmental Pollution Protection Branch**.** Correspondence with the State concerning the environmental permits and completed permits shall be delivered to the Contracting Officer.

g. Radon mitigation design and testing

All residential and non-residential construction performed at Fort Campbell must have passive radon mitigation features implemented into the design. The contractor will install preliminary features as per drawings. The contractor will hire an independent testing company to perform radon monitoring prior to inhabitation of the units. The testing firm must be EPA accredited and approved to perform work in the State of Tennessee (Kentucky). A list of accredited testing firms in the state of TN (KY) can be obtained through the state Radon Program Coordinator (615) 532-0733. In the event radon concentrations greater than 4 pCi/L (pico curies per liter of air) are revealed consult Fort Campbell DPW through the Contracting Officer's representative for guidance pertaining to retesting. If upon further testing, elevated (unacceptable)levels are present, additional mitigation features will be installed followed by more testing. The buildings will not be inhabited until levels of less than 4 pCi/L have been achieved.

Extend the pipe of the passive radon mitigation system through the roof and leave it open (do not Cap).

Place electrical outlets near (e.g. within 6 feet) of the radon vent pipe riser in the attic.

The riser should be located in an area of the attic with at least 3-4 feet of clearance to allow for easy access to install and maintain the fan.

If at all possible, the aggregate bed under the slab should not be compacted in order to provide the maximum subslab vacuum coverage.

With respect to the number of risers, suggest an interval of 1 for every 3-5000 SF of slab.

2.1.1.1 Environmental Protection Plan Format

The Environmental Protection Plan shall follow the following format:

1. Hazardous materials to be brought onto the post
2. MSDS package
3. Employee training documentation
4. Hazardous materials/waste storage plan
5. Hazardous waste to be generated
6. Pre-construction survey results
7. Permitting requirements identified
8. Waste Disposal Plan
9. Site Specific Spill Contingency Plan

2.1.1.2 Environmental Plan Review

Fourteen days after the environmental protection meeting, submit to the Contracting Officer the proposed environmental plan for further discussion, review, and approval.

2.1.1.3 Commencement of the Work

As directed by the Contracting Officer, following approval.

2.1.2 Storm Water Pollution Prevention Plan

The following Pollution Prevention Plan is incorporated into the contract documents as a portion of the construction activities to be undertaken by the Contractor. The plan as outlined below contains the minimum requirements for the work under this contract.

POLLUTION PREVENTION PLAN FOR
(PROJECT)

The purpose of this plan is to detail the controls that will be utilized for this construction in order to control sediment in the storm water runoff from the construction site drainage area.

Project Location: Fort Campbell Army Base
Fort Campbell, Kentucky
(PROJECT)
(LOCATION)
Latitude - 36 38'10" North
Longitude - 87 27' 40" East
(Values Approximate for Latitude - Longitude)

Constructed by: U.S. Army Corps of Engineers
Louisville District
P.O. Box 59
Louisville, KY 40201-0059

Description of Site and Construction Activity: This construction is **(INSERT DESCRIPTION)**.

The soil disturbing activity will consist of clearing and grubbing and demolition for the installation of the erosion and sediment control features, grade work, excavation for utilities, and parking lots. The sediment and erosion controls being utilized include straw bale dam, basket curb inlet, stone outlet sediment trap, fabric drop inlet protection, gravel donut inlet protection, construction entrance/exit, silt fence, and silt fence rock overflow, and temporary seeding and mulching. Clearing and grubbing must be held to a minimum necessary for grading and equipment operation.

Temporary seeding and mulching shall be deemed necessary if no construction activity occurs in the disturbed areas for more than fourteen (14) days. Construction must be sequenced to minimize the exposure time of cleared surface areas. Grading activities must be avoided during periods of highly erosive rainfall. Slopes of 2H:1V will be protected using and erosion control blanket. Other slopes that may be seeded and mulched may experience washout problems and require the use of an erosion control blanket. Contractor is to refer to manufacturer's recommendations for the type of erosion control blanket to be used on particular slopes.

Runoff Coefficient: The present runoff coefficient for the site is approximately 0.6 to 0.75. The development of the site will not significantly increase this coefficient. Developed coefficient is approximately **(INSERT COEFFICIENT).**

Receiving Waters: The water for the disturbed areas will pass through erosion control then into the storm system. The storm system for the majority of the site empties into **(LOCATION)**.

Erosion and Sediment Controls:

STABILIZATION PRACTICES	STRUCTURAL PRACTICES	
Permanent Seeding	Straw Bale Dam	Gravel Donut Inlet
Mulching	Basket Curb Inlet	Protection
	Stone Outlet Sediment	Temporary Construction
	Trap	Entrance/Exit
	Fabric Drop Inlet	Silt Fence
	Protection	Silt Fence Rock Overflow

2.1.2.2 Contracting Officer shall provide Environmental Plan for review to Environmental Division, Pollution Protection Branch.

2.2 ANTICIPATED SEQUENCE OF ACTIVITY:

Place erosion control measures in locations in close proximity to those shown on the drawings. Additional erosion control measures may be required to comply with the NPDES permit once demolition and construction begins.

Surface water flowing toward the construction area will be diverted around the construction area to reduce its erosion potential. Silt fence, sediment traps or straw bale check dams shall be properly constructed to detain runoff and trap sediment.

Construct new site amenities including utilities, buildings, parking areas, and sidewalks after completing the necessary demolition.

Landscape and grade remaining areas according to the drawings.

Upon completion, remove any temporary measures not necessary for future phases of the project after stabilization of the area. Any sediment removed from these measures shall be disposed of at a time and location designated by the Contracting Officer. Any other areas disturbed during the removal of the sediment control structures shall be seeded and mulched within 24 hours.
NOTE: The Contractor controls the actual sequence, however, the sediment control measures must be established prior to initiation of work in any area. Contractors for Phased projects will be required to coordinate this work and interface Pollution Prevention Plans to ensure compliance with the intent of the Pollution Control Plans and to maintain continuous pollution prevention. Construction should be staged or phased for this project. Areas of one phase should be stabilized before other phases are initiated. Stabilization shall be accomplished by temporarily or permanently protecting the disturbed soil surface from rain fall impacts and runoff.

2.3 DEMONSTRATION OF COMPLIANCE WITH FEDERAL, STATE AND LOCAL REGULATIONS.

All activities constructed under this contract will be performed in accordance with Federal, State and Local regulations. The construction contractor's specifications require compliance with all applicable regulations.

2.4 POLLUTION PREVENTION PLAN AND NOTICE OF INTENT

The Contractor will implement the Pollution Prevention Plan (PPP) as shown on the plans and directed in these specifications. This plan must be implemented in accordance with the NPDES permit. A Notice of Intent (NOI) will be prepared by the U.S. Army Corps of Engineers and submitted to the state of Tennessee (KENTUCKY) fourteen (14) days prior to the notice to proceed being issued. The NOI Contractor Consent form for Tennessee (KENTUCKY) must be signed by the Contractor. A blank **Contractor's Signature Form** is attached at the end of this section. The Contractor shall maintain a copy of the PPP in their construction trailer. Any changes made to the plan must be documented and approved by the Contracting Officer.

2.5 INVENTORY FOR POLLUTION PREVENTION PLAN

The materials or substances listed below are expected to be present onsite during construction:

These are examples of materials that could be Hazardous Materials and an inventory must be kept using Ft. Campbell's Hazardous Material Form attached. This list is not comprehensive but for illustration only. The Contractor must maintain and update a Hazardous Material list and inventory forms.

Concrete	Fertilizer	Detergents	Paints (Enamel and Latex)
Cleaning Solvents	Wood	Sealants	Metal Rebar/Structural Steel
Concrete Additives	Tar	Asphalt	Petroleum Based Products

2.6 SPILL PREVENTION

The following are the material management practices to reduce the risk of spills or other accidental exposure of materials and substances to storm water runoff.

2.6.1 Good Housekeeping

a. An effort will be made to store only enough product required to perform the task. Storage shall meet Federal, State and Local regulations to include 150 % containment of bulk storage over 19 liters.

b. All materials stored onsite will be stored in a neat and orderly manner in their appropriate containers and properly labeled. When possible, material should be stored under a roof or in an enclosed area. If this is not possible, material will be covered with a tarpaulin or suitable replacement to prevent direct contact between storm water and the materials. All runoff from the storage area will be routed through a control structure.

c. Products will be kept in their original containers with the original manufacturer's label.

d. Substances will not be mixed with one another unless recommended by the manufacturer.

e. Whenever possible, all of the product will be used up before disposing of container.

f. Manufacture's recommendations for proper use and disposal will be dictated by Federal, State and Local regulations. Manufacturer's recommendations may be followed if as stringent or more than Federal, State and Local.

g. The contractor will conduct daily inspections to ensure proper use and disposal of materials onsite.

2.6.2 Hazardous Products

These practices are used to reduce the risks associated with hazardous materials and must be incorporated into the Pollution Prevention Plan:

a. Products will be kept in their original containers unless they are not resealable.

b. Original labels and material safety data will be retained they contain important product information.

c. All containers will have the Diamond label affixed per the National Fire Prevention Associations Publication 704.

d. Disposal of surplus product will be performed as recommended by the manufacturer or as required by State and Local regulations.

2.7 SPILL PREVENTION PRACTICES

In addition to good housekeeping and material management practices discussed in the previous sections of this plan, a Site Specific Spill Contingency Plan must be prepared by the Contractor and submitted to Fort Campbell Environmental Division. The SSSCP must be developed as outlined in the Fort Campbell Environmental Handbook. Guidance and instructions for preparation of the **SITE SPECIFIC SPILL CONTINGENCY PLAN**

(SSSCP) are included at the end of this section. In addition to the requirements of the SSSCP, the following practices must be followed by the Contractor for spill prevention and clean up:

a. Materials and equipment necessary for cleanup will be kept in the material storage area. There will be enough equipment to supply at least three (3) men. Equipment and materials will include but not be limited to; brooms, dust pans, mops, rags, gloves, goggles, absorbing compound, and plastic and metal trash containers specifically for this purpose.

b. Manufacturer's recommended methods for spill cleanup will be clearly posted and site personnel will be made aware of the procedures and the location of information and cleanup supplies.

c. All spills will be cleaned up immediately after discovery. Disposal of the waste from the spill shall be at the Contractor's expense and shall be coordinated with the Pollution Prevention Branch before removal or disposal.

d. The spill area will be kept well ventilated and personnel will wear appropriate protective clothing to prevent injury from contact with a hazardous substance.

e. All spills of toxic or hazardous materials will be reported to the Ft. Campbell Fire Department and DPW Environmental through the Contracting Officers Representative who will report to the appropriate State or Local government agency if necessary.

f. Once a spill has occurred, the spill prevention plan will be adjusted to include measures to prevent this type of spill from recurring with a discussion of the appropriate cleanup for that type of spill. Also, a description of the spill, what cleaned it, and the cleanup measures will be included.

g. The prime Contractor will be responsible for the day-to-day site operations, including spill prevention and will designate an employee, by name, to be the primary cleanup coordinator. Each subcontractor bringing more than 75 liters or 68 kilograms of a spillable substance shall also designate a cleanup coordinator. The cleanup coordinators will designate three (3) additional site personnel for spill prevention and cleanup.

h. Everyone will be trained in spill prevention and cleanup and shall know the primary cleanup coordinator and any additional site personnel to contact. Fort Campbell's Environmental Handbook (excerpt included below) will be the basis for spill prevention training.

(TAKEN FROM)

FORT CAMPBELL ENVIRONMENTAL HANDBOOK
Guidance and Instruction

SPILL PLANNING AND RESPONSE

Spill response equipment is a critical component of an effective response to an unexpected release of hazardous materials. Making an inventory of potential spots for emergency releases and having appropriate and sufficient spill response equipment to deal with those potential releases is required for each unit. Attachment 1 provides spill response materials minimum requirements.

SPILL PLANNING AND RESPONSE TRAINING REQUIREMENTS:

1) All personnel involved with the management and handling of oil and hazardous materials must be periodically trained in spill prevention and response. The training will be similar to the Hazardous Communication Program - Worker Right to Know and will include the following key features:

a) Health effects of exposure to oil or hazardous materials;

b) Applicable first aid procedures to be used following exposure;

c) Personal Protective Equipment requirements and procedures for using equipment;

d) Evacuation procedures;

e) Spill material combustibility and potential for flash-back along vapor trails;

f) Fire fighting procedures and special hazards of combustible products;

g) Reactivity of spill material with common materials including water;

h) Use and maintenance of all alarms and monitoring equipment associated with spill prevention or response;

I) Initial Notification procedures;

j) Site specific contingency plans;

k) Location of posted Site Specific Spill Contingency Plan;

l) Immediate spill response actions including location of pump controls and valves to stop spill flow; location and use of fire extinguishers, absorbents, neutralizing agents and other immediate spill response procedures;

m) Visual inspections requirements of the particular areas; and

n) Purpose and requirements of good housekeeping.

2) Spill response training exercises will be conducted once per year for personnel working at oil and hazardous material sites. Personnel entering one of these positions will be trained within two weeks after starting work and after any significant changes to the spill plan or training program. Records of the type, extent, and frequency of each individual's training will be maintained until closure of the applicable area or until three years after the date the individual last worked in the area. . Refresher training shall be given with the Toolbox Safety Meetings and documented on the Quality Control Reports. Training shall cover what to do, and who to contact in case of a spill and what emergency action must be taken if any.

SPILL RESPONSE IS HANDLED BY FOUR DISTINCT OPERATIONS:

a) SPILL REPORTING

The first action to be taken in the event of a spill is to report the spill. If you observe a release of a hazardous material, report it to your supervisor and the Fire Department as required below. If the spill is in a Training Area, then the spill will be reported to Range Control, who will then notify the Fire Department. The Fire Department will notify DPW Environmental Division and if required, Installation Safety, Emergency Medical, and Preventative Medicine. The DPW Environmental Division does all reporting to State/Federal Agencies.

The Fire Department (or Range Control) must be promptly notified of any of the following spills:

(1) Any uncontrolled quantity of a hazardous substance, or if assistance is needed by Fire Department or Environmental Division, or as instructed by the MSDS or supervisor's discretion.

(2) Oil and other petroleum products with quantity exceeding 10 gallons or area of spill greater than two feet in any direction or any amount that has spilled into a stream or body of water.

Environmental Division review has determined the material(s) listed requires special reporting at the quantity shown: (To be supplied by environmental staff during plan review.)

b. STOP OR CONTAIN THE SPILL

Assess the situation before attempting to contain any hazardous material spilled and proceed only if it is safe to do so. You must have knowledge of the spilled substance and don any required personal protective equipment. If necessary, make the spill scene off limits to any unauthorized personnel. If situation warrants, evacuate the area.

c. CLEAN UP THE SPILL

Under no circumstances should untrained and/or ill-equipped persons attempt to perform cleanup. In some instances, spill cleanup may require respiratory protection and other personal protective equipment. If it is within the capability of the unit that caused the spill, then that unit is responsible for its cleanup. Environmental Division will make the decision to obtain assistance and coordinate with other units as required. If you handle/work with the hazardous material as part of your job, you are to be trained and qualified to participate in the cleanup of the spill. **All contractors must have an OSHA 1910.120 qualified spill response contractor available to respond to spills in 4 to 6 hours that require heavy equipment to remove contaminated soils/absorbents. Spill that cannot be removed because of response delays may need to be covered with heavy plastic and or secured to prevent further spread of contamination.**

d. DISPOSE OF SPILLED HAZARDOUS MATERIAL.

All spilled material and other contaminated material (soil, gravel, absorbents, etc.) must be properly disposed. It is the responsibility of the contractor that created the spill to properly package, dispose of the waste, and ensure the site is properly cleaned at no cost to the government. Some spill incidents may require cleanup, disposal, soil testing and a site closure report by an approved licensed environmental contractor approved by Fort Campbell. Environmental Division will determine the required cleanup and disposal method.

2.8 PRODUCT SPECIFIC PRACTICES

The following product specific practices will be followed on-site:

a. Petroleum Products - All vehicles will be periodically inspected for leaks and shall receive regular preventative maintenance to reduce the chance of leaks occurring. Petroleum products will be stored in tightly sealed containers which are clearly labeled. Bulk storage areas will be equipped with secondary containment appropriate for risk of loss from the primary container (s). Storage shall meet Federal, State and Local regulations. Secondary containment shall hold 150 % of the bulk amount stored over 19 liters. The Contractor will maintain a specific spill contingency and countermeasures plan for use in a bulk storage area.

b. Fertilizer - Fertilizers used will be applied only in the minimum amounts recommended by the manufacturer. Once applied, fertilizer will be worked into the soil to limit exposure to storm water. The contents of any partially used bags of fertilizer will be transferred to a sealable container to avoid spills.

c. Paints, Solvents, and Sealants - All containers will be tightly sealed and kept in the storage area when not in use. Any excesses of these materials will not be discharged

into the storm sewer system, but will be properly disposed of according to manufacturer's instructions or State and Local regulations.

d. Concrete Trucks - Concrete trucks will be allowed to wash out, discharge surplus concrete and drum wash water only in a designated area. All wash water from the concrete trucks must be retained on-site and treated according to Federal, State and Local regulations. Upon completion of the job, all discharges of surplus concrete and any soil contaminated by the concrete wash water will be removed from the site and taken to an approved disposal area. Water with the potential of entering sink holes or storm sewers will not be allowed to be discharged.

2.9 INSTALLATION/CONSTRUCTION

2.9.1 Inlet Protection

2.9.1.1 Fabric Drop Inlet Protection

a. Construct a dike on the downslope side of the inlet to prevent runoff from bypassing. Dike should be 150 mm higher than inlet protection.

b. Cut fabric from a single roll to avoid joints.

c. Construct the fence as shown on in the drawings.

d. Space the support posts evenly against the inlet perimeter a maximum of one (1) m apart, and drive them about 0.5 m into the ground.

2.9.1.2 Gravel Donut Inlet Protection

a. Construct a dike on the downslope side of the inlet to prevent runoff from bypassing. Dike should be 150 mm higher than inlet protection.

b. Construct as shown in the drawings.

2.9.1.3Basket Curb Inlet

a. Install immediately after a new inlet is placed or on existing inlets, before any land disturbing activity.

b. If necessary, adapt basket dimensions to fit inlet box dimensions, see drawings.

c. Remove the grate and place basket in the inlet.

d. Cut and install a piece of filter fabric large enough to line the inside of the basket and extending a minimum of 150 mm beyond the frame.

e. Replace the inlet grate, which also serves to anchor the fabric.

2.9.2 Silt Fence and Silt Fence Rock Overflow

a. Construct as shown on the drawings.

b. Staked and entrenched straw bales must be installed along the base of all fills and cuts and on the downhill sides of stockpiled soil.

2.9.3 Straw Bale Dam

a. Construct as shown on the drawings.

b. Staked and entrenched straw bales must be installed along the base of all fills and cuts and on the downhill sides of the stockpiled soil.

2.9.4 Seeding

a. Test soil to determine its nutrient level or apply a 12-12-12 fertilizer at a rate of 75 to 110 kilograms per hectare.

b. Work fertilizer into the soil 50 mm - 100 mm deep with a disk or rake operated across the slope.

c. Select a seed mixture and application rate that best suits the soil type and climate. Also, consult the county soil, water conservation office for assistance.

d. Apply seed uniformly with a drill or cultipacker seeder, or by broadcasting, and cover to recommended depth.

e. If drilling or broadcasting, firm the seedbed with a roller or cultipacker.

f. Mulch seeded area to increase seeding success.

2.9.5 Mulching

a. Apply at the recommended rate based on the material being used.
b. Spread uniformly with no more than 25% of the ground surface visible.
c. If straw or hay is used, it must be anchored immediately.

2.10 INSPECTION AND MAINTENANCE

All measures that are being utilized will be inspected at least once each week and after each storm event. An inspection report shall be written after each inspection and submitted to the Contracting Office representative within 24 hours. Once a problem is found or sediment has reached the clean-out elevation, corrective action shall commence

within 24 hours. Inspections shall continue until the controls are removed or the vegetative cover is firmly established.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall perform all work in such manner as to minimize the pollution of air, water, or land, and shall, within reasonable limits, control noise and the disposal of solid waste materials, as well as other pollutants. Information contained in the following specifications should also be referenced:

Section 02050	Demolition
Section 02080	Removal and Disposal of Asbestos Containing Materials
Section 02090	Demolition or Buildings with Lead Containing Paint and Disposal of Lead-Based Paint

3.2 IMPLEMENTATION

Within 10 calendar days after Notice to Proceed and prior to commencement of the work at the site, the Contractor shall meet the representatives of the Contracting Officer to review and alter his proposal as needed for compliance with the environmental pollution control program.

3.3 PROTECTION OF LAND AREAS

Except for any work on storage areas and access routes specifically assigned for the use of the Contractor under this contract, the land areas outside the limits of permanent work performed under this contract shall, in accordance with CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURE, UTILITIES AND IMPROVEMENTS, be preserved in their present condition. Contractor shall confine his construction activities to areas defined for work on the plans or specifically assigned for his use. In accordance with CONTRACT CLAUSE: OPERATIONS AND STORAGE AREAS, storage and related areas and access routes required temporarily by the Contractor in the performance of the work will be assigned by the Contracting Officer. No other areas on Government premises shall be used by the Contractor without written consent of the Contracting Officer.

3.4 PROTECTION OF TREES AND SHRUBS

CONTRACT CLAUSE: PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES AND IMPROVEMENTS, is hereby supplemented as follows: The Contractor shall not deface, injure or destroy trees or shrubs, nor remove or cut them without special authority. No ropes, cables, or guys shall be fastened to or attached to any existing nearby trees for anchorage.

3.4.1 Tree Protective Structures

Where, in the opinion of the Contracting Officer, trees may possibly be defaced, bruised, injured or otherwise damaged by the Contractor's equipment or by his other operations, he may direct the Contractor to provide temporary protection of such trees by placing boards, plans, or poles around them.

3.4.2 Restoration of Damaged Trees

Any tree scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense. All scars made on trees not designated on the plane to be removed by construction operations shall be coated as soon as possible with an approved tree wound dressing. Trees that are to remain, either within or outside established clearing limits, that are damaged by the Contractor so as to be beyond saving in the opinion of the Contracting Officer, shall be immediately removed, if so directed, and replaced with a nursery-grown tree of the same species and size.

3.5 PROTECTION OF WATER RESOURCES

The Contractor shall control the disposal of fuels, oils, bitumen, calcium chloride, acids, or harmful materials, both on and off the Government premises, and shall comply with applicable Federal, State, County and Municipal laws concerning pollution of rivers and streams while performing work under this contract. The contractor should note that the entire cantonment area is within the delineated Well Head Protection Area for Fort Campbell. This means any release in this area has the potential, due to the installations geological features to impact their drinking water source. For this reason special measures need to be taken to prevent chemicals, fuels, oils, greases, bituminous materials, herbicides and insecticides from entering public waters or potentially migrating via sinkholes or other karst related geologic features to drinking water sources. Special measures will include the generation of a site-specific Spill Prevention Control and Countermeasures Plan. Water used in onsite material processing, concrete curing, foundation and concrete cleanup, and other waste waters shall not be allowed to reenter a stream if an increase in the turbidity of the stream could result there from.

3.6 BURNING

Air pollution restrictions applicable to this project are as follows. Materials shall not be burned on the Government premises. If the Contractor elects to dispose of waste materials off the Government premises, by burning, he shall make his own arrangements for such burning area and shall, as specified in CONTRACT CLAUSE: PERMITS AND RESPONSIBILITIES, conform to all local regulations.

3.7 DUST CONTROL

The Contractor shall maintain all excavations, stockpiles, access roads, waste areas, and all other work areas free from excess dust to such reasonable degree as to avoid causing a hazard or nuisance to the Using Service or to others. Approved temporary methods consisting of sprinkling, chemical treatment, or similar methods will be permitted to control dust. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

3.8 EROSION CONTROL

Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall be graded to control erosion within acceptable limits. Temporary control measures shall be provided and maintained until permanent drainage facilities are completed and operative. The area of bare soil exposed at any one time by construction operations should be held to a minimum.

3.9 CORRECTIVE ACTION

The Contractor shall, upon receipt of a notice in writing of any noncompliance with the foregoing provisions, take immediate corrective action. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs of damages by the Contractor unless it was later determined that the Contractor was in compliance.

3.10 POST-CONSTRUCTION CLEANUP OR OBLITERATION

In accordance with CONTRACT CLAUSE: CLEANING UP, the Contractor shall, unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed areas shall be graded and filled and the entire area seeded.

3.11 PAYMENT

No separate payment or direct payment will be made for the cost of the work covered under this section, and such work will be considered as a subsidiary obligation of the Contractor.

-- END OF SECTION --

Return to designer instructions

FTCKY HAZMAT INVENTORY FORM

Date: ____/____/____ *Ft. Campbell Environmental Division/Pollution Prevention Branch/ 798-3105* Page ____ of ____

Unit (Bde, Bn, Co.): _____ Bldg #: _____ State:_____ POC Name: _____ Phone #: _____

Bldg Description: _____ HazMat Storage Location:_____
(i.e. motor pool, aviation hangar, supply room, etc.) *(i.e. flammable wall locker, supply closet, etc.)*

NSN (If unknown, attach MSDS)	**Manufacturer**	**Material Name**	**Material Use**	**Expire Date**	**Disposal Procedure**	**Containers On Hand**	**Weight or Volume Per Container**	**Amount Used Per Month (Approximate)**
Example: *6810-00-281-2785*	*CSD Inc.*	*MEK*	*Degreaser*	*12-99*	*Hazardous Waste Disposal*	*1 Can*	*1 Gal.*	*1Gal.*

Updated 3/25/98

Back to paragraph 2.1.1

Construction Activity Water Permitting Requirements
Contractor's Signature Form

State of Tennessee
Department of Environment and Conservation
Rule 1200-4-10.05
Division of Water Pollution Control
NPDS General Permit TNR 100000

To be completed by developer:
NOI Submission Date:_____

Project Name:_____

Project Location:_____
County

I have agreed to perform construction-related professional services, described as:
_____
that will likely impact the nature of storm water runoff from the named construction activity. Erosion control services involve primarily:

____ Prepare erosion control plan
____ Inspection of controls
____ Install, maintain erosion and sediment controls
____ Other

I understand the terms and conditions of Rule 1200-4-10.05 and that I, and my company, as the case may be, are responsible for the legally liable for complying with this Rule and the applicable State and Federal Laws. I understand that State or EPA or private actions may be taken against me if the terms and conditions of the Rule are not met.

Printed Name:_____ Title:_____

Signature:_____ Date:_____

Company Name:_____

Address:_____

City:_____ State:_____ Phone No._____

Field Person in charge:_____ Phone No._____

Owner/Developer: I certify that the above has been retained to perform the described construction related services noted above and as outlined in the referenced NOI.

Signature:_____ Date:_____

-- End of form --

Back to Paragraph 2.4

August 17, 1998

FORT CAMPBELL CONTRACTOR SITE SPECIFIC SPILL CONTINGENCY PLAN

NAME: _____

CONTRACT NUMBER: _____

GENERAL DISCRIPTION OF WORK: _____

_____

_____

1. RESPONSIBLE PERSONS

A. PRIMARY PERSON
Name: _____ TITLE:_____
Work Phone: _____ Home Phone: _____

B. ALTERNATE PERSON
Name: _____ TITLE:_____
Work Phone: _____ Home Phone: _____

C. SECOND ALTERNATE PERSON
Name: _____ TITLE:_____
Work Phone: _____ Home Phone: _____

2. SPECIAL PRECAUTIONARY MEASURES FOR BUILDING(S) AND ASSOCIATED AREAS

If more than one building, Specify hazardous materials for those buildings.
Building (S) # _____

A. Avoid contacts with spilled substances.
B. Refer to Material Safety Data Sheets (MSDS) for particular hazards and precautionary measures for special handling and spill procedures. Flammable materials will be extinguished as to local fire regulations and the material safety data sheets. If needed, list any materials that need special handling, PPE or special precautionary measures.

_____
_____
_____
_____
_____
_____
_____

3. EMERGENCY SPILL EQUIPMENT ON HAND

(For example, sweeping compound and absorbent material, brooms and plastic dust pans, emergency spill kits, non- sparking shovels, other items as needed and required)

BUILDING#: _____ **BUILDING#:** _____

_____

_____

_____

_____

_____

_____

_____

_____

_____

4. HAZARDOUS MATERIAL AND QUANTITY NORMALLY ON HAND

A. ***Attach a listing of Hazardous Materials on hand, using the FTCKY HAZMAT Inventory Form.***

B. Material Safety Data Sheets are readily available and located at (the specific location is required).

Bldg. #:_____

Bldg. #:_____

5. SPILL RESPONSE AND NOTIFICATION PROCEDURES

A. REPORT THE SPILL.

The first action in the event of a spill is to report the spill. If you observe a release of a hazardous material, report it to your supervisor and the Fire Department as required below. If the spill is in a Training Area, then the spill will be reported to Range Control, who will then notify the Fire Department. The Fire Department will notify Environmental Division and, if required, Installation Safety, Emergency Medical, and Preventative Medicine. The Environmental Division does all reporting to State/Federal Agencies.

The Fire Department (or Range Control) must be promptly notified of any of the following spills:

- Any uncontrolled quantity of a hazardous substance, or if assistance is needed by Fire Department or Environmental Division, or as instructed by the MSDS or supervisor's discretion:
- Oil and other petroleum products with quantity exceeding 10 gallons or area of spill greater than two feet in any direction or any amount that is spilled into a stream or body of water.
- Environmental Division review has determined the material(s) listed requires special reporting at the quantity shown: (To be supplied by environmental staff during plan review.)

Name: _____ Quantity _____
Name: _____ Quantity _____

Name: _____ Quantity _____

Signature of Environmental Division staff: _____
SUPERVISOR (to notify in case of spill)

NAME: _____ TITLE:_____
WORK PHONE: _____ HOME PHONE: _____

FIRE DEPARTMENT: phone 911
RANGE CONTROL: phone (270) 798-3001 or on radio frequency FM 49.95
ENVIRONMENTAL phone (270) 798-3105

1. If required by your **ORGANIZATION**, additional people to be notified within your chain of command: If not required, fill in N/A.

ALTERNATE PERSON

NAME: _____ RANK:_____
WORK PHONE: _____ HOME PHONE: _____

ALTERNATE PERSON

NAME: _____ RANK:_____
WORK PHONE: _____ HOME PHONE: _____

The spill report must include the following information:

- Name/Phone/Unit of individual reporting the spill; _____
- Spill (Building Location of Number, etc.); _____
- Name of spilled material; _____
- Amount spilled; _____
- Rate currently spilling; _____
- Extent of spill, including drainage features; _____
- Injuries, if any; _____
- Time spill occurred; _____
- Any additional information. _____

B. STOP OR CONTAIN THE SPILL.

Assess the situation before attempting to contain any hazardous material spilled and proceed only if it is safe to do so. You must have knowledge of the spilled substance and don any required personal protective equipment. If necessary, make the spill scene off limits to any unauthorized personnel. If situation warrants, evacuate the area.

C. CLEAN UP THE SPILL.

Under no circumstances should untrained and/or ill-equipped persons attempt to perform cleanup. In some instances, spill cleanup may require respiratory protection and other personal protective equipment. If it is within the capability of the unit that caused the spill, then that unit is responsible for its cleanup. Environmental Division will make the decision to obtain assistance and coordinate with other units as required.

If you handle/work with the hazardous material as part of your job, you are to be trained and qualified to participate in the cleanup of the spill.

D. DISPOSE OF SPILLED HAZARDOUS MATERIAL.

All spilled material and other contaminated material (soil, gravel, absorbents, etc.) must be properly disposed. It is the responsibility of the unit that created the spill to properly package and dispose of the waste. Environmental Division will determine the required disposal method.

Responsible Person Signature and Date

_____

`

SECTION 01572 - 01670
Construction and Demolition Waste Removal/Diversion Recycle of Recovered Materials

Ft. Campbell Requirements:

Requirements in this section and Appendix A-7. **Solid Waste Disposal/Diversion Practices** shall apply to all construction and demolition activities at Fort Campbell. Contract specifications shall require at least a 50% diversion of demolished building materials such as wood, plumbing fixtures, electrical materials (lights and panels), windows, doors, toilet partitions, HVAC equipment, and scrap metals be diverted from the landfill. See Chapter 2, Paragraph 2.1.4 (Click here). Diversion can be accomplished by deconstructing the wood buildings and components per instructions below or by moving the structure off-post.

Demolition materials shall not be salvaged by the contractor and shall not be removed from the installation. Non salvageable demolition materials shall not to be transported off the installation.

Notify the DPW Environmental Division if unknown waste is discovered during site investigations. Waste could be explosive, hazardous or toxic waste.

Dumpster service for new construction and for demolition is not provided by the installation. The contractor shall arrange for dumpster service at the Contractor's own expense.

In general, utilities are not to be abandoned in place; all abandoned utilities are to be removed. There are circumstances where this requirement does not apply. Abandonment of utilities and removal shall be a topic of discussion at design conferences.

Instructions to Designers:

1 Modify UFGS 01572 - 01670 paragraphs to include the building demolition/diversion requirements above and modify contract specifications.

2 Construction specifications shall require a Building Materials Diversion Plan to be submitted and approved by DPW.

3 When a project requires removal/disposal of environmentally hazardous waste generated at Fort Campbell, the DPW Environmental Division must be involved in the permitting process. Modify project drawings and specifications paragraphs to include each of the above features as they apply to the project. Additional guidance on Environmental Requirements and Hazardous Waste Disposal Practices is contained in **Appendix A**, and project specifications shall be modified to indicate these requirements.

4 For mercury containing light bulb disposal, insert the **Mercury Light Bulb** paragraph.

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APPENDIX F

CONCEPTUAL AESTHETIC CONSIDERATIONS
(PHOTOS OF SURROUNDING BUILDINGS)

Barracks & Dining Facility off Strike Boulevard

Barracks off Strike Boulevard

Barracks off Strike Boulevard

COF off California Road

Dining Facility off Strike Boulevard

Dining Facility off Strike Boulevard

Motor Pool off California Road

Office Building off Strike Boulevard

APPENDIX G

GIS DATA
(NOT USED – SEE APPENDIX J)

APPENDIX H

EXTERIOR SIGNAGE

CAM Regulation 420-6

DEPARTMENT OF THE ARMY

HEADQUARTERS 101ST AIRBORNE DIVISION (AASLT) AND FORT CAMPBELL
2700 Indiana Avenue
Fort Campbell, Kentucky 42223-5656
22 February 2011

Directorate of Public Works

FORT CAMPBELL EXTERIOR SIGNAGE AND MARKINGS

Contents (listed by paragraph and page number)

Purpose ● 1, *page 1*
Applicability ● 2, *page 1*
References ● 3, *page 1*
General ● 4, *page 1*
Responsibilities ● 5, *page 2*
Policies and Procedures ● 6, *page 2*
Memorialization and Unit Monuments ● 7, *page 3*
General Signage Guidance ● 8, *page 3*
Requisition Procedure for New and/or Replacement Signage ● 9, *page 3*
Proponent ● 10, *page 3*

Appendix List
Appendix A. Sign Specifications, *page 4*
Appendix B. Signage Fabrication Detail Sheet, *page 5*
Appendix C. Glossary, *page 7*

1. Purpose

This regulation prescribes the authorization, design, fabrication, placement and maintenance of exterior facility and user identification signs and markings. It also prescribes the procurement process for new/replacement signage and facility markings.

2. Applicability

This regulation applies to all military and civilian organizations assigned to Fort Campbell facilities that require unit identification and facility signage and applies to the standardization of all new and / or replacement signage. Building assignments will be made on the basis of personnel strength, approved programs, commercial activities contracts, and actual requirements for efficient working space.

3. References

a. Army TM 5-803-5, Installation Design, Chapter 10, Signing, 1 March 1981.
b. AR 1-33, The Army Memorial Program, 30 June 2009.
c. Manual on Uniform Traffic Control Devices for Streets and Highways, December 2009.
d. AR 190-13, The Army Physical Security Program, Chapter 6, Restricted Areas, 30 Sep 1993.
e. AR 190-5, Motor Vehicle Traffic Supervision, Chapter 4, 22 May 2006.
f. AR 420-1 Army Facilities Management, Chapter 7, Transportation, Infrastructure and Dams, 12 Feb 2008
g. UFC 3-120-01, Air Force Sign Standard, 6 Feb 2003.
h. DA Pam 600-45, Army Communities of Excellence-Guidelines for Community Excellence, paragraph 3-6, signage, 1 August 1991.
i. Unified Facilities Guide Specifications-10 14 01, Division 10-Specialties, Exterior Signage, April 2006.

4. General

A sign's fundamental purpose is to communicate information. They are highly visible features that should be simple, attractive, and compatible with their surroundings. Standardized signage systems facilitate movement, provide a sense of orientation, and reinforce standards of excellence.

This regulation is new.

5. Responsibilities

a. Garrison Commander: Has overall responsibility for the appearance and the safe and efficient movement of vehicles and personnel on the installation.

b. Director of Emergency Services: Provides law enforcement IAW AR 190-5.

c. Director of Public Works:

(1) Maintain the Installation Design Guide (IDG) which defines signage standards.

(2) Review and approve all organizational signage and the content of that sign prior to installation at a permanent facility or structure.

(3) Supply, erect, and maintain exterior identification, directional and regulatory signs.

(4) Provide appropriate work classification and project approvals.

(5) Provide professional guidance during the planning, design, and execution stages of signage construction and placement.

d. Unit/Organization:

(1) Comply with standards as outlines in this CAM Regulation and the IDG.

(2) Seek design guidance and approvals prior to the procurement of all exterior unit identification signage.

(3) Comply with existing contracting regulations for the procurement of signage by sources other than through the Directorate of Public Works.

6. Policies and procedures

The number of signs will be kept to a minimum to avoid visual clutter that can result in over-usage or bombardment of messages that have no relationship to each other. All signage will be organized into a coherent family of signs. Acronyms and abbreviations will be avoided.

Example of a coherent family of signs

a. Signage Types. Signs are organized into the following three general categories:

(1) **Identification Signs.** These are naming signs which identify the installation, major tenants, buildings and organizational or functional components.

(a) The use of branch insignia, shoulder sleeve insignia, coat of arms and or distinctive insignia on identification is authorized on unit identification signage:

(b) Only authorized Heraldry located on the US Army Institute of Heraldry web site http://www.tioh.hqda.pentagon.mil/default.aspx will be authorized for placement on Unit identification signage.

(c) Battalion level "Mottos" are permitted on identification signs.

(d) Motivational symbols or motifs will not be used or displayed on identification signage or assigned facilities. (see Appendix C for examples of motivational symbols)

(e) No signage, motivational symbols or motifs will be affixed to or painted on a building's exterior façade.

(f) Banners shall be allowed for temporary use only when attached at all corners to the principle structure.

(g) Single Soldier Barracks and other non-specific BASOPs facilities' (DFAC, Chapel, Fitness Center, etc.) signage will not contain unit specific information.

(2) **Directional Signs.** These signs serve to guide the motorists or pedestrians coming in, around, and out of the installation.

(3) **Regulatory Signs.** These signs regulate vehicular traffic and parking, warn of safety hazards and maintain security. Their use, placement, and enforcement are governed by AR 190-5. Included in this category are speed limit signs, signs controlling turning and lane usage, warning signs, signs controlling parking, etc. Refer to latest version of the Manual of Uniform Traffic Control devices (MUTCD) and AR 190-5 for guidance.

b. Appearance. Signs should be professional in appearance and be compatible with the environment and architecture of the community.

c. Temporary signs

(1) DPW approval is required prior to the placement of signage supporting the advertisement of special activities and events.

(2) No signs of any kind will be affixed to utility or telephone poles.

(3) Once approved, temporary signs will be:

(a) Installed no more than three working days prior to the event or activity.

(b) Removed within three working days following the event or activity.

7. Memorialization and Unit Monuments

a. AR 1-33 and CAM Regulation 1-3 will be followed regarding all memorialization and placement of monuments on the installation.

b. No memorials or monuments will be affixed to the exterior of a facility.

c. Unit must have at least a "Brigade level "command approval prior to design, or forwarding to memorialization board.

d. Unit must have siting board approval prior to installation.

8. General Signage Guidance

a. All signs and markings shall conform to the guidelines in Appendix-A, Sign Specifications and Appendix-B, Signage Graphic Detail Sheets.

b. No unit identification signage will be affixed or painted to any assigned real property facility.

c. Only approved signs will be constructed on any building or in any area. Signs or markings that affect fire safety standards must be approved by the Fort Campbell Fire and Emergency Services Inspection Section.

d. Signs shall not be located where they may obstruct, interfere with the view of, or be confused with, any authorized traffic regulatory control sign, signal or device.

e. Signage located along roadsides will not be installed within 9 feet of a road easement.

f. Unauthorized, or signage in poor condition, will be removed at the discretion of DPW.

9. Requisition procedure for new and/or replacement signage

a. New and replacement Signage Request must be submitted on a DA Form 4283, Work Request to DPW Work Management.

b. Work Request will include a fabrication detail sheet (see Appendix-B) showing the contents of the sign with approval signature of local unit commander, and include the following statement: "Unit identification signage is in compliance with applicable Ft Campbell regulations and will not be affixed to the exterior surface of any installation facility".

10. Proponent. The proponent for this regulation is the Directorate of Public Works; attn: IMSE-CAM-PW.

JOHN F. CAMPBELL
Major General, USA
Commanding

Official:

JEFFREY W. YAEGER
Director, Mission Support Element

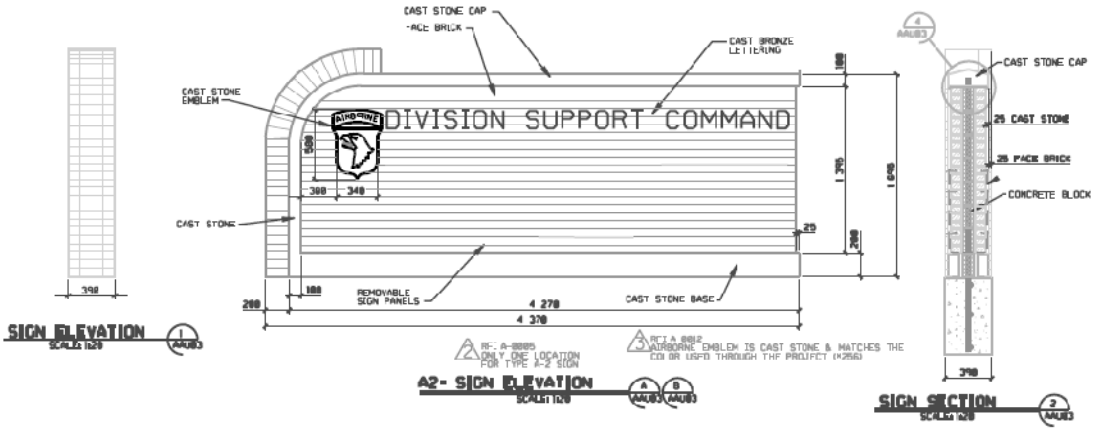
DISTRIBUTION:
INTRANET

Appendix A
Sign Specifications

Type	Description	Colors	Dimensions	Font	Sample
Building Number Signs (Type C8):	Facility Number assigned by DPW used for facility tracking and emergency response.	White letters on standard brown background, single sided.	1 ft X 3 ft. Sign will be placed 7' from Ground, on building corner no further than 6" from edge.	Upper case helvetica medium, 8-inch capital letter height. Copy – centered. Average line length – 5 characters per line.	
Area Identification Sign, (Bde, Grp) (Type A2)	Indentifies the Bde, Group "Area of Operations".	Complimentary letters on standard Brown Brick background, double sided	4-foot X 10-foot. placed perpendicular to primary access road for the Brigade/Group "Area of Operations"	Upper case helvetica medium, 8-inch capital letter height. Heraldry: 1'6" x 1'6" Proportional to size and lettering	
Unit Identification Sign, (Bde, BN, Directorate) (Type B2 & B3)	Indentifies individual Bde, BN, Directorate facilities.	White letters on standard brown background, double sided. Heraldry positioned in upper right hand corner.	30-inches X 72-inches. Placed within close proximity to facility identified	Upper & lower case helvetica medium, 6-8 inch capital letter height. Heraldry Graphic not to exceed 10" proportional	
Unit Identification Sign (Company, Motor-pool, etc) (Type C1 & C3)	Identifies subordinate Company and other Operations facilities, not headquarters. No Heraldry authorized	White letters on standard brown.	24-inches X 30-inches. Placed within close proximity to facility identified	Upper & Lower case helvetica medium, 6-8 inch capital letter height.	
Sign Plaque	Identifies the current Command Personnel only "Commander" and "CSM / 1SG"	White letters on standard brown background, double sided.	5-inch X 30-inch. Affixed under Type I-1 & I-2 signs only	Upper & lower case helvetica medium, 4-inch capital letter height.	

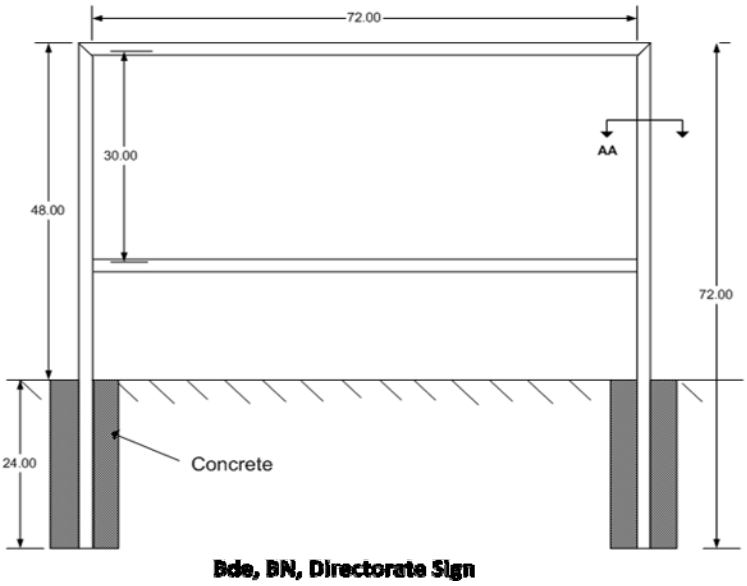
Appendix B
Signage Fabrication Detail Sheet

Type A2 Sign:

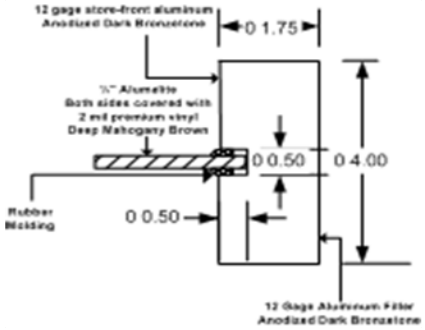


Measurement is in metric (mm)

Type B2 & B3 Sign:

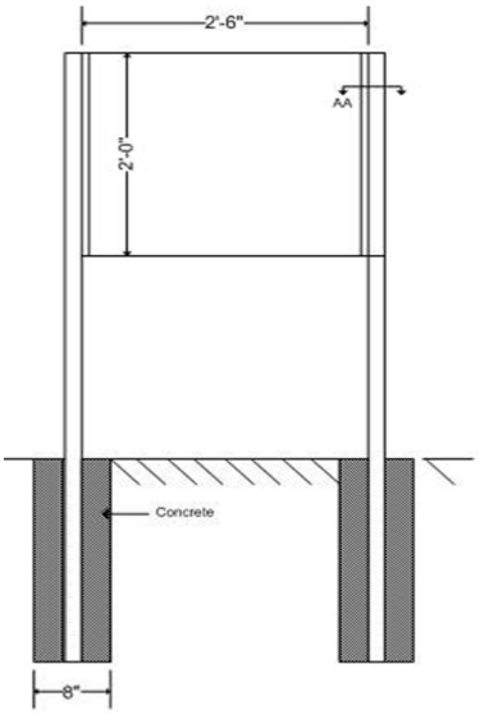


Bde, BN, Directorate Sign

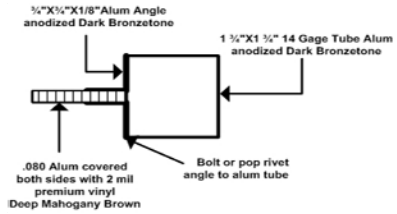


Detail AA

Type C1 & C3 Sign:

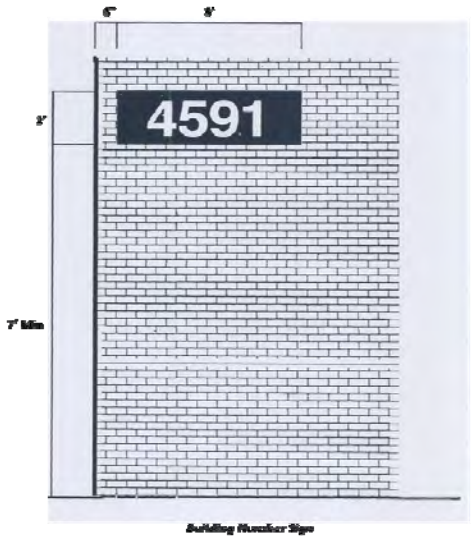


Company or TEMF Identification Sign



Section AA

Type C8 sign:



Building Number Sign

Appendix C
Glossary

Installation Design Guide (IDG)
The IDG is a document prepared by a Garrison that provides specific standards and guidance on the exterior and interior design parameters for the installation. These parameters include site, building, circulation, landscape, site element, and force protection design standards. The IDG may be as simple or as comprehensive as needed to achieve aesthetically pleasing working and living environments. All installation repair, modernization, and new construction projects must comply with the IDG.

Installation Identification Sign Types
Extracted from TM 5-807-10
Sign type A1: Main Installation entrance sign, identifies the principal visitor entrance.
Sign type A2: secondary entrance sign, identifies entry points with relatively high volumes of visitor traffic
Sign type A3: limited installation access entry gate signs, identifies entry points with limited public access.
Sign type B1: installation headquarters, identifies the central administration of the installation.
Sign type B2: command, division, and brigade headquarters sign
Sign type B3: battalion headquarters sign.
Sign type C1: centralized primary facilities sign, multiple service units or a complex of buildings
Sign type C2: centralized secondary facility sign
Sign type C3: primary facility sign
Sign type C4: secondary facility sign
Sign type C5: primary entrance sign
Sign type C6: secondary entrance sign
Sign type C7: restricted facility sign
Sign type C8: Building number

Memorial:
A marker or object that provides lasting evidence or preserves remembrance of a distinguished person or event, usually dedicated to the memory of a certain event or individual.

Memorialization
Naming a facility, building, road, etc, in the honor of a distinguished deceased person.

Memorialization Board
A board or group of individuals that considers and advises the approval authority on memorialization acts. If it is determined that a memorialization board takes on the characteristics of a committee, the proponent of the committee will follow all the requirements of AR 15–1 for establishing and continuing the group as a committee. Local procedures are outlines in CAM Reg 1-3.

Monument:
A marker or object that provides: a lasting evidence, reminder, or example of someone or something notable or great (2): a distinguished person b : a memorial stone or a building erected in remembrance of a person or event
4 archaic : an identifying mark

Motif
A design or figure that consists of recurring shapes or colors, as in architecture or decoration

Motivational Symbol
A design, figure or symbol that consists of objects or symbols that will activate or energize a goal-oriented behavior
Examples:

Examples of Motivational Signage:

Personal Property (Fixed)
Personal property consists of capital equipment and other equipment of a movable nature which has been fixed in place or attached to real property, but which may be severed or removed from buildings without sever structural damage.

APPENDIX I

ACCEPTABLE PLANT LIST

Fort Campbell Landscape Plant List

Native Plant Material

(Native) Conifers/Evergreens:

Botanical Name	Common Name
(Native) Tall Trees – (trees over 50 ft. at maturity)	
Pinus echinata	Shortleaf Pine
Tsuga canadensis	Eastern Hemlock
Taxodium distichum	Bald Cypress
(Native) Medium Trees – (trees 25 to 50 ft. at maturity)	
Pinus virginiana	*Virginia Pine*
Juniperus virginiana	Eastern Red Cedar
(Native) Small Trees/Large Shrubs – (10 to 25 ft. at maturity)	
Juniperus virginiana	*Eastern Red Cedar*

Return to Exterior Planting Section

(Native) Deciduous:

Botanical Name	Common Name
(Native) Tall Trees– (trees over 50 ft. at maturity)	
Liriodendron tulipifera	*Yellow or Tulip Poplar*
Sassafras albidum	Sassafras
Liquidambar styraciflua	Sweetgum
Ulmus thomasii	Rock Elm
Celtis occidentalis	Hackberry
Celtis laevigata	Sugarberry
Morus rubra	Red Mulberry
Juglans nigra	Black Walnut
Carya illinoensis	Pecan
Carya cordiformis	Bitternut Hickory
Carya tomentosa	Mockernut Hickory
Carya ovata	Shagbark Hickory
Carya glabra	Pignut Hickory
Fagus grandifolia	American Beech

Botanical Name	Common Name
(Native) Tall Trees– (trees over 50 ft. at maturity) continued	
Quercus alba	White Oak
Quercus stellata	Post Oak

Botanical Name	Common Name
Quercus bicolor	Swamp White Oak
Quercus michauxii	Swamp Chestnut Oak
Quercus prinus	*Chestnut Oak*
Quercus muehlenbergii	Chinkapin Oak
Quercus rubra	*Northern Red Oak*
Quercus palustris	Pin Oak
Quercus falcata	Southern Red Oak
Quercus velutina	Black Oak
Quercus shumardii	Shumard Oak
Quercus coccinia	Scarlet Oak
Quercus phellos	Willow Oak
Tilia americana	American Basswood
Populus deltoides	Eastern Cottonwood
Salix nigra	Black Willow
Diospyros virginiana	Common Persimmon
Prunus serotina	Black Cherry
Gleditsia tracanthos	Honeylocust
Gymnocladus dioica	Kentucky Coffeetree
Nyssa aquatica	Water Tupelo
Nyssa sylvatica	Black Tupelo
Aesculus octandra	Yellow Buckeye
Acer rubrum	Red Maple
Acer saccharinum	Silver Maple
Acer negundo	Box Elder
Fraxinus pennsylvanica	Green Ash
Fraxinus americana	White Ash
(Native) Medium Trees – (trees 25 to 50 ft. at maturity)	
Magnolia tripetala	Umbrella Magnolia
Magnolia macrophylla	Bigleaf Magnolia
Asimina triloba	Pawpaw
Ulmus alata	Winged Elm
Celtis occidentalis	Hackberry
Quercus stellata	Post Oak
Quercus marilandica	Blackjack Oak
Ostrya virginiana	Eastern Hop Hornbeam
Carpinus carolinia	American Hornbeam
Betula lenta	Sweet Birch
Betula nigra	River Birch
Salix nigra	Black Willow
Oxydendron arboreum	Sourwood
Diospyros virginiana	Common Persimmon
Halesia carolina	Carolina Silverbell

Botanical Name	Common Name
(Native) Medium Trees – (trees 25 to 50 ft. at maturity) continued	
Amelanchier arborea	Downey Serviceberry
Ilex opaca	American Holly
Rhamnus caroliniana	Carolina Buckthorn
Aesculus glabra	Ohio Buckeye
Acer negundo	Box Elder
(Native) Small Trees/Large Shrubs – (10 to 25 ft. at maturity)	

Botanical Name	Common Name
Hamamelis virginiana	Witch Hazel
Carpinus carolinia	American Hornbeam
Kalmia latifolia	Mountain Laurel
Prunus americana	American Plum
Crataegus spp.	Hawthorn
Cercis canadensis	Eastern Redbud
Cornus florida	Flowering Dogwood
Euonymus atropurpurens	Eastern Wahoo
Cephalanthus occidentalis	Buttonbush
Sambucus canadensis	American Elder

Return to Exterior Planting Section

Introduced Species (Kentucky Extension Service List)

(Introduced) Evergreen:

Botanical Name	Common Name
(Introduced) Tall Trees– (trees over 50 ft. at maturity)	
Abies nordmanniana	Nordmann Fir
Cedrus libani var. stenocoma	Hardy Cedar of Lebanon
Picea abies	Norway Spruce
Picea glauca 'Densata'	Black Hills Spruce
Picea omorika	Serbian Spruce
Picea orientalis	Oriental Spruce
Picea pungens	Colorado Spruce
Pinus densiflora	Japanese Red Pine
Pinus flexilis	Limber Pine
Pinus resinosa	Red Pine
Pseudotsuga menziesii	Douglas Fir
Thuja occidentalis	American Arborvitae
(Introduced) Medium Trees – (trees 25 to 50 ft. at maturity)	
Abies concolor	White Fir
Chamaecyparis obtusa	Hinoki Cypress
Chamaecyparis pisifera	Thread Cypress
Ilex attenuata 'Fosteri'	Foster No. 2 Holly
Juniperus chinensis	Chinese Juniper
Osmanthus americanus	Devil Wood

Botanical Name	Common Name
(Introduced) Medium Trees – (trees 25 to 50 ft. at maturity) continued	
Pinus bungeana	Lacebark Pine
Pinus cembra	Swiss Stone Pine
Pinus densiflora 'Oculus-draconis'	Japanese Red Pine
Pinus strobus 'Fastigiata'	Columnar White Pine
Pinus strobus 'Pendula'	Weeping White Pine
Pinus sylvestris	Scotch Pine
Platycladus orientalis	Oriental Arborvitae
Taxus baccata	English Yew
Taxus cuspidata 'Capitata'	Upright Japanese Yew

Botanical Name	Common Name
(Introduced) Small Trees/Large Shrubs – (10 to 25 ft. at maturity)	
Abies koreana 'Prostrate Beauty'	Prostrate Korean Fir
Chamaecyparis obtusa 'Torulosa'	Contorted Hinoki Cypress
Ilex aquifolium	English Holly
Ilex crenata 'Noble's Upright'	Noble's Upright Japanese Holly
Ilex pedunculosa	Longstock Holly
Juniperus chinensis	Chinese Juniper
Juniperus scopulorum	Rocky Mountain Juniper
Picea glauca 'Conica'	Dwarf Albert Spruce
Pinus densiflora 'Umbraculifera'	Tanyosho Pine
Pinus mugo	Mugho Pine
Pinus strobus 'Contorta'	Curly White Pine
Pinus sylvestris 'Wateri'	Waterer's Scotch Pine
Rhododendron catawbiense	Rhododendron
Rhododendron azalea	Azalea
Rhododendron maximum	Rosebay Rhododendron
Sciadopitys verticillata	Umbrella Pine
Taxus cuspidata	Japanese Yew
Viburnum pragense	Fragrant Viburnum
(Introduced) Medium Shrubs – (6 to 8 ft. at maturity)	
Chamaecyparis obtusa 'Sanderi'	Sanderi Hinoki False Cypress
Chamaecyparis pisifera	Sawara Cypress
Ilex meserveae	Blue Holly
Juniperus chinensis 'Sea Green'	Sea Green Chinese Juniper
Mahonia aquifolium	Oregon Holly Grape
Pieris japonica	Japanese Pieris
Taxus cuspidata	Japanese Yew
Taxus media	Spreading Yew
(Introduced) Small Shrubs – (4 to 5 ft. at maturity)	
Buxus microphylla	Boxwood
Chamaecyparis pisifera	Gold Thread Cypress
Ilex glabra 'Compacta'	Compact Inkberry
Ilex opaca 'Maryland Dwarf'	Maryland Dwarf American Holly
Juniperus chinensis	Chinese Juniper

Botanical Name	Common Name
(Introduced) Small Shrubs – (4 to 5 ft. at maturity) continued	
Leucothoe fontanesiana	Drooping Leucothoe
Mahonia aquifolium	Oregon Holly Grape
Picea abies	Norway Spruce
Picea pungens	Colorado Spruce
Pinus mugo	Mugho Pine
Pinus strobus 'Nana'	Dwarf White Pine
Pinus sylvestris 'Beuvronensis'	Dwarf Scotch Pine
Rhododendron 'Starry Night'	Starry Night Rhododendron
Taxus baccata 'Repandens'	Spreading English Yew
Tsuga canadensis 'Gentsch'	Gentsch White Canadian Hemlock
(Introduced) Low Shrubs – (2 to 3 ft. at maturity)	
Abies balsamea 'Nana'	Dwarf Balsam Fir

Botanical Name	Common Name
Chamaecyparis obtusa 'Pygmae	Dwarf Hinoki False Cypress
Aurescens'	
Chamaecyparis pisifera	Moss Cypress
Juniperus horizontalis	Compact Juniper
Juniperus sabina	Savin Juniper
Juniperus squamata 'Blue Star'	Blue Star Juniper
Leucothoe fontanesiana	Drooping Leucothoe
Mahonia aquifolium 'Compactum'	Compact Oregon Holly Grape
Picea abies	Dwarf Norway Spruce
Pieris japonica 'Pygmaea'	Pygmy Andromeda
Pinus sylvestris 'Riverside Gem'	Riverside Gem Scotch Pine
Rhododendron obrtusum	Azalea (several varities)

Return to Exterior Planting Section

(Introduced) Deciduous:

Botanical Name	Common Name
(Introduced) Tall Trees– (trees over 50 ft. at maturity)	
Acer platanoides	Norway Maple
Alnus glutinosa	European Alder
Cercidiphylium japonicum	Katusra Tree
Eucommia ulmoides	Hardy Rubber Tree
Fagus sylvatica	European Beech
Ginkgo biloba	Ginkgo or Maidenhair Tree
Larix kaempferi	Japanese Larch
Metasequoia glyptostroboides	Dawn Redwood
Platanus x acerfolia	London Planetree
Quercus acutissima	Sawtooth Oak
Quercus robur	English Oak
Tilia cordata	European Linden

Botanical Name	Common Name
(Introduced) Tall Trees– (trees over 50 ft. at maturity) continued	
Tilia tomentosa	Silver Linden
Ulmus parvifolia	Chinese Elm
Ulmus x	Hybrid Elms
Zelkova serrata	Japanese Zelkova
(Introduced) Medium Trees – (trees 25 to 50 ft. at maturity)	
Acer campestre	Hedge Maple
Acer griseum	Paperbark Maple
Aesculus x carnea	Red Horsechestnut
Aesculus pavia	Red Buckeye
Amelanchier grandiflora	Apple Serviceberry
Amelanchier laevis	Alleganey Serviceberry
Betula populifolia	Gray Birch
Betula maximowicziana	Monarch Birch
Carpinus betulus	European Hornbeam
Castanea mollissima	Chinese Chestnut
Corylus colurna	Turkish Filbert

Botanical Name	Common Name
Franklinia alatamaha	Franklin Tree
Ilex decidua	Possum Haw
Koeireuteria paniculata	Golden Raintree
Larix decidua 'Pendula'	Weeping European Larch
Maackia amurensis	Amur Maackia
Magnolia virginiana	Sweet Bay Magnolia
Phellodendron amurense	Cork Tree
Prunus sargentii	Sargent Cherry
Prunus serrulata 'Kwanzan'	Kwanzan Japanese Cherry
Pyrus fauriei	Korean Pear
Stewarti pseudocamellia	Japanese Stewartia
Syringa pekinensis	Pekin Lilac
Syringa reticulata	Japanese Tree Lilac
Prunus x yedoensis	Yoshino Cherry
Pyrus calleryana	Callery Pear
(Introduced) Small Trees/Large Shrubs – (10 to 25 ft. at maturity)	
Acer buergeranum	Trident Maple
Acer ginnala	Amur Maple
Acer japonicum	Fullmoon Maple
Acer maximowiczianum	Nikko Maple
Acer palmatum	Japanese Maple
Acer tegmentosum	Manchu Striped Maple
Aesculus parviflora	Bottlebrush Buckeye
Buddlela alternifolia	Fountain buddiela
Cercidiphyllum japonicum	Weeping Katsura Tree
Chionanthus retusus	Chinese Fringe Tree
Chionanthus virginicus	Fringe Tree
Cornus alternifolia	Pagoda Dogwood

Botanical Name	Common Name
(Introduced) Small Trees/Large Shrubs – (10 to 25 ft. at maturity) continued	
Cornus kousa	Kousa Dogwood
Cornus mas	Cornelian Cherry Dogwood
Cornus officinalis	Japanese Cornel Dogwood
Cornus racemosa	Gray Dogwood
Corylus avellana 'Cortorta'	Curly European Filbert
Corylus maxima 'Purpurea'	Purple Giant Filbert
Cotoneaster multiflorus	Many-flowered Cotoneaster
Crataegus crus-galli	Cockspur Hawthorn
Crataegus lavallei	Lavalle Hawthorn
Crataegus phaenopyrum	Washington Hawthorn
Crataegus viridis 'Winter King'	Winter King Hawthorn
Deutzia scabra 'Pride of Rochester'	Pride of Rochester Deutzia
Enkianthus campanulatus	Redvein Enkianthus
Euonymus alata	Burning Bush
Forsythia intermedia	Border Forsythia
Fothergilla major	Large Fothergilla
Ilex verticillata	Winterberry
Kolkwitzia amabilis	Beauty Bush
Ligustrum ibolium	Ibolium Privet

Botanical Name	Common Name
Ligustrum ovalifolium	California Privet
Ligustrum vicaryl	Vicary Golden Privet
Lindera benzoin	Spicebush
Lonicera morrowii	Fragrant Honeysuckle
Lonicera tatarica	Tatarian Honeysuckle
Magnolia x	Hybrid Magnolia (several varities)
Magnolia loebneri 'Merrill'	Dr. Merrill Magnolia
Magnolia soulanglana	Saucer Magnolia
Magnolia stellata	Star Magnolia
Malus x spp.	Crabapple
Malus floribunda	Flowering Crabapple
Malus sieboldii var. Zumi	Calocarpa Crabapple
Philadelphus virginalis	Mockorange
Physocarpus opulifolius	Eastern Ninebark
Prunus x 'Hally Jolivette'	Hally Jollivette Cherry
Prunus subhirtella	Higan Cherry
Rhamnus fragula 'Asplenifolia'	Cutleaf Buckthorn
Syringa vulgaris	Common Lilac
Ulmus glabra 'Camperdownii'	Camperdown Elm
Viburnum burkwoodii	Burkwood Viburnum
Viburnum carlcephalum	Fragrant Viburnum
Viburnum dentatum	Arrowwood Viburnum
Viburnum dilatum 'Iroquois'	Iroquois Linden Viburnum
Viburnum lantana	Wayfaring Tree
Viburnum lentago	Nannyberry Viburnum
Viburnum macrocephalum	Chinese Snowball Viburnum
(Introduced) Small Trees/Large Shrubs – (10 to 25 ft. at maturity) continued	
Viburnum opulus	Cranberry Bush Viburnum
Viburnum plicatum var. tomentosum'	Doublefile Viburnum
Viburnum prunifollum	Blackhaw
Viburnum rhytidophylioides	Lantanaphyllum Viburnum
Viburnum sargentii 'Onondaga'	Onondaga Viburnum
Viburnum sieboldii 'Seneca'	Seneca Viburnum
Viburnum setigerum	Tea Viburnum
Viburnum 'Sesquehana'	Sesquehanna Viburnum
(Introduced) Medium Shrubs – (6 to 8 ft. at maturity)	
Acanthopanax sieboldianus	Five-leaved Aralia
Acer palmatum	Japanese Maple
Aronia arbutifolia 'Brilliantissima'	Brilliant Red Chokeberry
Berberis mentorensis	Mentor Barberry
Berberis thunbergii	Japanese Barberry
Buddleia davidii	Orange-eyed Butterfly Bush
Clianthus florid us	Carolina Allspice
Cercis chinensis	Chinese Redbud
Chaenomeies speciosa	Flowering Quince
Clethra ainifloia	Summer Sweet
Cornus alba	Tatarian Dogwood
Cornus baileyi	Bailey's Dogwood
Cornus florida 'Pygmaea'	Pygmy Dogwood
Cornus sericea 'Flaviramea'	Yellow-twig Dogwood

Botanical Name	Common Name
Cotoneaster divaricata	Spreading Cotoneaster
Deutzia lemoinei	Slender Deutzia
Forsythia intermedia 'Sunrise'	Border Forsythia
Hamamelis vernalis	Vernal Witchhazel
Hibiscus syriacus	Rose of Sharon
Hydrangea quercifolia	Oakleaf Hydrangea
Ilex verticillata	Winterberry
Kerria japonica	Japanese Kerria
Ligustrum vulgare 'Lodense'	Lodense Privet
Lonicera xyldosteum 'Claveyl'	Clavey's Honeysuckle
Malus sargentii	Sargent Crabapple
Morus alba 'Pendula'	Weeping Mulberry
Myrica pensylvanica	Northern Bayberry
Prunus x cistena	Purpleleaf Sand Cherry
Pyracantha coccinea	Scarlet Firethorn
Rhus aromatica	Fragrant Summac
Ribes alpinum	Alpine Currant
Spiraea nipponica 'Snowmound'	Snowmound Spirea
Spiraea x vanhouttei	Vanhoutte Spirea
Viburnum acerfolium	Mapleleaf Viburnum
Viburnum carlesli	Koreanspice
Viburnum juddii	Judd Viburnum
(Introduced) Medium Shrubs – (6 to 8 ft. at maturity) continued	
Viburnum x 'Mohawk'	Mohawk Viburnum
Viburnum x pragense	Prague Viburnum
Weigela florida	Weigela
(Introduced) Small Shrubs – (4 to 5 ft. at maturity)	
Abelia grandiflora	Glossy Abelia
Berberis thunbergii 'Aurea'	Golden Japanese Barberry
Cotoneaster horizontalis	Rockspray Cotoneaster
Deutzia gracilis	Slender Deutzia
Divervilla sessilifolia	Southern Bush Honeysuckle
Hydrangea arborescens	Hills-of-Snow
Hypericum kalm	Kalm St. Johnswort
Ilex verticillata	Winterberry
Itea japonica 'Beppu'	Beppu Sweetspire
Malus sargentii 'Tina'	Tina Crabapple
Physocarpus opulifolius	Eastern Ninebark
Potentilla fruticosa	Bush Cinquefoil
Pyracantha coccinea	Scarlet Firethorn
Syringa meyeri 'Palibin'	Meyer's Lilac
Syringa patula 'Miss Kim'	Littleleaf Lilac
Vibunum opulus 'Nana'	Dwarf Cranberrybush Viburnum
Viburnum trilobum 'Compactum'	Compact American Cranberry Bush
Viburnum utile 'Eskimo'	Eskimo Viburnum
(Introduced) Low Shrubs – (2 to 3 ft. at maturity)	
Berberis thunbergii	Japanese Barberry
Caryopteris clandonensis 'Blue	Blue Mist Bluebeard
Cornus sericea 'Kelseyi'	Kelsey's Dwarf Dogwood
Cotoneaster apiculatus	Cranberry Cotoneaster
Cotoneaster dammeri	Bearberry Cotoneaster
Cotoneaster horizontalis 'Perpusilla'	Perpusilla Rock Cotoneaster
Cotoneaster microphylla	Small Leaf Cotoneaster
Forsythia viridissima 'Bronxensis'	Bronx Forsythia

Botanical Name	Common Name
Forsythia 'Arnold's Dwarf'	Arnold's Dwarf Forsythia
Fothergilla gardenii	Dwarf Fothergilla
Hypericum 'Hidcote'	Hidcote St. Johnswort
Jasminum nudiflorum	Winter Jasmine
Kalmia cuseata 'White Wicky'	White Wicky Mountain Laurel
Kerria japonica 'Picta'	Variegated Japanese Kerria
Physocarpus opulifolius 'Nana'	Dwarf Eastern Ninebark
Rhus aromatica 'Gro-low'	Gro-low Fragrant Summac
Ribes alpinum 'Greenmound'	Greenmound Alpine Currant
Rosa wichuriana	Memorial Rose
Spiraea x bumalda	Bumald Spirea
Spiraea japonica 'Little Princess'	Little Princess Japanese Spirea
Symphoricarpos albus	Snowberry
var. laevigatus	

Return to Exterior Planting Section

Return to Table of Contents

APPENDIX J

DRAWINGS

Section:

US Army Corps
of Engineers
Louisville District

DESIGN-BUILD RFP
PHYSICAL FITNESS FACILITY

FORT CAMPBELL, KY
PN 65147, P2 146364, FY12

GENERAL			
146364_G-001xxx.dgin	G-001	1	Cover Sheet
146364_G-001xxx.dgn	G-002	2	Site Location and Vicinity Maps
146364_G-002xxx.dgn	G-003	3	Borrow / Disposal Area Plan
146364_G-003xxx.dgn	G-004	4	Site Aerial Photo
CIVIL			
146364_V-101xxx.dgn	V-101	5	Overall Site Survey
146364_V-102xxx.dgn	V-102	6	Site Survey Area 1
146364_V-103xxx.dgn	V-103	7	Site Survey Area 2
146364_V-104xxx.dgn	V-104	8	Site Survey Area 3
146364_V-201xxx.dgn	V-201	9	Site Survey Control Points
146364_CS101xxx.dgn	CS101	10	Overall Site Plan
146364_CS102xxx.dgn	CS102	11	Conceptual Site Plan (Sheet 1 of 8)
146364_CS103xxx.dgn	CS103	12	Conceptual Site Plan (Sheet 2 of 8)
146364_CS104xxx.dgn	CS104	13	Conceptual Site Plan (Sheet 3 of 8)
146364_CS105xxx.dgn	CS105	14	Conceptual Site Plan (Sheet 4 of 8)
146364_CS106xxx.dgn	CS106	15	Conceptual Site Plan (Sheet 5 of 8)
146364_CS107xxx.dgn	CS107	16	Conceptual Site Plan (Sheet 6 of 8)
146364_CS108xxx.dgn	CS108	17	Conceptual Site Plan (Sheet 7 of 8)
146364_CS109xxx.dgn	CS109	18	Conceptual Site Plan (Sheet 8 of 8)
UTILITY			
146364_UT101xxx.dgn	UT101	19	Overall Utility Plan
ARCHITECTURAL			
146364_A-101xxx.dgn	A-101	20	First Floor Conceptual Layout
146364_A-102xxx.dgn	A-102	21	Second Floor Conceptual Layout

W912QR-12568463
SEPTEMBER 2011
READY TO ADVERTISE

SCOPE OF WORK

CONSTRUCT A STANDARD DESIGN MEDIUM PHYSICAL FITNESS FACILITY. THE PHYSICAL FITNESS FACILITY IS COMPOSED OF A MULTIPURPOSE COURT, FITNESS MODULE FOR BOTH CIRUIT AND FREE WEIGHTS, CARDIOVASCULAR EXERCISE ROOM, ELEVATED INDOOR JOGGING TRACK, MEN'S AND WOMEN'S LOCKER ROOMS WITH SHOWER, SAUNAS, TOILETS, ADMINISTRATIVE SPACE, LOUNGE AREA, PUBLIC TOILETS, VENDING AREA, LAUNDRY, EQUIPMENT ISSUE AREA, BUILDING INFORMATION SYSTEMS, FIRE PROTECTION AND ALARM SYSTEMS, AND ENERGY MONITORING & CONTROL SYTEM (EMCS) CONNECTION. PROJECT INCLUDES OPTIONS FOR A STANDARD DESIGN LIGHTED MULTIPURPOSE ATHETIC/SOCCER FIELD AND TWO SOFTBALL FIELDS, AN INDOOR CLIMBING WALL, AND ADDITIONAL PARKING.

SUPPORT FACILITIES INCLUDE CONNECTION TO WATER, ELECTRIC,SEWER AND NATURAL GAS UTILIITES, SITE IMPROVEMENT, FENCING, PARKING, LIGHTING, PAVING, WALKS, CURBS AND GUTTERS, STORM DRAINAGE, LANDSCAPING AND SIGNAGE.

SIGNATURES AFFIXED BELOW INDICATE OFFICAL RECOMMENDATION AND APPROVAL OF ALL DRAWINGS IN THIS SET AS INDEXED ON THIS SHEET.

REVIEWED BY:*

DOUG POHL, R.A. _____ _____
QUALITY CONTROL DATE

APPROVAL RECOMMENDED: *

AMANDA HARDAWAY _____ _____
PE/A DATE

APPROVED: *

STEPHEN G DURRETT, P.E. _____ _____
ENGINEERING DIVISION, CHIEF DATE

* THIS PROJECT WAS DESIGNED BY THE U.S. ARMY CORPS OF ENGINEERS, LOUISVILLE DISTRICT. INDIVIDUALS WHOSE SIGNATURES AND REGISTRATION DESIGNATIONS APPEAR ON THESE DOCUMENTS ARE OPERATING WITHIN THE SCOPE OF THIER EMPLOYMENT. SIGNATURES ARE REQUIRED BY ER 1110-1-8152.

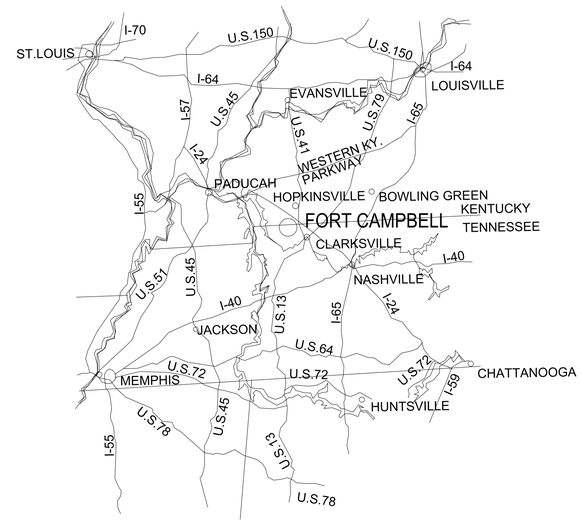
FILE: IP_PWP:dms24949\146364_G-001xxx.dgn
DATE: 07-NOV-2011 13:31

NOTE:

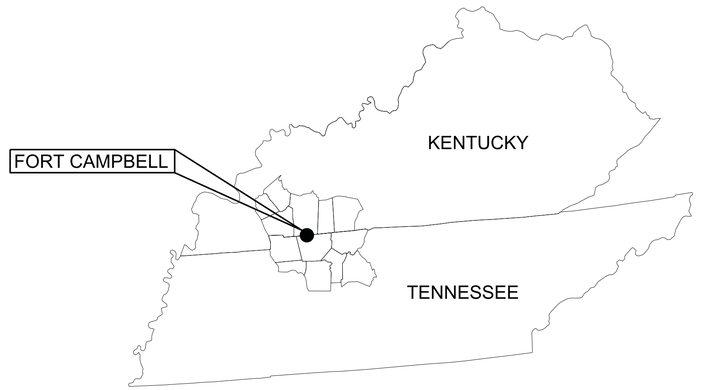
CONTRACTOR TO USE GATE 7 AS THE HAUL ROUTE TO THE CONSTRUCTION WORK AREA. THIS IS THE ONLY PERMITTED ROUTE FOR THIS CONTRACT.

CORPS OF ENGINEERS FT.CAMPBELL OFFICE BLDG. (BLDG. 849 GEORGIA AVE.)

A1 LOCATION MAP
NTS



D7 VICINITY MAP
NTS



A7 VICINITY MAP
NTS

US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

REVISIONS DESCRIPTION	DATE	APPR.

SYMBOL		

DATE: AUGUST 2011
SCALE: NTS
DRAWING CODE: F-740-28-04
DATE
AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT

DESIGNED BY: B. DORSCH
DRAWN BY: B. PHELPS
CHECKED BY: K. LANNING

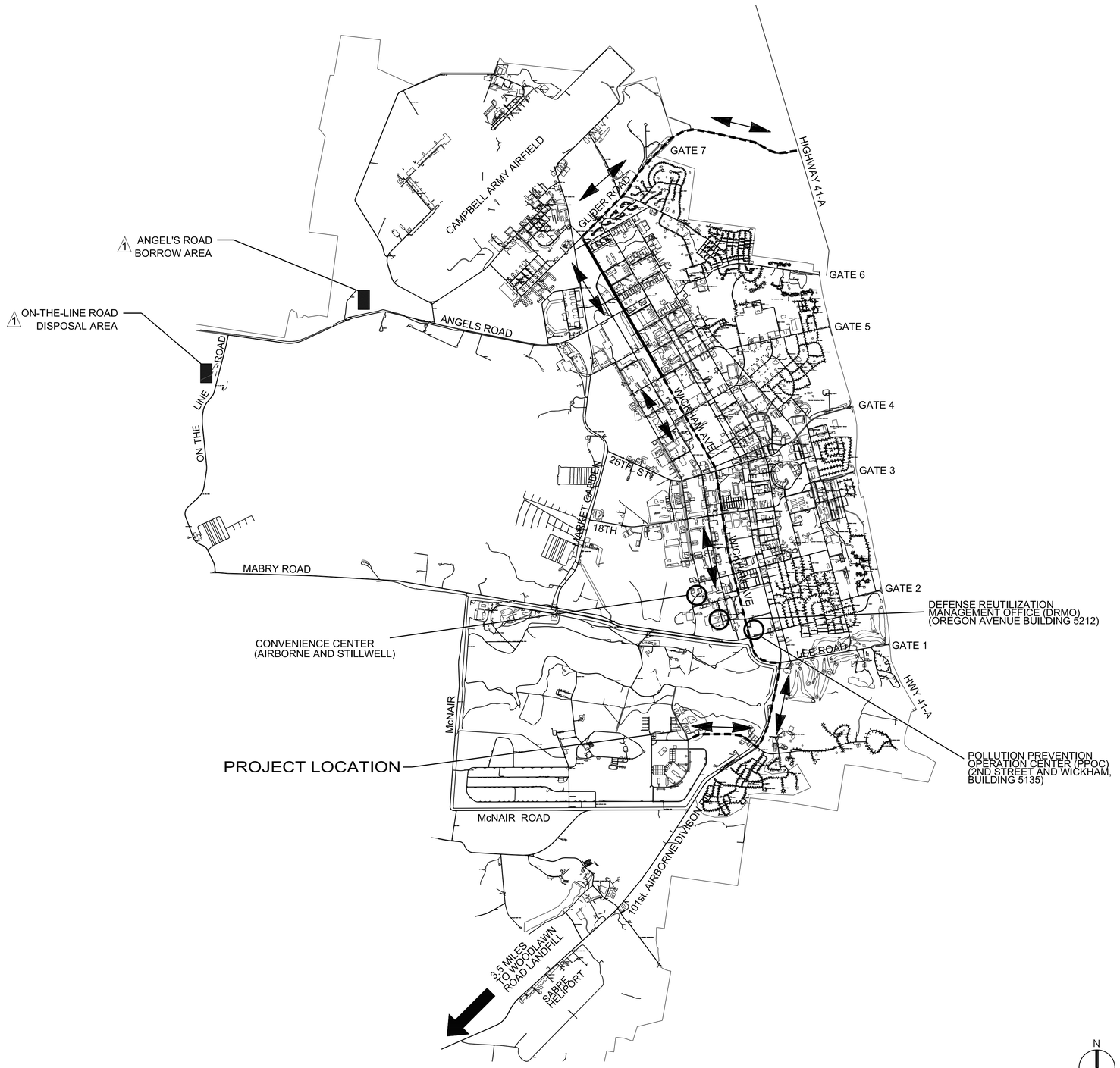
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

FY 2012 P.N. 65147 P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

SITE LOCATION AND VICINITY MAPS

SHEET REFERENCE NUMBER:
G-002
SHEET 2 OF 21

READY TO ADVERTISE



A1 BORROW / DISPOSAL AREA PLAN
NTS

GENERAL SHEET NOTES

1. SUBMIT A C&D WASTE MANAGEMENT PLAN.
   -CARDBOARD SHALL BE BROKEN DOWN AND DELIVERED TO THE FORT CAMPBELL RECYCLE CENTER (BUILDING 5225).

   -SCRAP METAL SHALL BE DELIVERED TO DRMO LOCATED AT BUILDING 5212. SCRAP METALS CAN BE STEEL, ALUMINUM, BRASS, COPPER, AND BRONZE.

   -WOODEN PALLETS (REUSABLE) CAN BE DELIVERED TO THE CONVENIENCE CENTER LOCATED AT AIRBORNE & STILLWELL ROAD.

   -REFUSE/TRASH (MATERIALS THAT CANNOT BE RECYCLED/REUSED) SHALL BE DISPOSED OF AT THE CONTRACTOR'S EXPENSE. THE CONTRACTOR MAY OBTAIN DUMPSTERS FROM A PRIVATE REFUSE HAULER.

1 -THE CONTRACTOR SHALL BE REQUIRED TO PERFORM ON SITE GRINDING OF 100% OF ANY CONCRETE, ASPHALT, AND MASONRY MATERIALS PER SPECIFICATION SECTION 02 41 00 DEMOLITION.

2. EXCESS SOIL THAT CANNOT BE USED ON SITE SHALL BE HAULED TO ON-THE-LINE ROAD DISPOSAL AREA. DEBRIS FROM CLEARING AND DEMOLITION OPERATIONS THAT CANNOT BE USED ON-SITE SHALL BE HAULED TO THE WOODLAWN LANDFILL OR TA14 BORROW AREA.
1 TREES, BRUSH, STUMPS AND ROOTS SHALL NOT GO TO THE WOODLAWN LANDFILL. THESE ITEMS SHALL BE REMOVED FROM THE PROJECT SITE AND DELIVERED TO A LICENSED LANDFILL. POINT OF CONTACT FOR THE LAND CLEARING DEBRIS IS DPW-ENGINEER DESIGN BRANCH AT 270-798-0972. POC FOR CONSTRUCTION DEBRIS IS DPW-ENVIRONMENTAL DIVISION AT 270-798-9773.

3. BORROW MATERIAL CAN BE OBTAINED AT THE ANGEL'S ROAD BORROW AREA. THE BORROW AREA WILL BE IN USE BY OTHERS. CONTRACTOR SHALL COOPERATE AND
1 COORDINATE HIS ACTIVITIES WITH DPW-ENGINEERING DESIGN BRANCH AT 270-798-0972. CONTRACTOR IS RESPONSIBLE FOR RESTORING PORTION OF BORROW AREA DISTURBED BY THIS CONTRACT.

4. ALL C&D DEBRIS MUST GO TO THE WOODLAWN LANDFILL. DPW-ENVIRONMENTAL DIVISION IN BUILDING 2186 WILL FURNISH LAND FILL PASSES TO THE CONTRACTOR FOR ENTRANCE INTO THE LANDFILL. ALL LOADS OF DEBRIS WILL BE WEIGHED AND RECORDED IN THE DATABASE AND A TABULATION FURNISHED TO THE CONTRACTING OFFICER. ALSO RECORDED WILL BE INFORMATION ON WASTE, WHETHER THE LOAD CONTAINED ASBESTOS OR ANY OTHER AUTHORIZED SPECIAL WASTE OR RECYCLABLE MATERIALS. ALSO THE OPERATORS NAME AND VEHICLE LICENSE NUMBER WILL BE RECORDED. NO MATERIAL WILL BE ACCEPTED WITHOUT A PASS.

5. PROJECT WORK AREA IS APPROXIMATELY 6 MILES FROM THE WOODLAWN LANDFILL. ANY C&D DEBRIS TAKEN TO THE ON-POST LANDFILL SHALL BE NO LARGER THAN 600mm X 900mm X 450mm (24" X 36" X 18") IN SIZE.

6. THE GOVERNMENT WOODLAWN LANDFILL WILL NOT ACCEPT C&D DEBRIS CONTAMINATED WITH RECYCLABLES OR REFUSE (WOOD PALLETS, CARDBOARD, AND REFUSE, ETC.) LIQUIDS ARE ALSO NOT ACCEPTED. THE CONTRACTOR IS RESPONSIBLE FOR SEPARATION OF THESE MATERIALS.

7. GOVERNMENT SALVAGABLE MATERIALS AND C&D MATERIALS WHICH ARE ACCEPTABLE FOR DISPOSAL AT GOVERNMENT WOODLAWN LANDFILL SHALL NOT BE REMOVED FROM THE INSTALLATION WITHOUT APPROVAL FROM THE CONTRACTING OFFICER REPRESENTATIVE (COR) AND DPW-ENVIRONMENTAL DIVISION.

8. POINT OF CONTACT FOR SOLID WASTE/RECYCLING QUESTIONS: DPW-ENVIRONMENTAL DIVISION AT 270-798-9773.

9. CONTRACTOR SHALL UTILIZE GATE 7 FOR HAUL ROAD ACCESS TO AND FROM SITE. ALL TRUCKS MUST ENTER THRU GATE 7.

10. ANY HAZARDOUS WASTE REMOVAL SHALL BE COORDINATED WITH THE POLLUTION PREVENTION OPERATION CENTER (PPOC) AT 2ND STREET AND WICKHAM. FLOURESCENT BULBS SHALL BE DISPOSED OF AT THE
1 POLLUTION PREVENTION OPERATION CENTER (PPOC).

US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

REVISIONS

SYMBOL	DESCRIPTION	DATE	APPR.
1	AMDT 0002 - BORROW/DISPOSAL REVISIONS	12/20/11	WMD

DESIGNED BY: B. PHELPS
DRAWN BY: B. PHELPS
CHECKED BY: K. LANNING
DATE: AUGUST 2011
SCALE: NTS
DRAWING CODE: F-740-28-04
AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT DATE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

FY 2012 P.N. 65147 PZ#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

BORROW / DISPOSAL AREA PLAN

SHEET REFERENCE NUMBER:
G-003
SHEET 3 OF 21

READY TO ADVERTISE

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DATE: 20-DEC-2011 09:47

Section:

1 2 3 4 5 6 7 8 9

F E D C B A

GENERAL SHEET NOTES

1. SITE BOUNDARY (36 Acres) INCLUDES SWMU#11 AREA (10 Acres).
2. ANY TEMPORARY CONSTRUCTION FENCING SHALL BE AT LEAST 20 FEET FROM THE EXISTING ROAD EDGES.
3. CONTRACTOR LAY-DOWN AREA SHALL BE WITHIN SITE BOUNDARY, BUT NOT WITHIN THE SWMU#11 BOUNDARY.

SHEET KEYNOTES

1. SITE BOUNDARY.
2. EXISTING GRAVEL TRAIL.
3. SOLID WASTE MANAGEMENT UNIT (SWMU) #11.

A1 SITE AERIAL PHOTO
1" = 100'

N

0 80' 160'

US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

REVISIONS

SYMBOL	DESCRIPTION	DATE	APPR.

DESIGNED BY:	B. DORSCH	DATE:	AUGUST 2011
DRAWN BY:	B. DORSCH	SCALE:	1" = 100 FEET
CHECKED BY:	J. TOE	DRAWING CODE:	F-740-28-04
AMANDA HARDAWAY			
PROJECT ENGINEER/ARCHITECT			DATE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

FY 2012 P.N. 65147 PZ#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

SITE AERIAL PHOTO

SHEET REFERENCE NUMBER:
G-004
SHEET 4 OF 21

READY TO ADVERTISE

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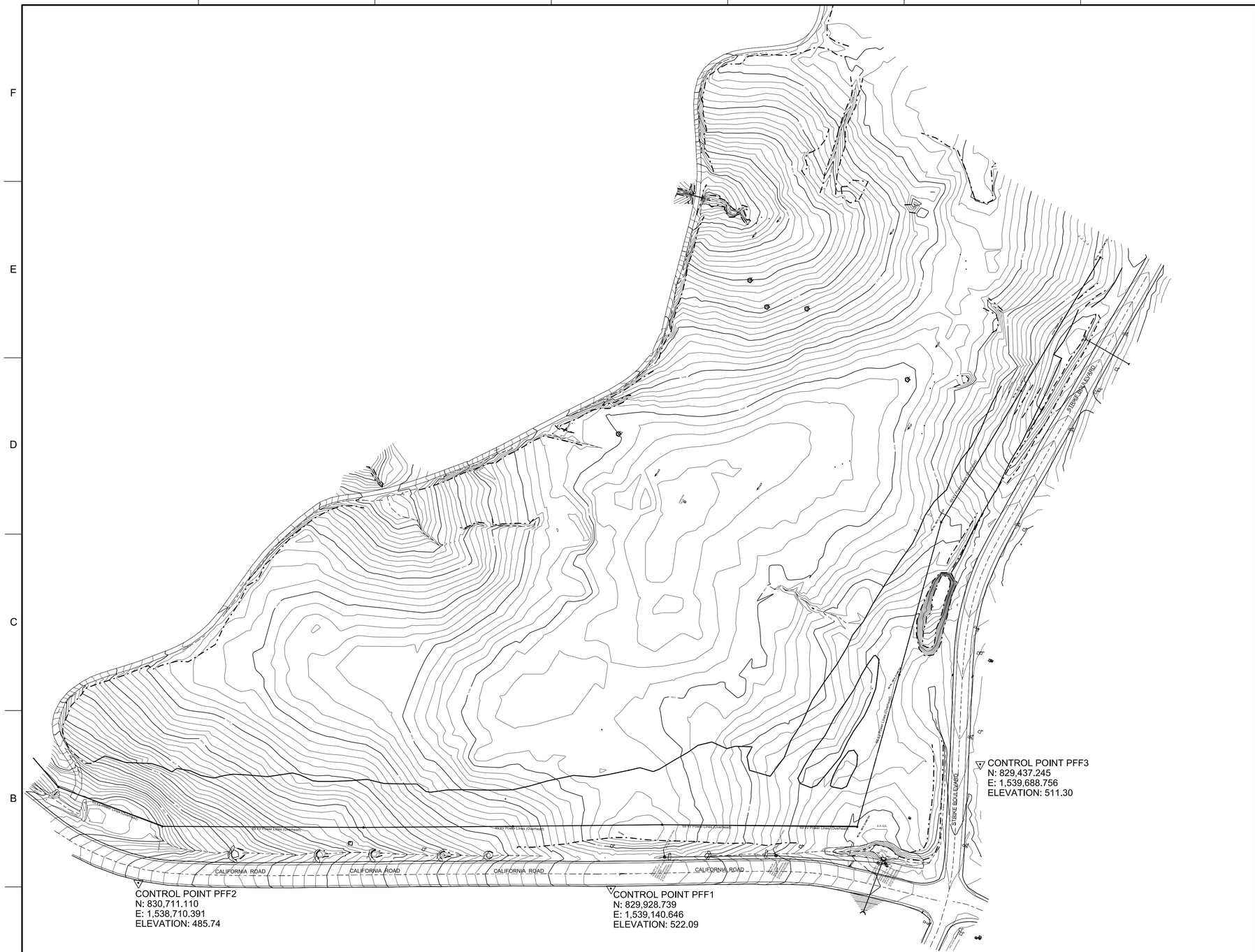


GENERAL SHEET NOTES

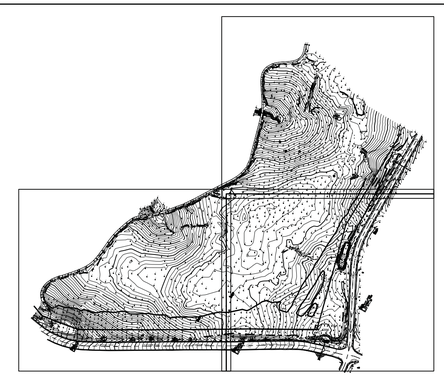
Survey was conducted by the U.S. Army Corps of Engineers from January 3, 2011 to January 14, 2011.

Horizontal Datum: TN State Plane Coordinates (NAD83)
Vertical Datum: NAVD 1988 (Geoid 2009)

Survey provided is based on use of control points PFF1, PFF2, and PFF3 using U.S. Survey Feet.

SEE SHEET V-201 FOR CONTROL POINT DESCRIPTIONS.

SITE SURVEY KEY MAP



A1 SITE SURVEY
1" = 100'

0 100' 200'

US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

REVISIONS

SYMBOL	DESCRIPTION	DATE	APPR.

DESIGNED BY: B. DORSCH
DRAWN BY: B. DORSCH
CHECKED BY: J. TOE
PROJECT ENGINEER/ARCHITECT: AMANDA HARDAWAY
DATE:
DATE: AUGUST 2011
SCALE: 1" = 100 FEET
DRAWING CODE: F-740-28-04

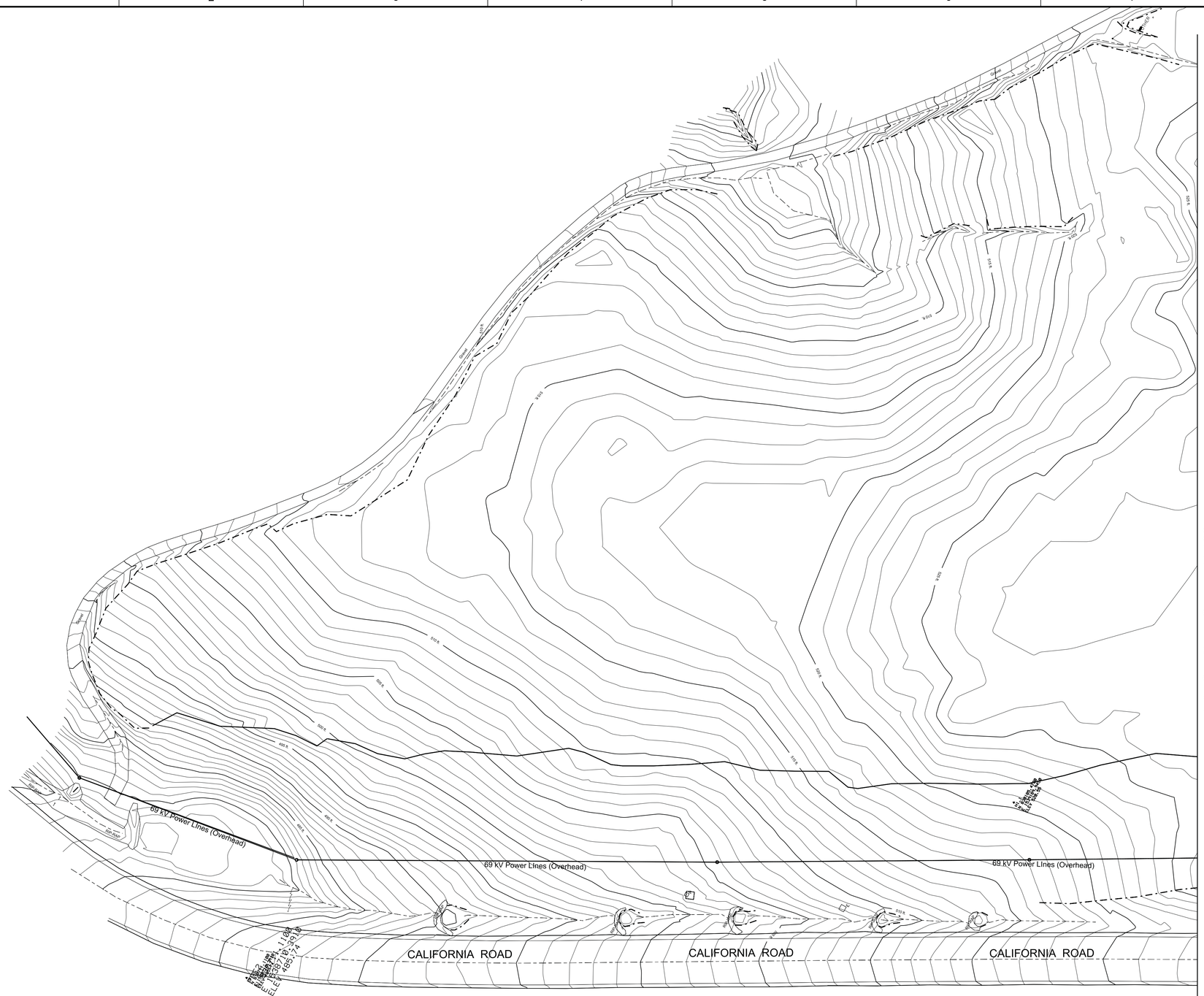
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

FY 2012 P.N. 65147 P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

OVERALL SITE SURVEY

SHEET REFERENCE NUMBER:
V-101
SHEET 5 OF 21

READY TO ADVERTISE



A1 SITE SURVEY
1" = 50'

GENERAL SHEET NOTES

Survey was conducted by the U.S. Army Corps of Engineers from January 3, 2011 to January 14, 2011.

Horizontal Datum: TN State Plane Coordinates (NAD83)
Vertical Datum: NAVD 1988 (Geoid 2009)

Survey provided is based on use of control points PFF1, PFF2, and PFF3 using U.S. Survey Feet.

SITE SURVEY KEY MAP

US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

REVISIONS
SYMBOL | DESCRIPTION | DATE | APPR.

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

DESIGNED BY: B. DORSCH
DRAWN BY: B. DORSCH
CHECKED BY: J. TOE
AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT DATE

DATE: AUGUST 2011
SCALE: 1" = 50 FEET
DRAWING CODE: F-740-28-04

FY 2012 P.N. 65147 P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

SITE SURVEY
AREA 1

SHEET REFERENCE NUMBER:
V-102
SHEET 6 OF 21

READY TO ADVERTISE

MATCHLINE - SHEET V-104

MATCHLINE - SHEET V-102

A1 SITE SURVEY
1" = 50'

0 50' 100'

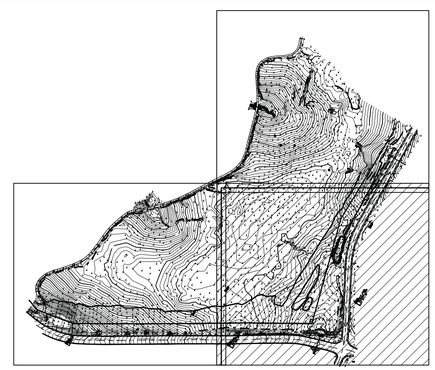
GENERAL SHEET NOTES

Survey was conducted by the U.S. Army Corps of Engineers from January 3, 2011 to January 14, 2011.

Horizontal Datum: TN State Plane Coordinates (NAD83)
Vertical Datum: NAVD 1988 (Geoid 2009)

Survey provided is based on use of control points PFF1, PFF2, and PFF3 using U.S. Survey Feet.

SITE SURVEY KEY MAP



US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

REVISIONS			
SYMBOL	DESCRIPTION	DATE	APPR.

DATE: AUGUST 2011
SCALE: 1" = 50 FEET
DRAWING CODE: F-740-28-04

DESIGNED BY: B. DORSCH
DRAWN BY: B. DORSCH
CHECKED BY: J. TOE
AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT DATE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE KENTUCKY

FY 2012 P.N. 65147 P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

SITE SURVEY
AREA 2

SHEET REFERENCE NUMBER:
V-103
SHEET 7 OF 21

READY TO ADVERTISE

GENERAL SHEET NOTES

Survey was conducted by the U.S. Army Corps of Engineers from January 3, 2011 to January 14, 2011.

Horizontal Datum: TN State Plane Coordinates (NAD83)
Vertical Datum: NAVD 1988 (Geoid 2009)

Survey provided is based on use of control points PFF1, PFF2, and PFF3 using U.S. Survey Feet.

SITE SURVEY KEY MAP

A1 SITE SURVEY
1" = 50'

US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

REVISIONS
DESCRIPTION | DATE | APPR.

DATE: AUGUST 2011
SCALE: 1" = 50 FEET
DRAWING CODE: F-740-28-04

DESIGNED BY: B. DORSCH
DRAWN BY: B. DORSCH
CHECKED BY: J. TOE
AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT DATE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

FY 2012 P.N. 65147 P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

SITE SURVEY
AREA 3

SHEET REFERENCE NUMBER:
V-104
SHEET 8 OF 21

READY TO ADVERTISE

FTC_PHYSICAL FITNESS FAC.

FORT CAMPBELL, KY.

PROJECT: FTC PHYSICAL FITNESS FAC.

DATE: JANUARY 2011 SURVEY BY: ED-T-C

STATION PFF-1

GEOGRAPHIC COORDINATES (NAD83-CORS 1996)

LATITUDE 36°36' 15.94589" N

LONGITUDE 087°27' 45.72354" W

ELEVATION 522.09 (FT)
NAVD 1988 (GEOID 2009)

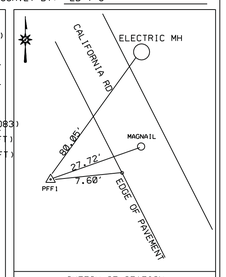
TN. STATE PLANE COORDINATES (NAD83)

NORTHING 829928.739 (U.S. FT)

EASTING 1539140.646 (U.S. FT)

CONV. ∠ -00°51' 22.76375"

COMB. FACTOR 1.000013720



SKETCH OF STATION

DESCRIPTION:
IRON PIN WITH YELLOW PLASTIC COE CAP ATTACHED. DRIVEN FLUSH INTO GROUND.

LOCATION:
STATION IS LOCATED APPROXIMATELY 0.18 MILE NORTHWEST FROM THE INTERSECTION OF CALIFORNIA ROAD AND STRIKE BOULEVARD.

DATE (SET)
JAN 4, 2011

DISTANCE AND DIRECTION FROM REF OBJECT

OBJECT	HORIZONTAL DISTANCE (FEET)	DIRECTION
ELECTRIC MH	80.05'	SW
MAGNAIL IN CL OF ROAD	27.72'	W
EDGE OF PAVEMENT	7.60'	W

FTC PHYSICAL FITNESS FAC.

FORT CAMPBELL, KY.

PROJECT: FTC PHYSICAL FITNESS FAC.

DATE: JANUARY 2011 SURVEY BY: ED-T-C\SURVEYS

STATION PFF2

GEOGRAPHIC COORDINATES (NAD83-CORS 1996)

LATITUDE 36°36' 23.61727" N

LONGITUDE 87°27' 51.14302" W

ELEVATION 485.74 (FT)
NAVD 1988 (GEOID 2009)

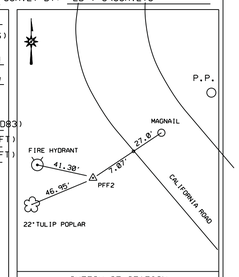
TN. STATE PLANE COORDINATES (NAD83)

NORTHING 830711.110 (U.S. FT)

EASTING 1538710.391 (U.S. FT)

CONV. ∠ -00°51' 25.93653"

COMB. FACTOR 1.000015960



SKETCH OF STATION

DESCRIPTION:
IRON PIN WITH YELLOW PLASTIC COE CAP ATTACHED. DRIVEN FLUSH INTO GROUND.

LOCATION:
STATION IS LOCATED APPROXIMATELY 0.25 MILE NORTHWEST FROM THE INTERSECTION OF CALIFORNIA ROAD AND STRIKE BOULEVARD.

DATE (SET)
JAN. 3, 2011

DISTANCE AND DIRECTION FROM REF OBJECT

OBJECT	DISTANCE (FEET)	DIRECTION
TOP OF FH (SLOPE DISTANCE)	41.30'	ESE
BASE OF 22" TULIP POPLAR	46.95'	NE
EDGE OF PAVEMENT	7.07'	SW
MAGNAIL IN CL ROAD, IN LINE W/ PP	27.0'	SW

FTC PHYSICAL FITNESS FAC.

FORT CAMPBELL, KY.

PROJECT: FTC PHYSICAL FITNESS FAC.

DATE: JANUARY 2011 SURVEY BY: ED-T-C\SURVEYS

STATION PFF3

GEOGRAPHIC COORDINATES (NAD83-CORS 1996)

LATITUDE 36°36' 11.16763" N

LONGITUDE 87°27' 38.91248" W

ELEVATION 511.30 (FT)
NAVD 1988 (GEOID 2009)

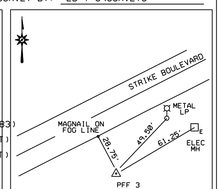
TN. STATE PLANE COORDINATES (NAD83)

NORTHING 829437.245 (U.S. FT)

EASTING 1539688.756 (U.S. FT)

CONV. ∠ -00°51' 18.77628"

COMB. FACTOR 1.000013925



SKETCH OF STATION

DESCRIPTION:
IRON PIN WITH YELLOW PLASTIC COE CAP ATTACHED. DRIVEN FLUSH INTO GROUND.

LOCATION:
STATION IS LOCATED APPROXIMATELY 250 FT NORTHEAST FROM THE INTERSECTION OF CALIFORNIA ROAD AND STRIKE BOULEVARD.

DATE (SET)
JAN. 3, 2011

DISTANCE AND DIRECTION FROM REF OBJECT

OBJECT	DISTANCE (FEET)	DIRECTION
SW OF METAL LIGHT POLE	49.50'	SW
SW OF CL ELECTRIC MH	61.25'	SW
MAGNAIL IN WHITE STRIPE	28.75'	SSE

GENERAL SHEET NOTES

Survey was conducted by the U.S. Army Corps of Engineers from January 3, 2011 to January 14, 2011.

Horizontal Datum: TN State Plane Coordinates (NAD83)
Vertical Datum: NAVD 1988 (Geoid 2009)

Survey provided is based on use of control points PFF1, PFF2, and PFF3 using U.S. Survey Feet.

SEE SHEET V-101 FOR CONTROL POINT LOCATION SITE MAP.

A1 SITE SURVEY CONTROL POINTS

US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

REVISIONS
DESCRIPTION | DATE | APPR.

DATE: AUGUST 2011
SCALE: NONE
DRAWING CODE: F-740-28-04

DESIGNED BY: B. DORSCH
DRAWN BY: B. DORSCH
CHECKED BY: J. TOE
AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT DATE

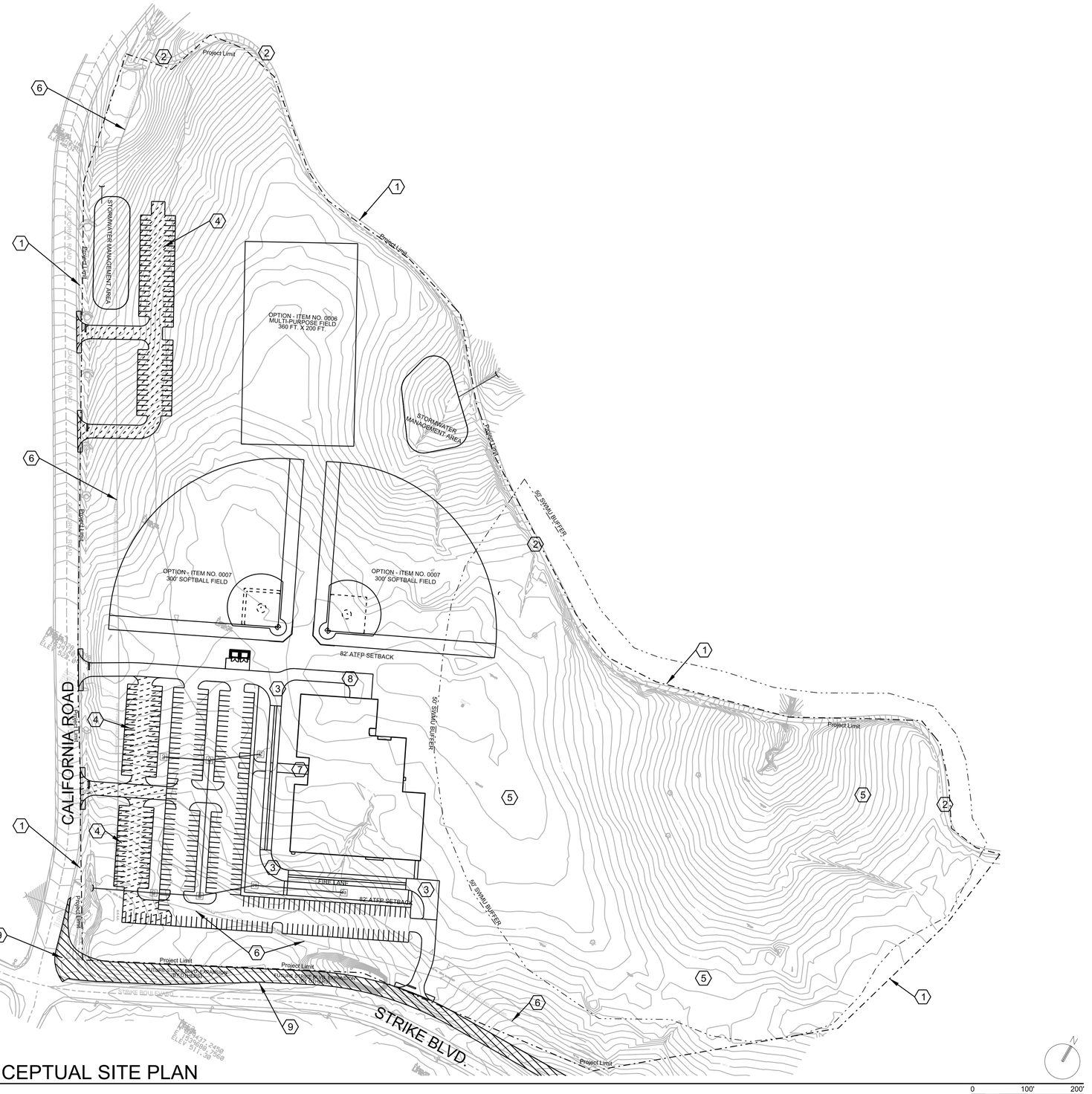
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

FY2012, P.N.65147, P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

SITE SURVEY CONTROL POINTS

SHEET REFERENCE NUMBER:
V-201
SHEET 9 OF 21

READY TO ADVERTISE



A1 OVERALL CONCEPTUAL SITE PLAN

1" = 100'

GENERAL SHEET NOTES

1. SITE BOUNDARY INCLUDES SWMU#11 AREA.
2. BOTH SOFTBALL FIELDS ARE SHOWN 300 FEET DEEP.
3. FOR CONCEPTUAL SITE UTILITY PLAN, SEE SHEET UT101.

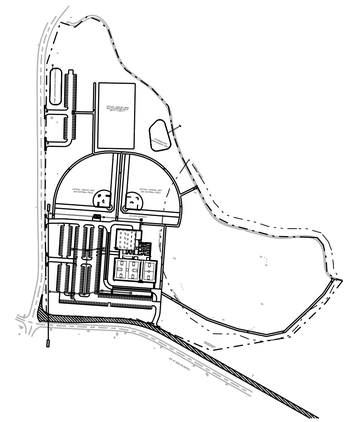
SHEET KEYNOTES

1. SITE BOUNDARY.
2. EXISTING GRAVEL TRAIL.
3. FIRE ACCESS LANE
4. PARKING ADDITION (OPTION - ITEM NO. 0008)
5. SOLID WASTE MANAGEMENT UNIT (SWMU) #11.
6. EXISTING 69kV POWER LINE.
7. MAIN BUILDING ENTRANCE.
8. BUILDING SERVICE ENTRANCE.
9. STRIKE BOULEVARD EXPANSION (BY OTHERS)

LEGEND

- SWMU #11 BOUNDARY
- PROJECT LIMIT
- STRIKE BLVD. EXPANSION (BY OTHERS)
- PARKING OPTIONS

SITE PLAN KEY MAP



US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

REVISIONS

SYMBOL	DESCRIPTION	DATE	APPR.

DESIGNED BY: B. DORSCH
DRAWN BY: B. DORSCH
CHECKED BY: J. TOE
AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT DATE

DATE: AUGUST 2011
SCALE: 1" = 100 FEET
DRAWING CODE: F-740-28-04

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

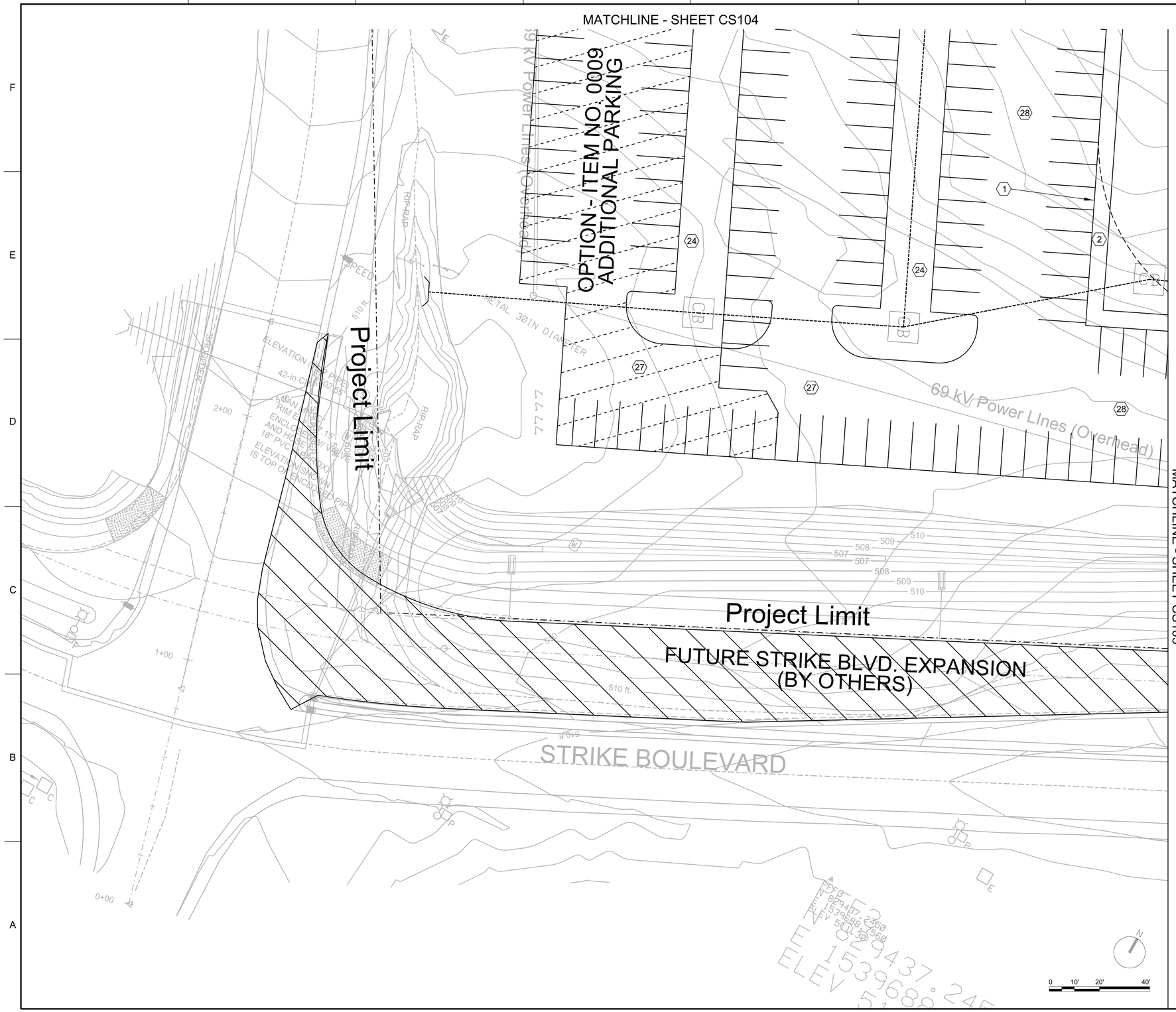
FY 2012 P.N. 65147 P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

OVERALL CONCEPTUAL SITE PLAN

SHEET REFERENCE NUMBER:
CS101

SHEET 10 OF 21

READY TO ADVERTISE



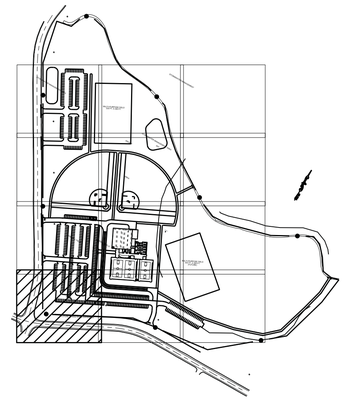
GENERAL SHEET NOTES

1. CONTRACTOR SHALL COORDINATE WORK WITH STRIKE BOULEVARD EXPANSION.
2. PAVEMENT MARKINGS, STREET SIGNS, GRADING AND DRAINAGE NECESSARY TO COMPLETE THE OPTION SHALL BE CONSIDERED INCIDENTAL TO THE OPTION.

SHEET KEYNOTES

1 NEW CONCRETE HEADER CURB.
2 NEW CONCRETE SIDEWALK (6 FOOT UNLESS INDICATED OTHERWISE).
3 NEW GRAVEL SHOULDER, 6" KY DGA.
4 NEW 12" WHITE STOP BAR PAVEMENT MARKING.
5 NEW 4" WHITE PAVEMENT MARKING.
6 NEW 4" YELLOW PAVEMENT MARKING.
7 NEW NO PARKING AREA STRIPING (WHITE).
8 NEW RESERVED PAVEMENT MARKING FOR LOW EMITTING AND FUEL EFFICIENT VEHICLES (WHITE).
9 NEW RESERVED PAVEMENT MARKING FOR CARPOOL/VANPOOL (WHITE).
10 NEW HANDICAP PARKING STALL.
11 TIE TO EXISTING PAVEMENT.
12 NEW 2' CURB OPENING.
13 NEW STOP SIGN, SEE R1-1 IN THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) 2009 EDITION.
14 NEW REMOVEABLE BOLLARD.
15 NEW CONCRETE PAD WITH 9 SLOT BICYCLE RACKS.
16 NEW CONCRETE PAD WITH 11 SLOT BICYCLE RACK.
17 NEW TRUNCATED DOMES.
18 NEW PRECAST WHEEL STOP.
19 NEW CHAINLINK FENCE.
20 NEW PERSONNEL GATE.
21 NEW SWING GATE.
22 NEW CONCRETE DUMPSTER PAD.
23 NEW DUMPSTER ENCLOSURE.
24 NEW BIORETENTION AREA.
25 NEW 8 ft. WIDE CONCRETE PAVEMENT (FIRE LANE).
26 NEW CONCRETE PAD FOR BOLLARD STORAGE.
27 NEW LIGHT DUTY HOT MIX ASPHALT PAVEMENT OR PERMEABLE PAVEMENT.
28 NEW HEAVY DUTY HOT MIX ASPHALT PAVEMENT.
29 NEW 6" WHITE CROSSWALK PAVEMENT MARKING.
30 NEW HANDICAP ACCESS RAMP.
31 NEW CONCRETE PAVEMENT (FIRE LANE).
32 NEW SOFTBALL FIELD (OPTION - ITEM NO. 0007)
33 NEW GRASS STRIP.

SITE PLAN KEY MAP



US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

SYMBOL	DESCRIPTION	DATE	APPR.
	REVISIONS		

DESIGNED BY: B. DORSCH
DRAWN BY: B.DORSCH
CHECKED BY: J. TOE
AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT

DATE: AUGUST 2011
SCALE: 1" = 20 FEET
DRAWING CODE: F-740-28-04
DATE

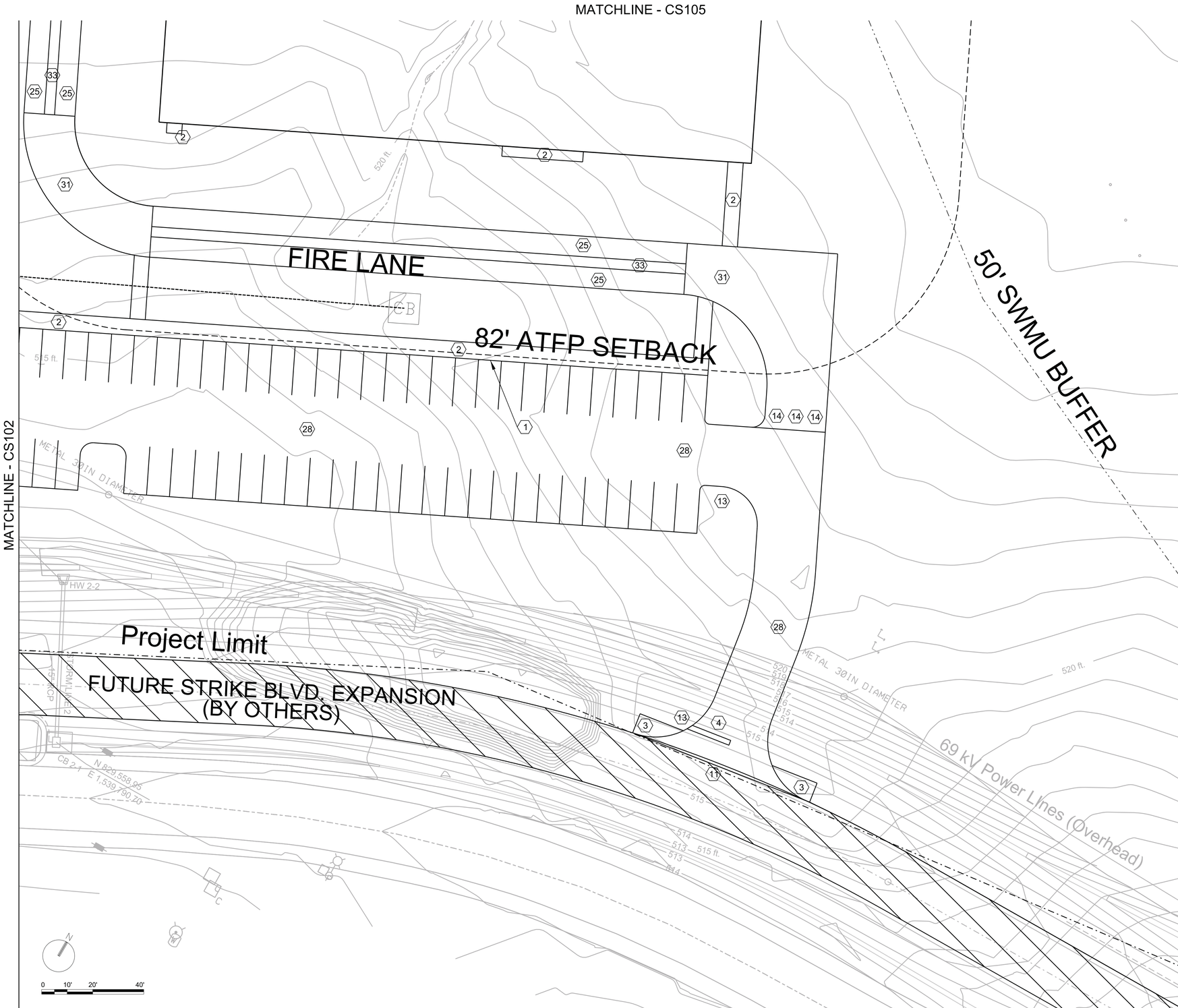
U.S. ARMY ENGINEER DISTRICT
LOUISVILLE, KENTUCKY

FY 2012 P.N. 65147 P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

CONCEPTUAL
SITE PLAN
SHEET 1 OF 8

SHEET REFERENCE NUMBER:
CS102
SHEET 11 OF 21

READY TO ADVERTISE



GENERAL SHEET NOTES

1. FIRE LANE SHALL BE A MINIMUM OF 20 FEET WIDE.

SHEET KEYNOTES

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2 NEW CONCRETE SIDEWALK (6 FOOT UNLESS INDICATED OTHERWISE).
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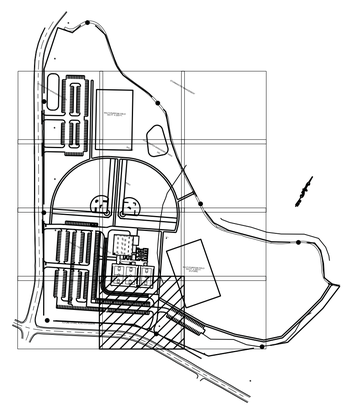
31 NEW CONCRETE PAVEMENT (FIRE LANE).
32 NEW SOFTBALL FIELD (OPTION - ITEM NO. 0007)
33 NEW GRASS STRIP.

SITE PLAN KEY MAP



US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

SYMBOL	REVISIONS DESCRIPTION	DATE	APPR.

DESIGNED BY: B. DORSCH
DRAWN BY: B.DORSCH
CHECKED BY: J. TOE
AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT
DATE: AUGUST 2011
SCALE: 1" = 20 FEET
DRAWING CODE: F-740-28-04
DATE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

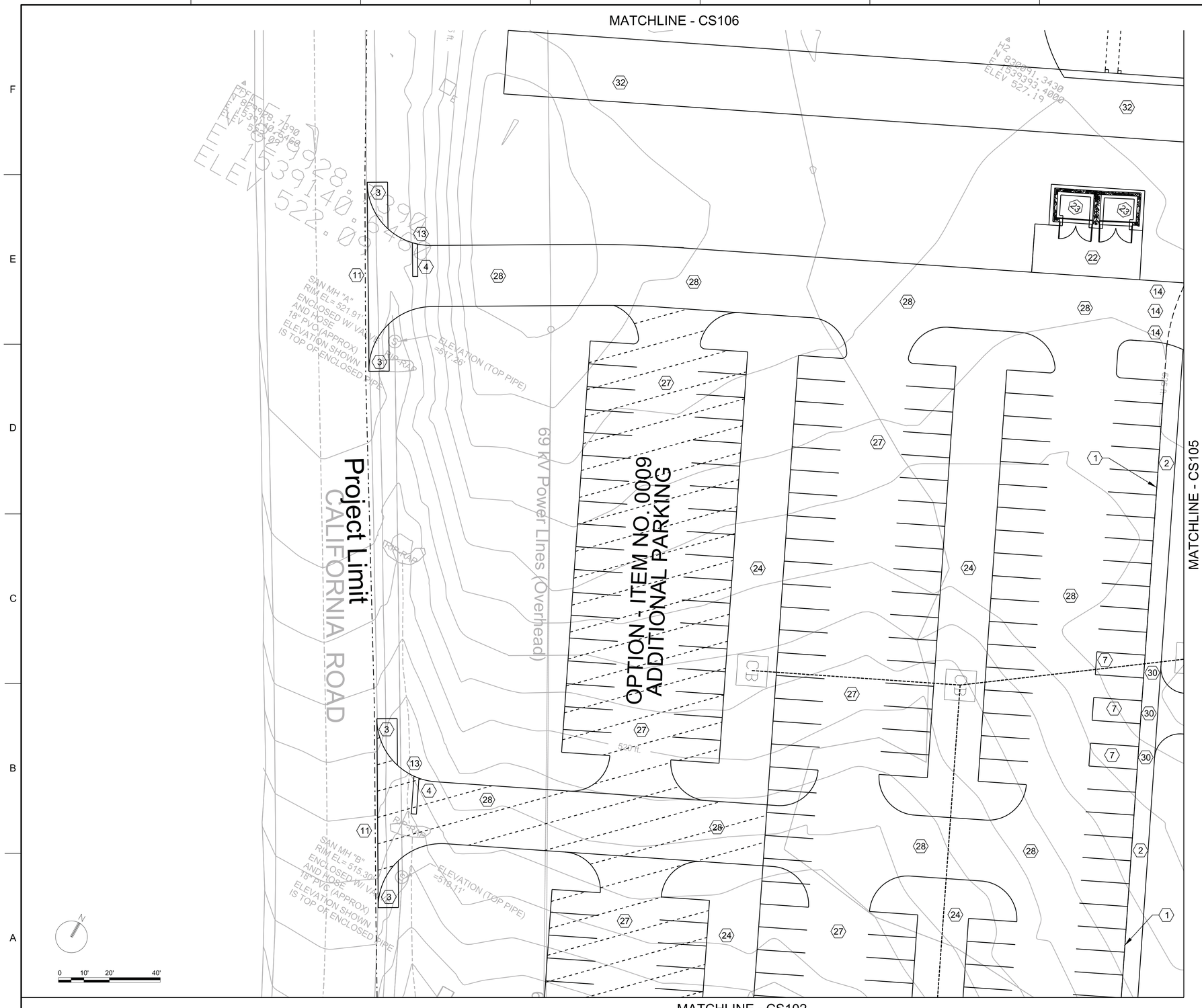
FY 2012 P.N. 65147 P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

CONCEPTUAL
SITE PLAN
SHEET 2 OF 8

SHEET REFERENCE NUMBER:
CS103

SHEET 12 OF 21

READY TO ADVERTISE



GENERAL SHEET NOTES

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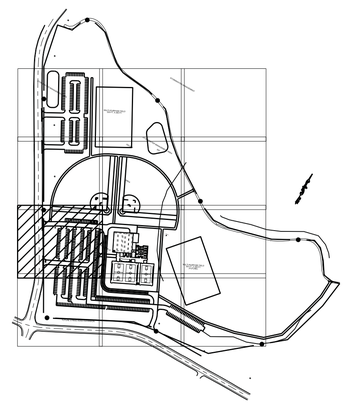
30 NEW HANDICAP ACCESS RAMP.
31 NEW CONCRETE PAVEMENT (FIRE LANE).
32 NEW SOFTBALL FIELD (OPTION - ITEM NO. 0007)
33 NEW GRASS STRIP.

SITE PLAN KEY MAP



US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

SYMBOL	DESCRIPTION	DATE	APPR.

REVISIONS

DESIGNED BY: B. DORSCH
DRAWN BY: B.DORSCH
CHECKED BY: J. TOE
AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT
DATE

DATE: AUGUST 2011
SCALE: 1" = 20 FEET
DRAWING CODE: F-740-28-04
DATE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

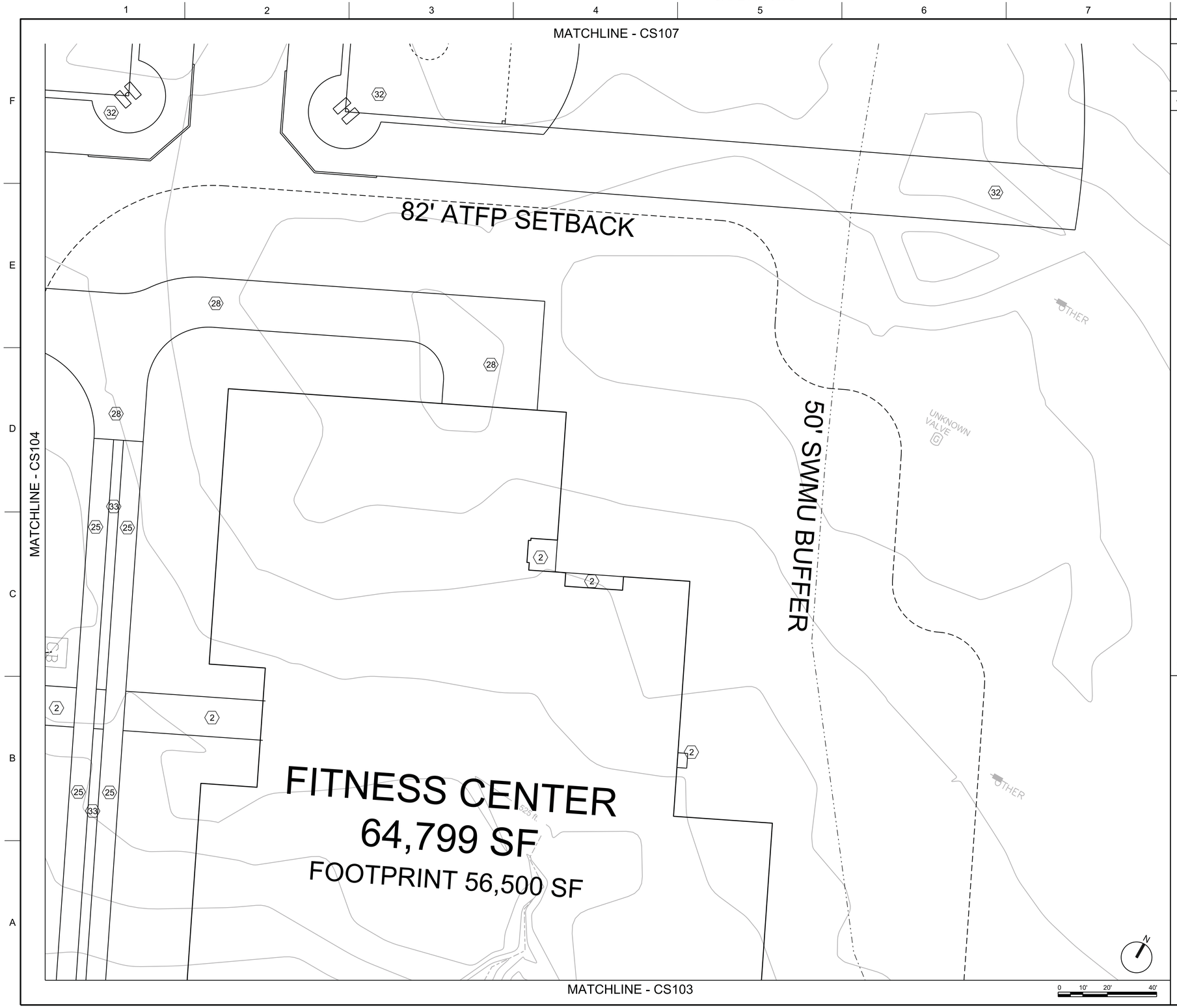
FY 2012 P.N. 65147 P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

CONCEPTUAL
SITE PLAN
SHEET 3 OF 8

SHEET REFERENCE NUMBER:
CS104
SHEET 13 OF 21

READY TO ADVERTISE

FILE: IP_PWP:dms24949\146364_CS104xxx.dgn
DATE: 14-OCT-2011 10:08



GENERAL SHEET NOTES

1. FIRE LANE SHALL BE A MINIMUM OF 20 FEET WIDE.

SHEET KEYNOTES

1 NEW CONCRETE HEADER CURB.
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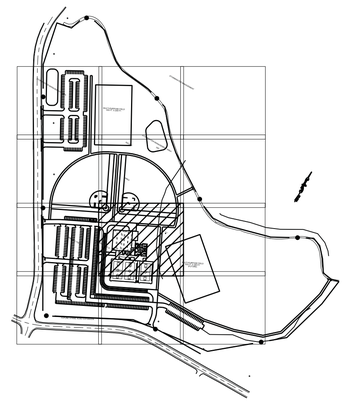
33 NEW GRASS STRIP.

SITE PLAN KEY MAP



US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

REVISIONS

SYMBOL	DESCRIPTION	DATE	APPR.

DESIGNED BY: B. DORSCH
DRAWN BY: B.DORSCH
CHECKED BY: J. TOE
DATE: AUGUST 2011
SCALE: 1" = 20 FEET
DRAWING CODE: F-740-28-04

AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT DATE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

FY 2012 P.N. 65147 P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

CONCEPTUAL
SITE PLAN
SHEET 4 OF 8

SHEET REFERENCE NUMBER:
CS105
SHEET 14 OF 21

READY TO ADVERTISE

FILE: IP_PWP:dms24949\146364_CS105xxx.dgn
DATE: 14-OCT-2011 10:08

MATCHLINE - CS108

OPTION - ITEM NO. 0009
ADDITIONAL PARKING

RIP-RAP

RIP-RAP

CALIFORNIA ROAD

Project Limit

69 kV Power Lines (Overhead)

OPTION - ITEM NO. 0007
300' SOFTBALL FIELD

MATCHLINE - CS107

MATCHLINE - CS104

0 10' 20' 40'

GENERAL SHEET NOTES

1. PAVEMENT MARKINGS, STREET SIGNS, GRADING AND DRAINAGE NECESSARY TO COMPLETE THE OPTION SHALL BE CONSIDERED INCIDENTAL TO THE OPTION.

SHEET KEYNOTES

1 NEW CONCRETE HEADER CURB.
2 NEW CONCRETE SIDEWALK (6 FOOT UNLESS INDICATED OTHERWISE).
3 NEW GRAVEL SHOULDER, 6" KY DGA.
4 NEW 12" WHITE STOP BAR PAVEMENT MARKING.
5 NEW 4" WHITE PAVEMENT MARKING.
6 NEW 4" YELLOW PAVEMENT MARKING.
7 NEW NO PARKING AREA STRIPING (WHITE).
8 NEW RESERVED PAVEMENT MARKING FOR LOW EMITTING AND FUEL EFFICIENT VEHICLES (WHITE).
9 NEW RESERVED PAVEMENT MARKING FOR CARPOOL/VANPOOL (WHITE)
10 NEW HANDICAP PARKING STALL.
11 TIE TO EXISTING PAVEMENT.
12 NEW 2' CURB OPENING.
13 NEW STOP SIGN, SEE R1-1 IN THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) 2009 EDITION.
14 NEW REMOVEABLE BOLLARD.
15 NEW CONCRETE PAD WITH 9 SLOT BICYCLE RACKS.
16 NEW CONCRETE PAD WITH 11 SLOT BICYCLE RACK.
17 NEW TRUNCATED DOMES.
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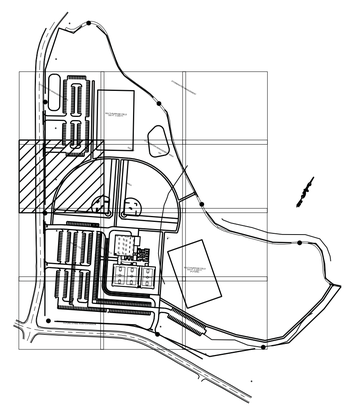
21 NEW SWING GATE.
22 NEW CONCRETE DUMPSTER PAD.
23 NEW DUMPSTER ENCLOSURE.
24 NEW BIORETENTION AREA.
25 NEW 8 ft. WIDE CONCRETE PAVEMENT (FIRE LANE).
26 NEW CONCRETE PAD FOR BOLLARD STORAGE.
27 NEW LIGHT DUTY HOT MIX ASPHALT PAVEMENT OR PERMEABLE PAVEMENT.
28 NEW HEAVY DUTY HOT MIX ASPHALT PAVEMENT.
29 NEW 6" WHITE CROSSWALK PAVEMENT MARKING.
30 NEW HANDICAP ACCESS RAMP.
31 NEW CONCRETE PAVEMENT (FIRE LANE).
32 NEW SOFTBALL FIELD (OPTION - ITEM NO. 0007)
33 NEW GRASS STRIP.

SITE PLAN KEY MAP



US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

REVISIONS DESCRIPTION	DATE	APPR.
SYMBOL		

DESIGNED BY: B. DORSCH
DRAWN BY: B.DORSCH
CHECKED BY: J. TOE
DATE: AUGUST 2011
SCALE: 1" = 20 FEET
DRAWING CODE: F-740-28-04
AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT
DATE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

FY 2012 P.N. 651447 P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

CONCEPTUAL
SITE PLAN
SHEET 5 OF 8

SHEET REFERENCE NUMBER:
CS106
SHEET 15 OF 21

READY TO ADVERTISE

MATCHLINE - CS109

MULTIPURPOSE FIELD
360 FT X 200 FT

STORMWATER MANAGEMENT AREA

Project Limit

50' SWMU BUFFER

300'
Baseball
Field

MATCHLINE - CS106

OPTION - ITEM NO. 0007
300' SOFTBALL FIELD

MATCHLINE - CS105

0 10' 20' 40'

GENERAL SHEET NOTES

1. NONE

SHEET KEYNOTES

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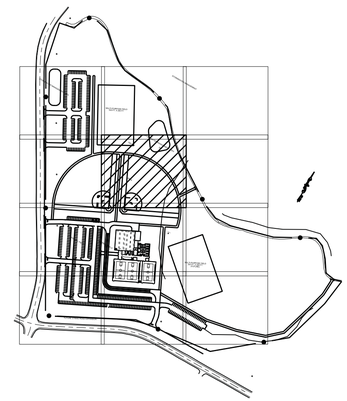
SITE PLAN KEY MAP



US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

REVISIONS			
SYMBOL	DESCRIPTION	DATE	APPR.

DESIGNED BY: B. DORSCH
DRAWN BY: B.DORSCH
CHECKED BY: J. TOE
AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT DATE

DATE: AUGUST 2011
SCALE: 1" = 20 FEET
DRAWING CODE: F-740-28-04

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

FY 2012 P.N. 65147 P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

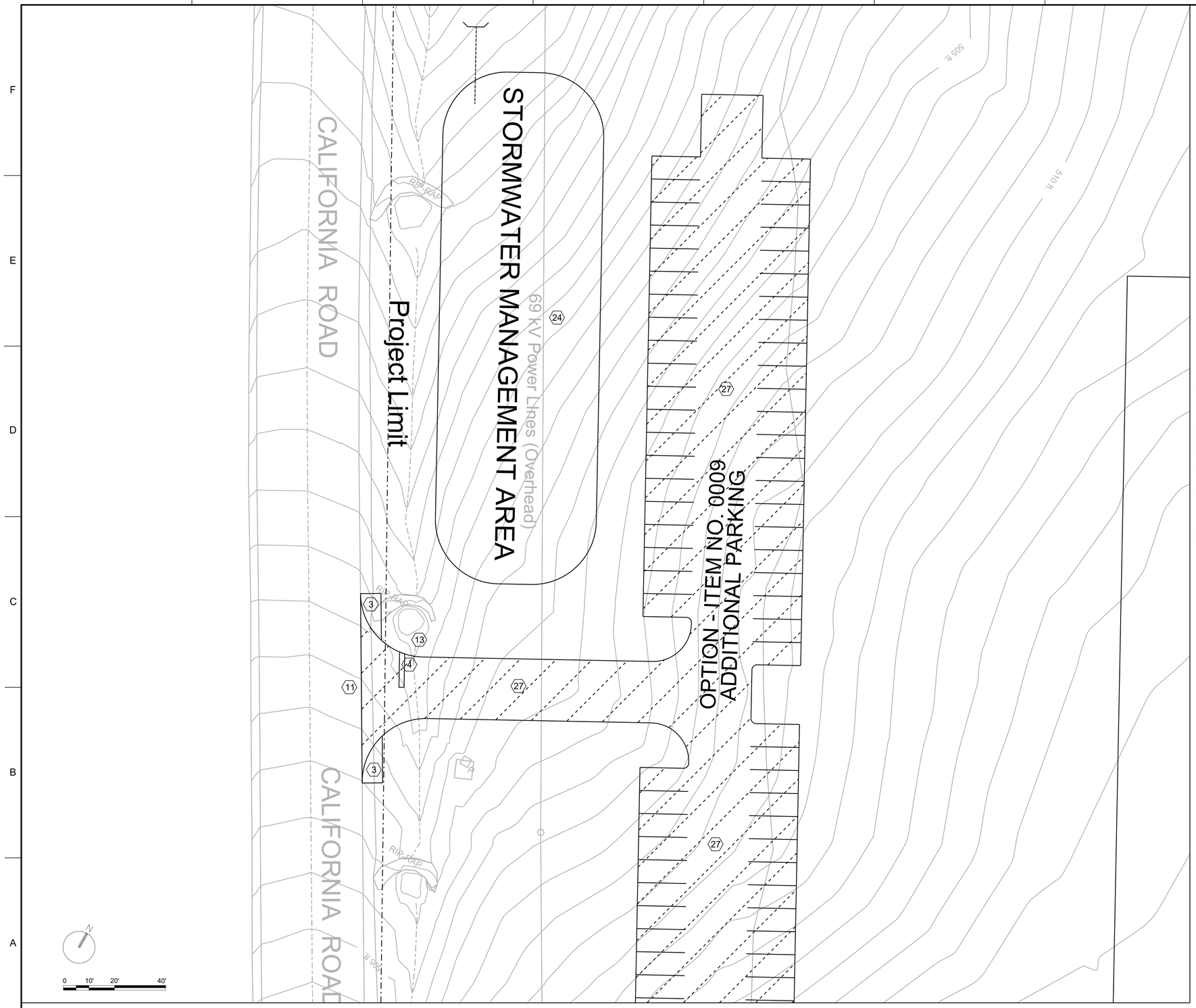
CONCEPTUAL
SITE PLAN
SHEET 6 OF 8

SHEET REFERENCE NUMBER:
CS107

SHEET 16 OF 21

READY TO ADVERTISE

FILE: IP_PWP:dms24949\146364_CS107xxx.dgn
DATE: 14-OCT-2011 10:09



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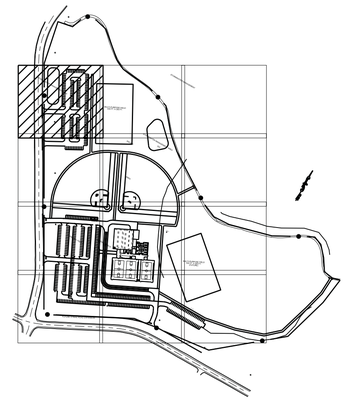


US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

SYMBOL	DESCRIPTION	DATE	APPR.
	REVISIONS		

DATE: AUGUST 2011
SCALE: 1" = 20 FEET
DRAWING CODE: F-740-28-04

DESIGNED BY: B. DORSCH
DRAWN BY: B.DORSCH
CHECKED BY: J. TOE
AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

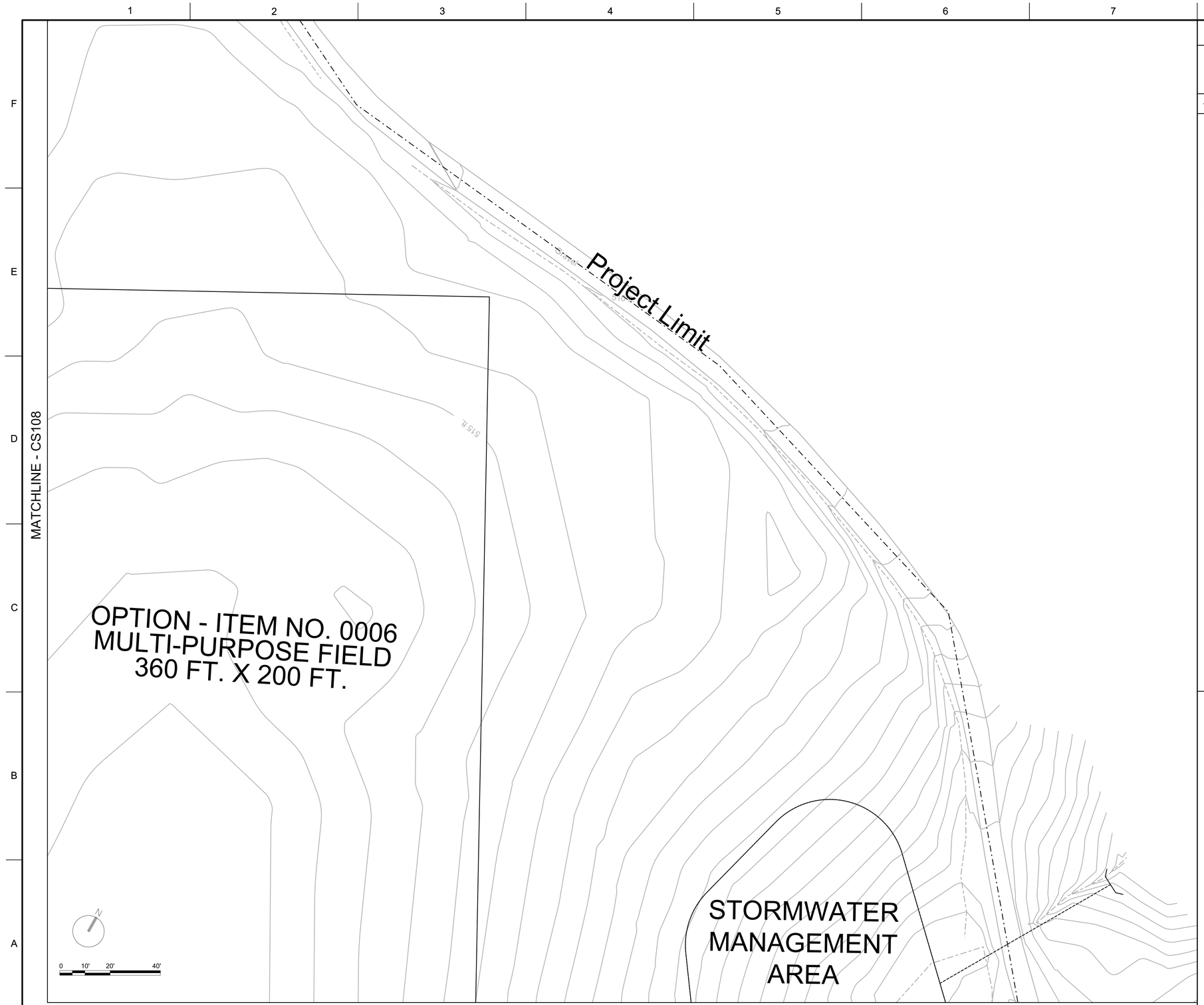
FY 2012 P.N. 65147 P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

CONCEPTUAL
SITE PLAN
SHEET 7 OF 8

SHEET REFERENCE NUMBER:
CS108
SHEET 17 OF 21

READY TO ADVERTISE

FILE: IP_PWP:dms24949\146364_CS108xxx.dgn
DATE: 14-OCT-2011 10:09



GENERAL SHEET NOTES

1. NONE

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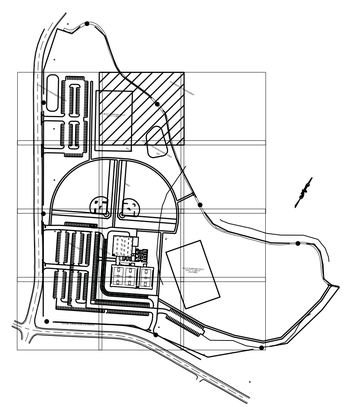
SITE PLAN KEY MAP



US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

SYMBOL	REVISIONS DESCRIPTION	DATE	APPR.

DESIGNED BY: B. DORSCH
DRAWN BY: B.DORSCH
CHECKED BY: J. TOE
AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT DATE

DATE: AUGUST 2011
SCALE: 1" = 20 FEET
DRAWING CODE: F-740-28-04

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

FY 2012 P.N. 65147 P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

CONCEPTUAL
SITE PLAN
SHEET 8 OF 8

SHEET REFERENCE NUMBER:
CS109
SHEET 18 OF 21

READY TO ADVERTISE

GENERAL NOTES

1. ANY LIGHT POLES LOCATED IN BIORETENTION AREAS WILL REQUIRE LARGER, DEEPER FOUNDATIONS AND COORDINATION WITH STRUCTURAL ENGINEER.

SHEET KEYNOTES

1. SITE BOUNDARY
2. EXISTING GRAVEL TRAIL
3. FIRE ACCESS LANE
4. ADDITIONAL PARKING (OPTION - ITEM NO. 0009)
5. EXISTING SOLID WASTE MANAGEMENT UNIT (SWMU#11)
6. EXISTING 69 kV OVERHEAD POWER LINE
7. MAIN BUILDING ENTRANCE
8. BUILDING SERVICE ENTRANCE
9. EXISTING SANITARY FORCE MAIN (DO NOT DISTURB)
10. NEW GRAVITY SANITARY SEWER
11. STRIKE BOULEVARD EXPANSION (BY OTHERS)
12. WATER AND FIRE CONNECTION TO EXISTING 12" PVC WATER MAIN
13. NEW FIRE WATER SERVICE
14. NEW POTABLE WATER SERVICE
15. NEW GAS SERVICE
16. GAS SERVICE CONNECTION TO EXISTING 6" PLASTIC GAS MAIN
17. SANITARY SERVICE CONNECTION AT EXISTING MANHOLE
18. NEW COMMUNICATION DUCT BANK
19. COMMUNICATION LINE CONNECTION IN EXISTING MANHOLE
20. NEW ELECTRIC DUCT BANK
21. ELECTRIC CONNECTION IN EXISTING MANHOLE
22. NEW ELECTRIC MANHOLE
23. COMCAST POINT OF SERVICE (TIE POINT).
24. COMCAST DEMARK POINT TO FACILITY
    2" SCHEDULE 40 CONDUIT TO FACILITY.
25. 4" SCHEDULE 40 CONDUIT BETWEEN COMCAST POINT OF SERVICE (TIE POINT) AND COMCAST DEMARK POINT TO FACILITY.

A1 OVERALL CONCEPTUAL UTILITY PLAN

1" = 100'

0 100' 200'

US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

REVISIONS DESCRIPTION	DATE	APPR.

DESIGNED BY: B. DORSCH / B. SMITH	DATE: AUGUST 2011
DRAWN BY: B. DORSCH / B. SMITH	SCALE: 1" = 100 FEET
CHECKED BY: J. TOE / V. NGUYEN	DRAWING CODE: F-740-28-04
AMANDA HARDAWAY PROJECT ENGINEER/ARCHITECT	DATE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

FY 2012 P.N. 65147 PZ#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

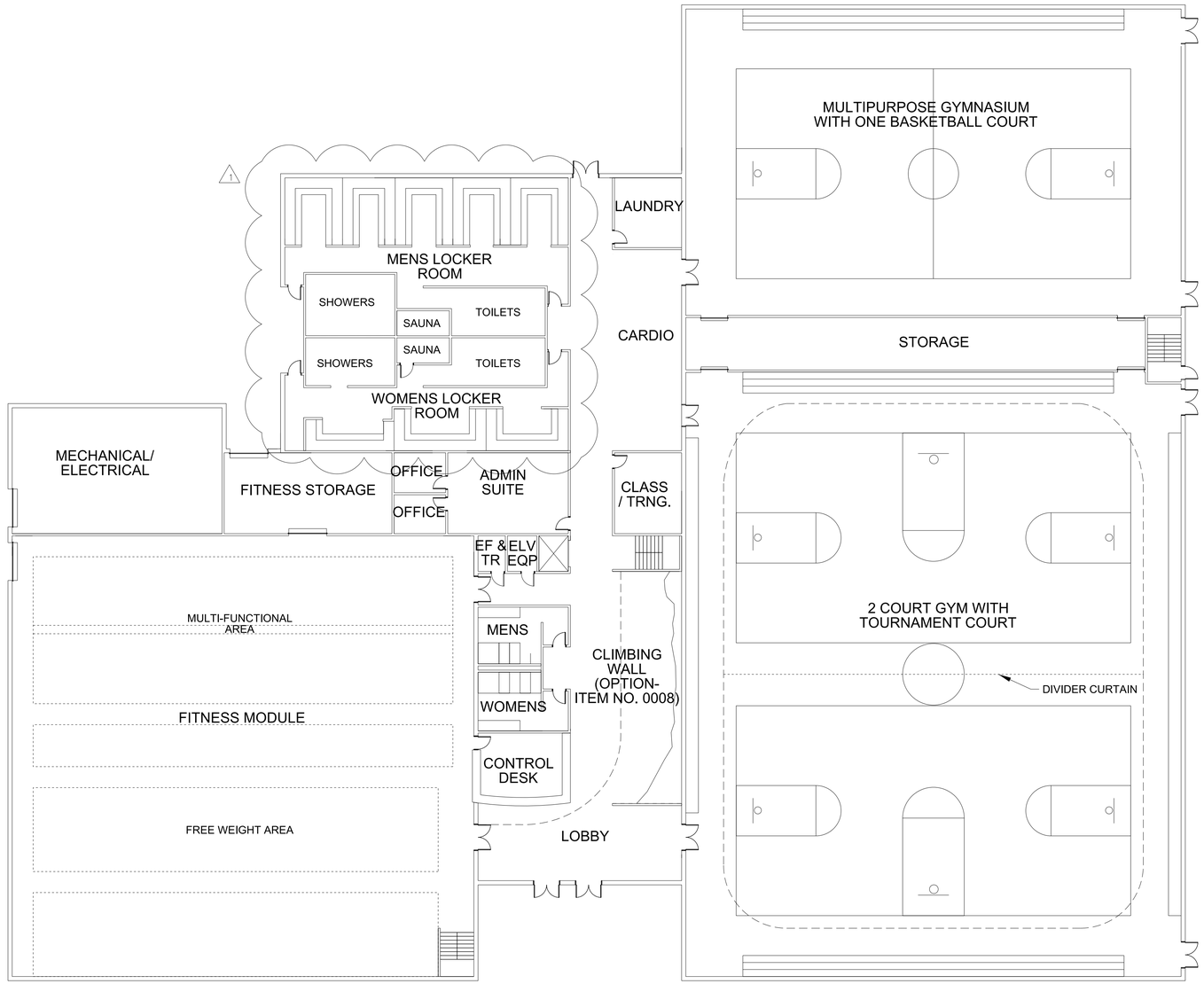
OVERALL CONCEPTUAL UTILITY PLAN

SHEET REFERENCE NUMBER:
UT101

SHEET 19 OF 21

READY TO ADVERTISE

FILE: IP_PWP:dms24949\146364_UT101xxx.dgn
DATE: 14-OCT-2011 10:09



A1 FIRST FLOOR CONCEPTUAL LAYOUT
1/16" = 1'-0"

GENERAL NOTES:

1. CONCEPTUAL LAYOUTS AS SHOWN ARE DIAGRAMS OF THE FUNCTIONAL RELATIONSHIPS AND ARE FOR REFERENCE ONLY. THESE DIAGRAMS HAVE BEEN CREATED TO REPRESENT THE USERS' PREFERED ADJACENCIES OF THE PROGRAMMED FUNCTIONAL SPACE.
2. THE CURRENT SPACE ARRANGEMENT SHOWN IS BASED ON ALLOWABLE SQUARE FOOTAGE OF 66,095 SF (WITH AN ADDITIONAL 5,946 SF OF INDOOR RUNNING TRACK)
3. THE FLOOR PLAN SHALL BE CREATED TO BE FLEXIBLE AND OPEN AS POSSIBLE. THE PFF SPACE TYPES SHOULD PROVIDE A COMPREHENSIVE, VARIED PROGRAM OF PHYSICAL ACTIVITIES TO MEET THE INDIVIDUAL TRAINING REGIMENS, AS WELL AS THE TRAINING NEEDS OF THE GARRISON.
4. SEE SECTION 01 10 00 FOR THE TECHNICAL AND FUNCTIONAL DESIGN CRITERIA OF THE INDIVIDUAL SPACES.

US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

REVISIONS

SYMBOL	DESCRIPTION	DATE	APPR.
1	AMDT 0002 - REMOVED SWING SPACE FROM LOCKER ROOM LAYOUT.		
	AMDT 0002 - REMOVED DIMENSIONS.		
	AMDT 0002 - ADDED GENERAL NOTE 4.		
	AMDT 0002 - REVISED ALLOWABLE SQUARE FOOTAGE		

DESIGNED BY:
DRAWN BY:
CHECKED BY:
DATE: AUGUST 2011
SCALE: 1/16" = 1'-0"
DRAWING CODE: F-740-28-04
AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT DATE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

FY 2012 P.N. 65147 P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

FIRST FLOOR
CONCEPTUAL LAYOUT

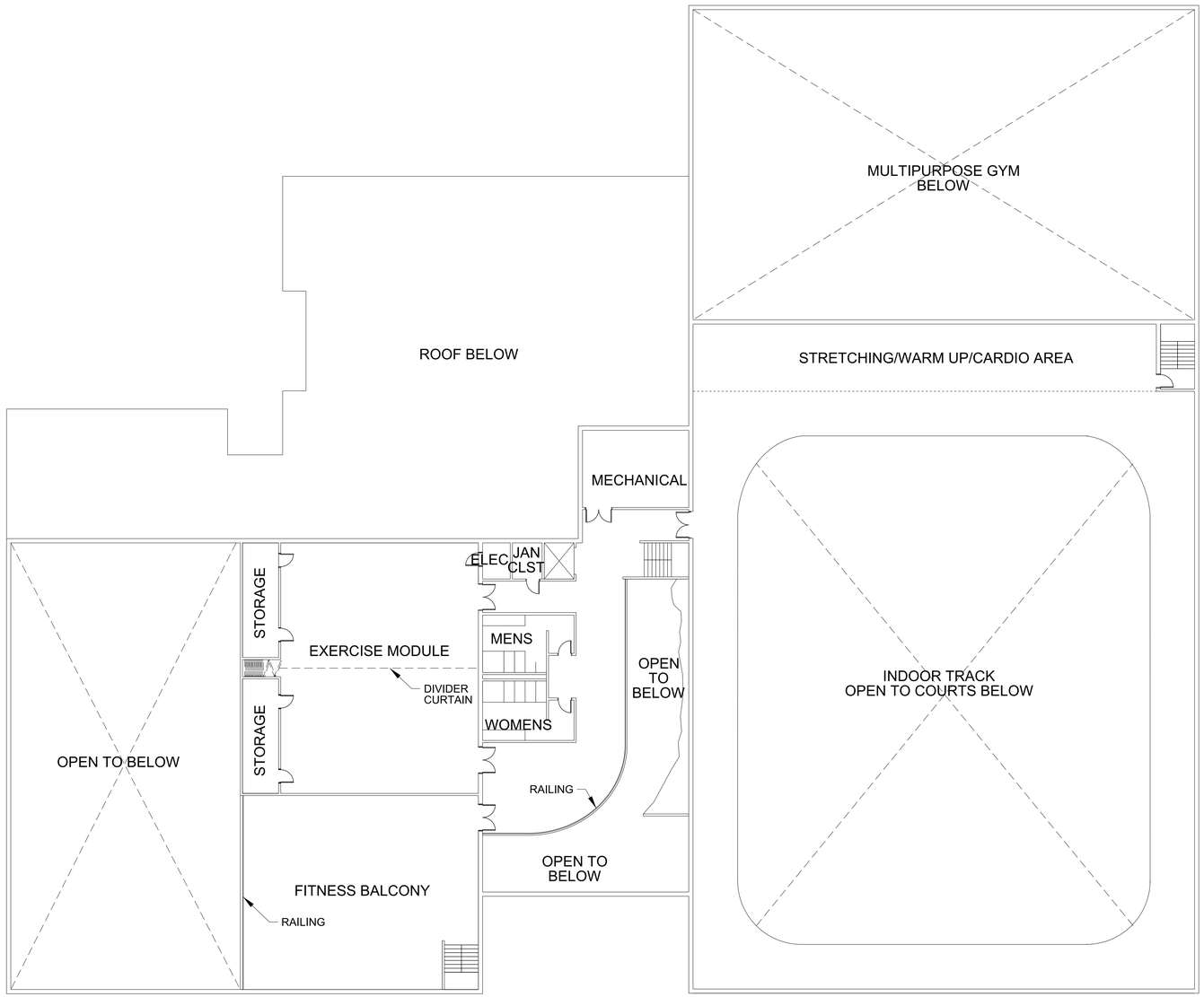
SHEET REFERENCE NUMBER:
A101
SHEET 20 OF 21

READY TO ADVERTISE

FILE: $$$PATHNAME
DATE: $$$DATETIME

*** SUPPORT VALUE ENGINEERING - IT PAYS ***

Wednesday, December 21, 2011



A1 SECOND FLOOR CONCEPTUAL LAYOUT 1

1/16" = 1'-0"

0 8' 16' 32'

GENERAL NOTES:

1. CONCEPTUAL LAYOUTS AS SHOWN ARE DIAGRAMS OF THE FUNCTIONAL RELATIONSHIPS AND ARE FOR REFERENCE ONLY. THESE DIAGRAMS HAVE BEEN CREATED TO REPRESENT THE USERS' PREFERED ADJACENCIES OF THE PROGRAMMED FUNCTIONAL SPACE.
2. THE CURRENT SPACE ARRANGEMENT SHOWN IS BASED ON ALLOWABLE SQUARE FOOTAGE OF 66,095 SF (WITH AN ADDITIONAL 5,946 SF OF INDOOR RUNNING TRACK)
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US ARMY CORPS OF ENGINEERS
SAVANNAH DISTRICT

REVISIONS

SYMBOL	DESCRIPTION	DATE	APPR.
1	AMDT 0002 - REMOVED DIMENSIONS. AMDT 0002 - ADDED GENERAL NOTE 4. AMDT 0002 - REVISED ALLOWABLE SQUARE FOOTAGE		

DATE: AUGUST 2011
SCALE: 1/16" = 1'-0"
DRAWING CODE: F-740-28-04

DESIGNED BY:
DRAWN BY:
CHECKED BY:

AMANDA HARDAWAY
PROJECT ENGINEER/ARCHITECT DATE

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

FY 2012 P.N. 65147 P2#146364
PHYSICAL FITNESS COMPLEX
CLARKSVILLE BASE
FT. CAMPBELL, KY/TN

SECOND FLOOR
CONCEPTUAL LAYOUT

SHEET REFERENCE NUMBER:
A102
SHEET 21 OF 21

READY TO ADVERTISE 1

APPENDIX K

FUEL COST INFORMATION

APPENDIX K
Fuel Cost Information

The following utility rates for this installation are provided for design

Electrical:
Demand Charge - $18.24 per kilowatt

Energy Charge - $ .0307 per kilowatt-hour Blended Rate - $ .0696 per kilowatt-hour (blended annual energy and demand cost)

Natural Gas:
Commodity Charge Rate - $ 6.84 per thousand cubic feet

Water:
Commodity Charge Rate - $3.00 per [volume]

Sewer:
Commodity Charge Rate - $3.00 per [volume]

APPENDIX L

LEED PROJECT CREDIT GUIDANCE

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, LOUISVILLE
CORPS OF ENGINEERS
P.O. BOX 59
LOUISVILLE, KENTUCKY 40201-0059

CELRL-ED-D-A (415-10f) 31 March 2011

MEMORANDUM FOR DISTRIBUTION

SUBJECT: Physical Fitness Facility
PN 65147, FY12, P2 146364
SITE: Fort Campbell, KY
PURPOSE: LEED Project Credit Narrative

LEED Credit Checklist documentation:

1. Credits indicated as "YES" are considered attainable by the Government.
2. Credits indicated as "NO" are not permitted by DPW or are not considered attainable due to Fort Campbell constraints or non-compliance to Fort Campbell requirements.
3. All credits not identified as "YES" or "NO" are considered to be Contractor specified, thus allowing and flexibility and creative control.

\S\
Louisville District

LEED-NC Version 3.0 Project Checklist

Project Name: Physical Fitness Facility
Project Location: Fort Campbell, KY
Date: March 2011
Required Rating: Silver

Note:

Points required by RFP or provided (Includes both GOV/Infrastructure AE & Building Contractor Points) to meet Silver Rating
Possible points by GOV/Infrastructure AE or Building Contractor.
POINTS NOT AVAILABLE OR NOT ALLOWED

Yes D/B	Yes GOV	? D/B	? GOV	No	Avail	ExP			Note: Refer to LEED-NC Reference Guide for Specific Requirements for Credits & Prerequisites	Notes
0		3		3	26				**Sustainable Sites**	
Y					0		Prereq 1	C	**Construction Activity Pollution Prevention**	
									Erosion & Sedimentation Control Plan shall conform to EPA Construction General Permit (comply with NPDES)	
	1				1		Credit 1	D	**Site Selection**	
									Do not develop on the following: farmland, previously undeveloped land 5' below 100 yr flood, endangered species habitat, w/in 100' of wetlands, previously undeveloped land w/in 50' of water body & public parkland	
				1	5	+	Credit 2	D	**Development Density & Community Connectivity**	
									Previously developed site with density of 60,000 sf/acre OR within 1/2 mile of residential zone (or average density of 10 units/acre) and 10 basic services w/ pedestrian access (exemplary for 120,000 sf/acre)	
				1	1		Credit 3	D	**Brownfield Redevelopment**	
									Defined as contaminated by ASTM E1903-97 Phase II Environmental Site Assessment, local voluntary cleanup program or government agency	
					6	+	Credit 4.1	D	**Alternative Transportation**, Public Transportation Access	
									Must have pedestrian/bike access AND within 1/2 mile of light rail OR 1/4 mile of 2+ bus lines (exemplary for comprehensive plan OR 2+ light rail lines OR 4+ bus lines AND 200+ transit rides per day)	
	1				1		Credit 4.2	D	**Alternative Transportation**, Bicycle Storage & Changing Rooms	
									Bike racks for 5% of peak building users AND showers for 0.5% employees	
	3				3		Credit 4.3	D	**Alternative Transportation**, Low-Emitting and Fuel-Efficient Vehicles	
									Preferred/discounted parking for 5% parking capacity OR refueling stations for 3% parking capacity OR low-emitting/fuel-efficient vehicles for 3% FTE OR access to LEV/FEV vehicle-sharing program for 3% FTE	*Provide preferred parking for 5% total parking capacity*
			2		2		Credit 4.4	D	**Alternative Transportation**, Parking Capacity	
									Meet minimum zoning AND provide preferred parking OR 20% discount for carpools for 5% parking capacity OR provide no new parking	*Verify parking minimums as designated by military are not exceeded*
				1	1	+	Credit 5.1	C	**Site Development,** Protect or Restore Habitat	
									Greenfield : limit site disturbance (40' bldg, 10' walks/parking, 15' roads/main utilities, 25' constructed permeable surfaces); Previously Developed : native landscape for 50% (excluding building footprint) or 20% (including building footprint) of site, whichever is greater (exemplary for 75%)	*Native landscaping will be used to greatest extent possible, but not expected to exceed 50% of site*
	1				1	+	Credit 5.2	D	**Site Development,** Maximize Open Space	
									Exceed zoning by 25% OR equal to building footprint if no zoning OR 20% of site if no open space required by zoning (exemplary for double)	
		1			1	+	Credit 6.1	D	**Stormwater Design,** Quantity Control	
									Existing imperviousness less than 50% : post-development rate and quantity less than pre-development OR stream channel protection; Existing imperviousness greater than 50% : decrease runoff by 25%	
		1			1	+	Credit 6.2	D	**Stormwater Design,** Quality Control	
									Use BMPs to capture & treat 90% avg annual rainfall and remove 80% TSS	
		1			1	+	Credit 7.1	C	**Heat Island Effect,** Non-Roof	
									50% hardscape shaded OR pavement with SRI 29+ OR open grid paving OR 50% parking covered by material with SRI 29+ (exemplary for 100%)	
					1	+	Credit 7.2	D	**Heat Island Effect,** Roof	
									75% of roof SRI 78+ for low-slope (≤2:12) / SRI 29+ for steep-slope OR 50% vegetated roof OR combination (exemplary for 100% vegetated roof)	
					1		Credit 8	D	**Light Pollution Reduction**	
									Limit light trespass from interior, exterior lighting power density to meet ASHRAE 90.1-2007, reduce sky-glow and light trespass at project boundary	

Yes D/B	Yes GOV	? D/B	? GOV	No	Avail	ExP				
0		0		0	10				**Water Efficiency**	
Y					0		Prereq 1	D	**Water Use Reduction**, 20% Reduction	
									Reduction based on EPAct 2005 baseline - fixture type and controls (wc: 1.6 gpf; urinals: 1.0 gpf; public lavs: 0.5 gpm; private lavs, kitchen & janitor sinks: 2.2 gpm; showers: 2.5 gpm) AND/OR non-potable water use	
	4				4		Credit 1	D	**Water Efficient Landscaping,** 50% (2 pts) or No Potable/No Irrigation (4 pts)	
									Reduce potable water use for irrigation by plant species selection and irrigation efficiency AND/OR use of captured rainwater, recycled wastewater/greywater or non-potable public water system OR install landscaping that requires no permanent irrigation system	*No irrigation to be provided*
					2	+	Credit 2	D	**Innovative Wastewater Technologies**	
									Reduce potable water use by 50% for sewage conveyance through fixture type/non-potable water use OR treat/infiltrate 50% wastewater on-site (exemplary: 100% reduction in potable water use OR 100% reuse/infiltration)	
	2				4	+	Credit 3	D	**Water Use Reduction**, 30% (2 pts), 35% (3 pts) or 40% (4 pts)	
									Reduction based on EPAct 2005 baseline - fixture type and controls AND/OR non-potable water use (exemplary for 45%)	

Yes D/B	Yes GOV	? D/B	? GOV	No	Avail	ExP			
0	2	0	0	2	35		**Energy & Atmosphere**		
Y					0		Prereq 1	C	**Fundamental Commissioning of the Building Energy Systems**
							CxA to review OPR and BOD, develop/incorporate commissioning requirements into construction documents, develop/implement commissioning plan, verify installation/performance of systems to be commissioned AND complete summary commissioning report		
Y					0		Prereq 2	D	**Minimum Energy Performance**
							10% improvement for new buildings (5% for renovations) based on ASHRAE 90.1-2007 baseline (building envelope, HVAC, lighting, etc.) OR Prescriptive Compliance Path by ASHRAE Advanced Energy Design Guide or Advanced Buildings Core Performance Guide		
Y					0		Prereq 3	D	**Fundamental Refrigerant Management**
							Zero CFC-based refrigerants OR phase-out plan for existing equipment		
					19	+	Credit 1	D	**Optimize Energy Performance**
							Improve proposed building performance compared to ASHRAE 90.1-2007 baseline by whole building simulation OR Prescriptive Compliance Path by ASHRAE Advanced Energy Design Guide (1 pt max) or Advanced Buildings Core Performance Guide (1-3 pts max)		
							☐ *12% New Buildings or 8% Existing Building Renovations*		
							☐ *14% New Buildings or 10% Existing Building Renovations*		
							☐ *16% New Buildings or 12% Existing Building Renovations*		
							☐ *18% New Buildings or 14% Existing Building Renovations*		
							☐ *20% New Buildings or 16% Existing Building Renovations*		
							☐ *22% New Buildings or 18% Existing Building Renovations*		
							☐ *24% New Buildings or 20% Existing Building Renovations*		
							☐ *26% New Buildings or 22% Existing Building Renovations*		
							☐ *28% New Buildings or 24% Existing Building Renovations*		
							☐ *30% New Buildings or 26% Existing Building Renovations*		
							☐ *32% New Buildings or 28% Existing Building Renovations*		
							☐ *34% New Buildings or 30% Existing Building Renovations*		
							☐ *36% New Buildings or 32% Existing Building Renovations*		
							☐ *38% New Buildings or 34% Existing Building Renovations*		
							☐ *40% New Buildings or 36% Existing Building Renovations*		
							☐ *42% New Buildings or 38% Existing Building Renovations*		
							☐ *44% New Buildings or 40% Existing Building Renovations*		
							☐ *46% New Buildings or 42% Existing Building Renovations*		
							☐ *48% New Buildings or 44% Existing Building Renovations*		
					7	+	Credit 2	D	**On-Site Renewable Energy**
							Based on annual building energy cost as calculated in EA Credit 1 - consider solar, wind, geothermal, hydro, biomass, bio-gas, etc. (exemplary for 15%)		
							☐ *1% On-Site Renewable Energy*		
							☐ *3% On-Site Renewable Energy*		
							☐ *5% On-Site Renewable Energy*		
							☐ *7% On-Site Renewable Energy*		
							☐ *9% On-Site Renewable Energy*		
							☐ *11% On-Site Renewable Energy*		
							☐ *13% On-Site Renewable Energy*		
	2				2	+	Credit 3	C	**Enhanced Commissioning**
							In addition to EAp1 : CxA to review design documents prior to mid-construction document phase, review contractor submittals, develop systems manual for O&M staff, verify training for O&M staff & occupants AND review building operation within 10 months after substantial completion		
					2		Credit 4	D	**Enhanced Refrigerant Management**
							No refrigerants OR requires calculation of refrigerant ozone depletion and global warming potentials ($LCGWP + LCODP \times 10^5 \leq 100$)		
					3		Credit 5	C	**Measurement & Verification**
							Requires M&V Plan to monitor and evaluate building and/or energy systems performance for minimum 1 year post-construction occupancy AND corrective action plan if results show savings are not being achieved		
				2	2	+	Credit 6	C	**Green Power**
							Provide 35% of building's electricity use (from EA Credit 1) through two-year renewable energy contract (exemplary for 70% or four-year contract)		

Yes D/B	Yes GOV	? D/B	? GOV	No	Avail	ExP			
0	2	0	0	0	14		**Materials & Resources**		
Y					0		Prereq 1	D	**Storage & Collection of Recyclables** *Include area to collect and store recyclables including paper, corrugated cardboard, glass, plastics AND metals*
					3		Credit 1.1	C	**Building Reuse-Structure:** Maintain Existing Walls, Floors & Roof *Maintain existing structure (structural floor and roof decking) and envelope (exterior skin and framing, excluding window assemblies and non-structural roofing) - if project includes an addition over 2x the sf of existing building, credit is not applicable (55%=1 pt, 75%=2 pts, 95%=3 pts)*
					1		Credit 1.2	C	**Building Reuse-Interior:** Maintain 50% of Non-Structural Elements *Includes int. walls, doors, floor coverings, clg systems, etc. - if project includes addition over 2x the sf of existing building, credit is not applicable*
	2				2	+	Credit 2	C	**Construction Waste Management**, Divert 50% (1 pt), 75% (2 pts) *Recycle or salvage construction and demolition debris - calculations based on weight or volume but must be consistent (exemplary for 95%)*
					2	+	Credit 3	C	**Materials Reuse**, 5% (1 pt), 10% (2 pts) *Salvaged, refurbished or reused materials - calculations based on total materials cost for Div. 3-10 (exemplary for 15%)*
					2	+	Credit 4	C	**Recycled Content**, 10% (1 pt), 20% (2 pts) *Recycled content = post-consumer + 1/2 pre-consumer : consider steel, concrete, gypsum, carpet, acoustic ceiling tiles, etc. - calculations based on total materials cost for Div. 3-10 (exemplary for 30%)*
					2	+	Credit 5	C	**Regional Materials**, 10% (1 pt), 20% (2 pts) *Use products extracted, harvested or recovered, processed AND manufactured within 500 miles of project site - calculations based on total materials cost for Div. 3-10 (exemplary for 30%)*
					1	+	Credit 6	C	**Rapidly Renewable Materials**, 2.5% *Use products made from plants typically harvested within ten-year cycle or shorter - consider bamboo, wool, cotton insulation, agrifiber, linoleum, wheatboard, strawboard, cork, etc. (exemplary for 5%)*
					1	+	Credit 7	C	**Certified Wood** *Minimum 50% of wood must be FSC certified - based on total wood material cost only (exemplary for 95%)*

Yes D/B	Yes GOV	? D/B	? GOV	No	Avail	ExP			
0	1	0	0	0	15		**Indoor Environmental Quality**		
Y					0		Prereq 1	D	**Minimum IAQ Performance** *Meet ASHRAE 62.1-2007 minimum outdoor air ventilation rates*
Y					0		Prereq 2	D	**Environmental Tobacco Smoke** (ETS) **Control** *No smoking in building or within 25' of all entries, outdoor air intakes and operable windows OR separate designated smoking rooms with direct outside exhaust, deck-to-deck partitions and negative pressure*
					1		Credit 1	D	**Outdoor Air Delivery Monitoring** *CO2 sensors (in spaces with greater than 25 people per 1000 sf / less than 40 sf per occupant) AND direct outdoor airflow measurement devices*
					1		Credit 2	D	**Increased Ventilation** *30% beyond ASHRAE 62.1-2007 minimum outdoor air ventilation rates*
					1		Credit 3.1	C	**Construction IAQ Management Plan**, During Construction *Contractor to develop & implement IAQ Plan based on SMACNA guidelines AND protect stored & installed absorptive materials from moisture damage AND use MERV 8 filters at each return air grille if air handlers used during construction AND replace all filters immediately prior to occupancy*
					1		Credit 3.2	C	**Construction IAQ Management Plan**, Before Occupancy *Building flush-out (14,000 cu.ft. of outdoor air per sf) while maintaining at least 60 °F and less than 60% relative humidity OR occupancy after partial flush-out (3,500 cu.ft. per sf) while continuing flush-out OR air quality testing*
					1		Credit 4.1	C	**Low-Emitting Materials**, Adhesives & Sealants *VOC limits for site-applied interior adhesives, sealants and sealant primers (SCAQMD Rule 1168) and aerosol adhesives (GS-36)*
					1		Credit 4.2	C	**Low-Emitting Materials**, Paints & Coatings *VOC limits for site-applied interior paints, coatings and primers (GS-11: flats 50 g/L; non-flats 150 g/L), anti-corrosive and anti-rust paints applied to interior ferrous metal substrates (GS-03: 250 g/L) and wood finishes, floor coatings, stains, etc. (SCAQMD Rule 1113)*
					1		Credit 4.3	C	**Low-Emitting Materials**, Flooring Systems *Requirements for interior carpet (CRI Green Label Plus), carpet cushions (CRI Green Label), carpet adhesives (EQ Credit 4.1 VOC limit of 50 g/L), hard surface flooring (FloorScore), concrete / wood / bamboo / cork finishes (SCAQMD Rule 1113) and tile setting adhesive / grout (SCAQMD Rule 1168)*
					1		Credit 4.4	C	**Low-Emitting Materials**, Composite Wood & Agrifiber Products *No composite wood products or laminating adhesives with added urea-formaldehyde resins (on-site and shop-applied)*
					1		Credit 5	D	**Indoor Chemical & Pollutant Source Control** *10' entryway system at regularly used entries AND direct exhaust (0.50 cfm/sf) w/ neg. pressure (5 Pa avg, 1 Pa w/ closed doors) AND self-closing doors & hard lid clg where gas/chemicals used AND install MERV 13 filters at regularly occupied spaces (return & outdoor air) AND containment for hazardous liquid waste from chem. mixing (janitor, housekeeping, labs, etc.)*
					1		Credit 6.1	D	**Controllability of Systems**, Lighting *Controls for 90% occupants (individual task lighting in open work spaces) AND lighting system controllability for all shared multi-occupant spaces*
					1		Credit 6.2	D	**Controllability of Systems**, Thermal Comfort *Temperature controls for 50% of occupants (including open work spaces) AND controls for all shared multi-occupant spaces*
	1				1		Credit 7.1	D	**Thermal Comfort**, Design *Meet ASHRAE 55-2004, Thermal Comfort Conditions for Human Occupancy*
					1		Credit 7.2	D	**Thermal Comfort**, Verification *Achieve credit above AND implement occupant survey with corrective action AND install permanent monitoring system*
					1	+	Credit 8.1	D	**Daylight & Views**, Daylight 75% of Spaces *For all regularly occupied areas: computer simulation (daylight illumination level 25 fc to 500 fc) OR calculated prescriptive daylight zone ratio (VLT x WFR = 0.150 to 0.180) OR measurement of indoor light level (25 fc) AND glare control required for all options*
					1	+	Credit 8.2	D	**Daylight & Views**, Views for 90% of Spaces *Vision glazing between 2'-6" and 7'-6" AFF for 90% of all regularly occupied spaces - demonstrated by horizontal (section) view and plan view*

Yes D/B	Yes GOV	? D/B	? GOV	No	Avail	ExP		
1	0	0	0	0	6		**Innovation & Design Process**	
					1		Credit 1.1 D **Innovation in Design or Exemplary Performance**	
					1		Credit 1.2 D **Innovation in Design or Exemplary Performance**	
					1		Credit 1.3 D **Innovation in Design or Exemplary Performance**	
							TBD	
					1		Credit 1.4 D **Innovation in Design**	
							TBD	
					1		Credit 1.5 D **Innovation in Design**	
							TBD	
1					1		Credit 2 C **LEED® Accredited Professional**	
							At least one principal participant of the project team shall be a LEED AP (include copy of certificate)	

Yes D/B	Yes GOV	? D/B	? GOV	No	Avail	ExP		
0	0	0	0	0	6		**Regional Priority Credits (project zip code: 42223)**	
					1		Credit 1.1 C **Regional Priority:**	
					1		Credit 1.2 D **Regional Priority:**	
					1		Credit 1.3 D **Regional Priority:**	
					1		Credit 1.4 D **Regional Priority:**	
					1		Credit 1.5 D **Regional Priority:**	
					1		Credit 1.6 C **Regional Priority:**	

Yes D/B	Yes GOV	? D/B	? GOV	No	Avail	ExP	
1	5	3	0	5	112		**Project Totals** (pre-certification estimates)

Certified 40-49 points **Silver** 50-59 points **Gold** 60-79 points **Platinum** 80-110 points

APPENDIX M

LEED OWNER'S PROJECT REQUIREMENTS

Appendix M

Owner's Project Requirements Document for LEED Fundamental Commissioning

Project: _____

Approved:

_____	_____	_____
Name	Owner's Representative	Date
_____	_____	_____
Name	Design Agent's Representative	Date

Overview and Instructions

The purpose of this document is to provide clear and concise documentation of the Owner's goals, expectations and requirements for commissioned systems, and shall be utilized throughout the project delivery and commissioning process to provide an informed baseline and focus for design development and for validating systems' energy and environmental performance.

The Owner's Project Requirements Document is a required document for LEED-NC EA Prerequisite Fundamental Commissioning of the Building Energy Systems. It shall be completed by the Corps District/Design Agent based on coordination with the Installation/User/Proponent and shall be approved by the Installation/User/Proponent representative.

The intent of the Owner's Project Requirements Document is to detail the functional requirements of a project and the expectations of the building's use and operation as it relates to commissioned systems. This template contains the basic recommended components indicated in the LEED Reference Guide. It should be adapted as needed to suit the project, remaining reflective of the LEED intent.

The Owner's Project Requirements Document should ideally be completed before the start of design and furnished to the design team. It must be completed prior to the approval of Contractor submittals of any commissioned equipment or systems to meet LEED requirements.

Updates to the Owner's Project Requirements Document throughout the course of project delivery shall be made by the Corps District/Design Agent based on decisions and agreements coordinated with and agreed to by the Installation/User/Proponent.

The Owner's Project Requirements Document shall be included in the project's LEED documentation file under EA PR1, Fundamental Commissioning of the Building Energy Systems.

Owner's Project Requirements Document for LEED Fundamental Commissioning

Table of Contents

1. Owner and User Requirements
   - Primary Purpose, Program and Use
   - Project History
   - Broad Goals
2. Environmental and Sustainability Goals
   - Energy Efficiency Goals
   - General
   - Siting
   - Building Façade
   - Building Fenestration
   - Building Envelope
   - Roof
   - Other
3. Indoor Environmental Quality Requirements
   - Intended Use
   - Occupancy Schedule
   - Accommodations for After-Hours Use
   - Lighting, Temperature, Humidity, Air Quality, Ventilation, Filtration
   - Acoustics
   - Occupant Ability to Adjust System Controls
   - Types of Lighting
4. Equipment and Systems Expectations
   - Space Heating
   - Ventilation
   - Air Conditioning
   - Refrigeration
   - HVAC Controls
   - Domestic Hot Water
   - Lighting Controls
   - Daylighting Controls
   - Emergency Power
   - Other
5. Building Occupant and O&M Personnel Requirements
   - Facility Operation
   - EMCS
   - Occupant Training and Orientation
   - O&M Staff Training and Orientation

TABLE 1

1. *Owner and User Requirements*

What is the primary purpose, program and use of this project? (example: office building with data center)

_____
_____
_____

Describe pertinent project history. (example: standard design development)

_____
_____
_____

Broad Goals

What are the broad goals relative to program needs?

_____
_____
_____

What are the broad goals relative to future expansion?

_____
_____
_____

What are the broad goals relative to flexibility?

_____
_____
_____

What are the broad goals relative to quality of materials?

_____
_____
_____

What are the broad goals relative to construction costs?

_____
_____
_____

What are the broad goals relative to operational costs?

_____
_____
_____

Other broad goals: *(Insert as applicable)*

_____
_____
_____

2. Environmental and Sustainability Goals

What are the project goals relative to sustainability and environmental issues? (example: LEED Silver rating)

_____
_____
_____

What are the project goals relative to energy efficiency? (example: Meet EPACT)

_____
_____
_____

What are the project goals and requirements for building siting that will impact energy use?

_____
_____
_____

What are the project goals and requirements for building facade that will impact energy use?

_____
_____
_____

What are the project goals and requirements for building fenestration that will impact energy use?

_____
_____
_____

What are the project goals and requirements for building envelope that will impact energy use?

_____
_____
_____

What are the project goals and requirements for building roof that will impact energy use?

_____
_____
_____

Other: *(Insert as applicable)*

_____
_____
_____

3. Indoor Environmental Quality Requirements

What is the intended use for all spaces? For all spaces that have an intended use that is not readily apparent from the space name, provide this information in Table 1.

_____
_____
_____

What is the anticipated occupancy schedule (numbers of occupants and time frames) for all occupied spaces? Indicate the default occupancy schedule below and for all spaces that have an occupancy schedule that differs from the default, provide this information in Table 1.

_____
_____
_____

What accommodations for after-hours use are required? (example: access control, lighting controls, HVAC controls) Indicate general accommodations required below and for all spaces that have special requirements, provide this information in Table 1.

_____
_____
_____

What are the lighting, temperature, humidity, air quality, ventilation and filtration requirements for all spaces? Indicate the default requirements below and for all spaces that have a requirement that differs from the default, provide this information in Table 1.

Lighting: _____
Temperature: _____

Humidity: _____
Air Quality: _____

Ventilation: _____

Filtration: _____

What are the acoustical requirements for all spaces? Indicate the default acoustical requirements below and for all spaces that have a requirement that differs from the default, provide this information in Table 1.

_____
_____
_____

What is the desired level of occupant ability to adjust systems controls? Indicate the default desired levels below and for all spaces that have a desired level that differs from the default, provide this information in Table 1.

Lighting: _____

Temperature: _____
Humidity: _____
Air Quality: _____

Ventilation: _____

What, if any, specific types of lighting are desired? (example: fluorescent in 2x2 grid, accent lighting, particular lamps)

_____
_____
_____

4. Equipment and System Expectations

(Complete for each category as applicable or indicate "none identified" or "N/A". Add desired features information for other anticipated commissioned systems as applicable)

Indicate desired features for the following commissioned system: Space Heating

Desired Type: _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: _____

Flexibility: _____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: _____

Indicate desired features for the following commissioned system: Ventilation

Desired Type: _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: _____

Flexibility: _____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: _____

Indicate desired features for the following commissioned system: Air Conditioning

Desired Type: _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: _____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: _____

Indicate desired features for the following commissioned system: Refrigeration

Desired Type: _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: _____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies:

Indicate desired features for the following commissioned system: HVAC Controls

Desired Type: _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: _____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: _____

Indicate desired features for the following commissioned system: Domestic Hot Water

Desired Type: _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: _____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: _____

Indicate desired features for the following commissioned system: Lighting Controls

Desired Type: _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: _____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: _____

Indicate desired features for the following commissioned system: Daylighting Controls

Desired Type: _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: _____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: _____

Indicate desired features for the following commissioned system: Emergency Power

Desired Type: _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: _____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: _____

Indicate desired features for the following commissioned system: Other - _____

Desired Type: _____

Quality: _____

Preferred Manufacturer: _____
Reliability: _____
Automation: _____

Flexibility:_____
Maintenance Requirements: _____
Efficiency Target: _____

Desired Technologies: _____

5. Building Occupant and O&M Personnel Requirements

How will the facility be operated? Who will operate the facility?

_____
_____
_____

Will the facility be connected to an EMCS? If so, what are the interface requirements? (example: monitoring points, control points, scheduling)

_____
_____
_____

What is the desired level of training and orientation for building occupants to understand and use the building systems?

_____
_____
_____

What is the desired level of training and orientation for O&M staff to understand and maintain the building systems?

_____
_____
_____

Table 1

Space	Use / Activity	Num of Occs	Special Occupancy Schedule	After Hours Use Reqmt.	Special Cooling Reqmt.	Special Heating Reqmt.	Special Humidity Reqmt.	Special Ventil./Filtration Reqmt.	Special Acoustic Reqmt.	Special Lighting Reqmt.	Special Occup Adjustability Reqmt.

APPENDIX N

NOT USED

APPENDIX O

NOT USED – SEE APPENDIX L

APPENDIX P

LEED Registration of Army Projects

15 April 2010

Number of Registrations

Each building must be registered separately, except multiple instances of a standard building on a shared site may be registered as a single project. If a single registration for multiple buildings is chosen, all buildings under the single registration must earn exactly the same points. Do not register buildings that are exempt from a specific LEED achievement requirement.

Typical Registration Procedure

1. Login, complete the online registration form (see guidance below) at the GBCI LEED Online website http://www.gbci.org/DisplayPage.aspx?CMSPageID=174 and submit it online.
2. Pay the registration fee via credit card (USACE staff: credit card PR&C is funded by project design or S&A funds).
3. GBCI will follow up with a final invoice, the LEED-online passwords and template information.
4. The individual who registers the project online is, by default, the Project Administrator.

Completing the Registration Form

BEFORE YOU BEGIN:
Create a personal account with USGBC if you do not have one.
You will need the following information:
Project name as it appears in P2 (obtain from USACE Project Manager)
Building number/physical address of project
Zip code for Installation/project location
Anticipated construction start and end dates
Total gross area all non-exempt buildings in registration
Total construction cost all non-exempt buildings only (see Project Details Section instructions below)

ACCOUNT/LOGIN INFORMATION

1. The person registering the project **must have an account with USGBC** (login and password) to complete the form. Go to http://www.gbci.org/ , click on “register a project” at the drop-down menu for project certification (at the top of the page) and select “register now for LEED 2009” to start the project registration process. If you have an account, login with your email address and password and select “register new project” to proceed. If you do not have an account, you may select “register a new account” and follow the instructions. It is recommended that you create an account separately on the USGBC website before you start the form. IMPORTANT: USACE team members are members of USGBC and are eligible for Member prices. USACE team members registering projects should be sure to include the USACE Corporate Access ID in their personal account profile (if you do not have it contact richard.l.schneider@usace.army.mil or judith.f.milton@usace.army.mil for the number).
2. The Account/Login Information section is filled out by the person registering the project. It may be a Contractor or a USACE staff member.

ELIGIBILITY SECTION

Follow directions (accepting the terms and conditions)
Review your profile information and make corrections if needed

RATING SYSTEM SELECTION SECTION

Select single project registration and I know which rating system.
Select the rating system - currently only LEED-NC and LEED for Homes are approved for Army use without special approval.
LEED Minimum Program Requirements: select YES

RATING SYSTEM RESULTS SECTION

Confirm selected rating system.

PROJECT INFORMATION SECTION

Project Title: Begin the project title with a one-word identifier for the Installation. Do not include the word “Fort”. After this match the project name used in P2 (contact the USACE Project Manager for this information) and identify the building being registered. Example: “Stewart 4th IBCT - DFAC”.
Project Address 1 and 2: This is the physical location of the project. Provide building number, street address, block number or whatever is known to best describe the location of the project on the Installation.
Project City: Installation Name
State, Country, Zip Code: Self-explanatory
Anticipated Construction Start and End Dates: Self-explanatory – give your best guess if unknown. Note that required data entry format is: 1 or 2 digit month/1 or 2 digit date/4 digit year (example 3/23/2010)
Gross Square Footage: Provide total area all buildings in LEED project. Exclude the area of any buildings that are exempt from the LEED achievement requirement (for example, exclude an unconditioned storage shed to be constructed with a barracks complex).
Is Project Confidential: Indicate NO except, if project has security sensitivity (elements that are FOUO or higher security), indicate YES.
Notification of Local Chapter: Indicate NO unless Government/USACE Project Manager requests you to indicate YES.
Anticipated Project Type: Select the most appropriate option from the drop-down menu.
Anticipated Certification Level: Select the applicable option from the drop-down menu (Silver is the usual level).

PROJECT OWNER INFORMATION SECTION

Project Owner First Name, Last Name, email, phone, address: The Project Owner is the USACE Project Manager. Obtain this info from the USACE Project Manager.
Organization: U.S. Army Corps of Engineers. This field MUST be completed this way because it will be used as a search field by higher HQ to find all USACE registered projects. You may supplement it with district name at the end but DO NOT revise or use an acronym.
May we publish Owner information: Indicate NO
Owner Type: Pick Federal Government from drop-down menu.
Project Owner Assertion: Check the box

PAYMENT INFORMATION

Self-explanatory

APPENDIX Q
REV 2.1 – 30 SEP 2010
AREA COMPUTATIONS

Computation of Areas: Compute the "gross area" and "net area" of facilities (excluding family housing) in accordance with the following subparagraphs:

(1) Enclosed Spaces: The "gross area" is the sum of all floor spaces with an average clear height ≥6'-11" (as measured to the underside of the structural system) and having perimeter walls which are ≥4'-11". The area is calculated by measuring to the exterior dimensions of surfaces and walls.

(2) Half-Scope Spaces: Areas of the following spaces shall count as one-half scope when calculating "gross area":

- Balconies
- Porches
- Covered exterior loading platforms or facilities
- Covered but not enclosed spaces, canopies, training, and assembly areas
- Covered but not enclosed passageways and walks
- Open stairways (both covered and uncovered)
- Covered ramps
- Interior corridors (Unaccompanied Enlisted Personnel Housing Only)

(3) Excluded Spaces: The following spaces shall be excluded from the "gross area" calculation:

- Crawl spaces
- Uncovered exterior loading platforms or facilities
- Exterior insulation applied to existing buildings
- Open courtyards
- Open paved terraces
- Uncovered ramps
- Uncovered stoops
- Utility tunnels and raceways
- Roof overhangs and soffits measuring less than 3'-0" from the exterior face of the building to the fascia

(4) Net Floor Area: Where required, "net area" is calculated by measuring the inside clear dimensions from the finish surfaces of walls. If required, overall "assignable net area" is determined by subtracting the following spaces from the "gross area":

- Basements not suited as office, special mechanical, or storage space
- Elevator shafts and machinery space
- Exterior walls
- Interior partitions
- Mechanical equipment and water supply equipment space
- Permanent corridors and hallways
- Stairs and stair towers
- Janitor closets
- Electrical equipment space
- Electronic/communications equipment space

APPENDIX R

PRELIMINARY SUBMITTAL REGISTER

RMS SUBMITTAL REGISTER INPUT FORM

CONTRACT NUMBER | DELIVERY ORDER NUMBER

TITLE AND LOCATION

Button <-----Right click for Instructions

			TYPE OF SUBMITTAL											CLASSIFICATION						REVIEWING OFFICE					
SECTION	PARAGRAPH NUMBER	DESCRIPTION OF ITEM SUBMITTED	01 - PRECON SUBMITTALS	02 - SHOP DRAWINGS	03 - PRODUCT DATA	04 - SAMPLES	05 - DESIGN DATA	06 - TEST REPORTS	07 - CERTIFICATES	08 - MFRS INSTRUCTIONS	09 - MFRS FIELD REPORT	10 - O&M DATA	11 - CLOSEOUT SUBMITTALS	FIO - FOR INFORMATION ONLY	GA - GOVERNMENT APPROVED	DA - DESIGNER OF RECORD APPROVAL	CR - CONFORMANCE REVIEW	DA / CR	DA / GA	DO - DISTRICT OFFICE	AO - AREA OFFICE	RO - RESIDENT OFFICE	PO - PROJECT OFFICE	DR - DESIGNER OF RECORD	AE - ARCHITECT / ENGINEER
00 72 00	52.236-13	Accident Prevention Plan	X														X				X				
00 73 00	1.11	Dev. From Accept. Design. No Deviation from Contract					X											X			X			X	
00 73 00	1.11	Dev. From Accepted Design - Deviates from Contract					X												X		X			X	
00 73 00	1.17	Supplemental Price Breakdown	X											X								X				
00 73 00	1.18	SSHO Qualifications	X												X							X				
01 10 00	5.2.3.1	(if concrete pavement) Joint Layout Plan with design drawings					X										X								
01 10 00	5.5.2	Building Envelope Sealing Performance Testing						X						X								X			
01 10 10	***	Tests as Req by Codes - DOR Develops Test Program						X						X								X		X	
01 10 00	5.8.3	BAS Review Information		X														X			X	X		X	
01 10 00	5.8.3	BAS Performance Verification Test						X						X								X		X	
01 10 00	5.8.4	Testing Adjusting and Balancing						X						X								X		X	
01 10 00	5.8.5	Commissioning						X						X								X		X	
01 10 00	6.15	Environmental As Required for Site Specific					X										X					X		X	
01 10 00	6.16	Permits as required for Site specific					X										X					X		X	
01 10 00	5.10.2	Fire Protection Tests						X	X					X								X		X	
01 32 01.00 10	3.4.1	Preliminary Project Schedule	X												X							X			
01 32 01.00 10	3.4.2	Initial Project Schedule	X												X							X			
01 32 01.00 10	3.4.3	Design Package Schedule	X												X							X			
01 32 01.00 10	3.6.1	Periodic schedule updates from the Contractor	X												X							X			
01 32 01.00 10	3.7	Time Extension Request (Schedule)	X												X							X			
01 33 00	1.8	Submittal Register - DOR Input Required	X												X							X		X	
01 33 00	1.8	Submittal Register Updates (Design Packages, etc.)	X												X							X		X	
01 33 00	1.3.1	Substitution of Manuf or Model Named in Proposal		X	X													X				X		X	
01 33 16	1.2	Identify Designer(s) of Record	X												X							X			
01 33 16	1.1.2 / 3.2.4	Fast Track Design Package(s)					X										X				X	X			
01 33 16	1.2	Identification of all Designers of Record	X														X					X			
01 33 16	3.2.1	Site and Utility Des Package, incl. Substantiation					X										X				X	X			
01 33 16	3.2.2/3.5	Interim Des Subm Package(s), incl. Substantiation					X										X				X	X			
01 33 16	3.5.1	Drawings					X										X				X	X			
01 33 16	3.5.2.2	Sitework Design Analyses					X										X				X	X			
01 33 16	3.5.2.3	Structural Design Analyses					X										X				X	X			
01 33 16	3.5.2.4	Security Design Analyses					X										X				X	X			
01 33 16	3.5.2.5	Architectural Design Analyses					X										X				X	X			
01 33 16	3.5.2.6	Mechanical Design Analyses					X										X				X	X			
01 33 16	3.5.2.7	Life Safety Design Analyses					X										X				X	X			
01 33 16	3.5.2.8	Plumbing Design Analyses					X										X				X	X			
01 33 16	3.5.2.9	Elevator Design Analyses (as Applicable)					X										X				X	X			
01 33 16	3.5.2.10	Electrical Design Analyses					X										X				X	X			
01 33 16	3.5.2.11	Telecommunications Design Analyses					X										X				X	X			
01 33 16	3.5.2.12	Cathodic Protection Design Analyses					X										X				X	X			
01 33 16	3.5.3	Geotechnical Investigations and Reports					X										X				X	X			
01 33 16	3.5.4	LEED Submittals					X										X				X	X			
01 33 16	3.5.5	Energy Conservation Documentation					X										X				X	X			
01 33 16	3.5.6	Specifications					X										X				X	X			
01 33 16	3.5.7	Building Rendering					X										X				X	X			
01 33 16	3.2.4/3.7	Final Des Submittal Package(s), incl. Substantiation					X										X				X	X			
01 33 16	3.7.5	DD Form 1354 (Transfer of Real Property)											X				X					X			
01 33 16	3.7	Independent Technical Review					X										X				X	X			
01 33 16	3.2.5/3.8	Design Complete Submittal Package(s)					X										X				X	X			
01 33 16	3.3.3	Design and Code Review Checklists					X										X				X	X			
01 33 16	A-2.0	SID - Interim and Final (as applicable)			X	X	X								X							X			
01 33 16	B-2.0	FFE (as Applicable)					X								X							X			
01 33 16	F-3.1.3	BIM Model and data					X										X				X	X			
01 45 04.00 10	3.2	Design and Construction QC Plan	X														X					X			
01 57 20.00.10	1.2	Environmental Protection Plan	X														X					X			
01 78 02.00 10	1.2.1	Final as-Built Drawings/ BIM Model											X		X										
01 78 02.00 10	1.2.3.11	Non-Hazardous Solid Waste Diversion Reports							X					X								X			
01 78 02.00 10	1.2.7	Provide final as-built CADD and BIM Model files											X		X							X			
01 78 02.00 10	1.2.9	Provide scans of all other docs in Adobe.pdf format											X		X							X			
01 78 02.00 10	1.3.1	Equip-in-Place list of all installed equip and cost											X		X							X			
01 78 02.00 10	1.3.2	Data on equip not addressed in O&M manuals											X		X							X			
01 78 02.00 10	1.3.3	Final as-built specs - electronic files											X		X							X			
01 78 02.00 10	1.4.2.1	Warranty management plan - FAR 52.246-21											X		X							X			
01 78 02.00 10	1.4.2.1	Certificates of Warranty for extended warranty items											X		X							X			
01 78 02.00 10	1.4.2.1	Contractor's POCs for implementing warranty process											X		X							X			
01 78 02.00 10	1.4.2.1	List of each warranted equip, item, feature or system											X		X							X			
01 78 02.00 10	1.5	See also Section 01 10 00 par. 5.8.4 and 5.8.5											X		X							X			
01 78 02.00 10	1.6.1.2	Equipment O&M Manuals - 1 electronic / 2 hard copies											X		X							X			
01 78 02.00 10	1.7	Field Training DVD Videos										X		X								X			
01 78 02.00 10	1.8	Pricing of CF/CI and GF/CI Property											X	X								X			
01 78 02.00 10	1.11	List of Completed Cleanup Items											X				X					X			
01 78 02.00 10	1.12	Interim Form DD 1354											X				X					X			

Appendix S

REV 1.1 JUL 2011.

Manufacturing Performance Requirements for Plumbing Fixtures From The Energy Policy Act of 1992 (PL 102-486) (Including Exceptions for Projects Registered for LEED 3.0 or higher)

Note: This information is for use in establishing the Baseline to calculate flow rate reductions from said Baseline, where required by the contract.

Subtitle C--Appliance and Equipment Energy Efficiency Standards

SEC. 123. ENERGY CONSERVATION REQUIREMENTS FOR CERTAIN LAMPS AND PLUMBING PRODUCTS.

… (j) STANDARDS FOR SHOWERHEADS AND FAUCETS- (1) The maximum water use allowed for any showerhead manufactured after January 1, 1994, is 2.5 gallons per minute when measured at a flowing water pressure of 80 pounds per square inch. Any such showerhead shall also meet the requirements of ASME/ANSI A112.18.1M-1989, 7.4.3(a).

`(2) The maximum water use allowed for any of the following faucets manufactured after January 1, 1994, when measured at a flowing water pressure of 80 pounds per square inch, is as follows:

`Lavatory faucets: 2.5 gallons per minute **(BUT SEE BELOW**)**

`Lavatory replacement aerators: 2.5 gallons per minute

`Kitchen faucets : 2.5 gallons per minute

`Kitchen replacement aerators: 2.5 gallons per minute

`Metering faucets: 0.25 gallons per cycle

`(k) STANDARDS FOR WATER CLOSETS AND URINALS- (1)(A) Except as provided in subparagraph (B), the maximum water use allowed in gallons per flush for any of the following water closets manufactured after January 1, 1994, is the following:

`Gravity tank-type toilets --1.6 gpf.

`Flushometer tank toilets --1.6 gpf.

`Electromechanical hydraulic toilets --1.6 gpf.

`Blowout toilets --3.5 gpf.

`(B) The maximum water use allowed for any gravity tank-type white 2-piece toilet which bears an adhesive label conspicuous upon installation consisting of the words `Commercial Use Only' manufactured after January 1, 1994, and before January 1, 1997, is 3.5 gallons per flush.

`(C) The maximum water use allowed for flushometer valve toilets, other than blowout toilets, manufactured after January 1, 1997, is 1.6 gallons per flush.

`(2) The maximum water use allowed for any urinal manufactured after January 1, 1994, is 1.0 gallon per flush.

**** EXCEPTIONS for Projects Registered under LEED 3.0 or higher.**

1. Any exceptions identified in the applicable LEED criteria.

2. Public lavatory faucets shall deliver a maximum flow rate of 0.5 gallons per minute, when tested in accordance with ASME A 112.18/CSA B125. Use that flow rate as the Baseline figure for calculating any required reductions from the Baseline.

APPENDIX T
FUNCTIONAL AREA LIGHTING CONTROL STRATEGY (FALCS)

A. GENERAL LIGHTING CONTROL SYSTEM ENERGY MANAGEMENT STRATEGIES

SUMMARY: This appendix describes various lighting energy management strategies to utilize across functional areas. These strategies are intended to supplement and NOT supersede the requirements of ASHRAE 90.1.

1. Consider LIGHT LEVEL TUNING to maintain the appropriate light level for a given space. Initial light levels are set high to compensate for light depreciation over time. Where dimming ballasts or dimmable LED drivers are used, they shall be digital and addressable in nature (where available) that can provide individual fixture light level tuning and reconfigurability that dims the light level to the target level, saving the energy that otherwise would be used to compensate for future light depreciation. Provide a life-cycle cost-benefit analysis (LCCBA) of light level tuning for all spaces where the general lighting luminaires are equipped with digital addressable dimming ballasts or LED drivers. The LCCBA shall follow the methodology contained in the IESNA Lighting Handbook. Provide light level tuning where the LCCBA shows it to be economical.

2. Use OCCUPANCY/VACANCY SENSORS to automatically turn off lighting a specified time after all occupants leave the space. The off time shall be adjustable settable to 1, 5, 15, or 30 minutes. Select the type (single or dual technology, wired or wireless) based on the use and configuration of the space. Lighting control system shall have the capability to manage both hard-wired and wireless sensors where applicable. Single technology solutions shall incorporate signal processing technology that distinguishes between background noise and actual motion without automatically changing their sensitivity threshold. To maximize energy savings potential, all occupancy sensors shall be either MANUAL ON – AUTOMATIC OFF (vacancy sensor) or AUTOMATIC ON (to a specified light level of 50% or less) – AUTOMATIC OFF to maximize energy savings. Occupancy/Vacancy sensors properly located in the space and set appropriately can offer typical lighting energy savings of 15% or more.

3. Use DAYLIGHT HARVESTING to control lighting in areas within at least two window head heights (head height is the distance from the floor to the top of the glazing) adjacent to exterior view windows. Typical daylight penetrates three times the window head height into the space. To maximize energy savings, daylight dimming strategies need to penetrate beyond the first row of luminaires (first daylight zone). When daylighting installed fluorescent or LED luminaires, accomplish daylight harvesting by digitally addressable dimming ballasts or drivers. As the natural light in the space increases, the artificial light level should dim gradually to maintain a uniform light level and prevent disruption to the occupants. One daylight sensor must be able to control multiple daylighting zones (cross-zoning) without the need of adding more sensors. All controls (daylight sensors, occupancy sensors, wall stations) shall have the capability to connect to the system via hard wire or wireless. Apply the same daylighting strategies to areas where skylights are available (refer to ASHRAE 189.1 daylight zone definitions). Daylighting systems properly tuned and calibrated can offer typical lighting energy savings of 15% or more.

4. Consider AUTOMATED SHADING in spaces utilizing daylight harvesting to maximize the energy savings of the day lighting system. The shades shall be controlled to reduce glare and unwanted heat gain while still allowing natural light to enter the space. When utilizing automated shading consider the following :

    A. For ease of use and space aesthetics, operate the automated shades by common controls, wired or wireless (i.e. same appearance and design) with the lighting control system.
    B. For maximum energy savings the automated shading system shall predictably position the shades based on a combination of time of day, façade direction, and sky conditions.
    C. For maximum design flexibility and ease of installation, shade system should have the capability to address and control each shade individually.
    D. The shading system shall have a manual override that allows the occupant to temporarily adjust the shades to any desired position. The system will revert back to automatic control after a specified period of time.

    Provide a life-cycle cost-benefit analysis (LCCBA) of automated shading for all spaces where daylight harvesting is provided. The LCCBA shall follow the methodology contained in the IESNA Lighting Handbook. Provide automated shading where the LCCBA shows it to be economical.

5. Use SCENE BASED DIMMING in multiple-use areas including auditoriums, conference rooms and classrooms. Also provide scene based dimming in dining rooms and gymnasiums with multiple functions. One button preset touch recall shall allow multiple zones of light within a space to go to the appropriate light levels, known as a scene, for a specific task or use. Scene based control shall allow the integration of AV controls, shading/projection screens and lighting to work seamlessly with one button preset touch (i.e. lights dim, projection screen lowers, and shades go down). If dimming ballasts or LED drivers are used, they shall also be digital and addressable in nature (where available) to take advantage of installation and life-cycle reconfiguration benefits.

6. Provide PERSONAL CONTROL of lighting in spaces to allow the user of the space to vary the general light level based on the task at hand. Personal control can be achieved by wall mounted controls (hard wired or wireless), Infrared or Radio Frequency (RF) wireless devices, or via computer. Digital addressable ballasts and LED drivers allow the control flexibility of personal dimming of installed lighting on the occupant's work area (i.e. dim the luminaire over their cubicle to the appropriate light level).

7. Consider WIRELESS lighting control options for all installations, including retrofit projects (easy installation, lower installed cost, no power packs necessary). Wireless products shall include but not be limited to occupancy / vacancy sensors, daylight sensors, local wall controls, plug in switching and dimming appliance and parasitic load modules. To avoid interference, wireless products should communicate in an FCC frequency band that does not allow continuous transmissions and is free of Wi-Fi devices.

B. FUNCTIONAL TESTING AND MANUFACTURER SUPPORT

SUMMARY: This section describes functional testing to be performed on the lighting control system and the support required from the lighting control manufacturer.

1. Hire an independent agent with no less than three years experience in testing of complex lighting control systems to conduct and certify functional testing of lighting control devices and control systems. The testing agent shall not be directly involved in either the design or construction of the project and shall certify the installed lighting controls meet or exceed all requirements of ASHRAE 90.1 and all documented performance criteria. The lighting control manufacturer's authorized technical representative may serve as the testing agent. Submit qualifications of the testing agent for approval. Submit copies of test results to the Government.

2. LIGHTING CONTROL MANUFACTURER SUPPORT shall include technical phone support located in the United States. The technical phone support shall be available 24 hours a day, 365 days a year.

APPENDIX AA

UFC 4-750-02N
DESIGN: OUTDOOR SPORTS & RECREATION FACILITIES

UNIFIED FACILITIES CRITERIA (UFC)

DESIGN: OUTDOOR SPORTS AND RECREATION FACILITIES

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UNIFIED FACILITIES CRITERIA (UFC)

DESIGN: OUTDOOR SPORTS AND RECREATION FACILITIES

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U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEERING SUPPORT AGENCY

Record of Changes (changes indicated by **1**\ ... /**1**/)

Change No.	Date	Location

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD(AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA.) Therefore, the acquisition team must ensure compliance with the more stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Support Agency (AFCESA) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale should be sent to the respective service proponent office by the following electronic form: Criteria Change Request (CCR). The form is also accessible from the Internet sites listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://dod.wbdg.org/.

Hard copies of UFC printed from electronic media should be checked against the current electronic version prior to use to ensure that they are current.

AUTHORIZED BY:

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1-2.4 Antiterrorism/Force Protection 1-1
1-3 REFERENCES 1-2

APPENDIX A MIL-HDBK 1037/3 ..... A-1

CHAPTER 1

INTRODUCTION

1-1 **PURPOSE AND SCOPE**. This UFC is comprised of two sections. Chapter 1 introduces this UFC and provides a listing of references to other Tri-Service documents closely related to the subject. Appendix A contains the full text copy of the previously released Military Handbook (MIL-HDBK) on this subject. This UFC serves as criteria until such time as the full text UFC is developed from the MIL-HDBK and other sources.

This UFC provides general criteria for the design of outdoor sports and recreation facilities.

Note that this document does not constitute a detailed technical design, maintenance or operations manual, and is issued as a general guide to the considerations associated with the design of outdoor sports and recreation facilities.

1-2 **APPLICABILITY**. This UFC applies to all Navy service elements and Navy contractors; Army and Air Force service elements should use the references cited in paragraph 1-3 below; all other DoD agencies may use either document unless explicitly directed otherwise.

1-2 **APPLICABILITY**. This UFC applies to all DoD agencies and contractors preparing designs of maintenance facilities for ammunition, explosives and toxins.

1-2.1 **GENERAL BUILDING REQUIREMENTS**. All DoD facilities must comply with UFC 1-200-01, *Design: General Building Requirements*. If any conflict occurs between this UFC and UFC 1-200-01, the requirements of UFC 1-200-01 take precedence.

1-2.2 **SAFETY**. All DoD facilities must comply with DODINST 6055.1 and applicable Occupational Safety and Health Administration (OSHA) safety and health standards.

NOTE: All **NAVY** projects, must comply with OPNAVINST 5100.23 (series), *Navy Occupational Safety and Health Program Manual*. The most recent publication in this series can be accessed at the NAVFAC Safety web site: www.navfac.navy.mil/safety/pub.htm. If any conflict occurs between this UFC and OPNAVINST 5100.23, the requirements of OPNAVINST 5100.23 take precedence.

1-2.3 **FIRE PROTECTION**. All DoD facilities must comply with UFC 3-600-01, *Design: Fire Protection Engineering for Facilities*. If any conflict occurs between this UFC and UFC 3-600-01, the requirements of UFC 3-600-01 take precedence.

1-2.4 **ANTITERRORISM/FORCE PROTECTION**. All DoD facilities must comply with UFC 4-010-01, *Design: DoD Minimum Antiterrorism Standards for Buildings*. If any conflict occurs between this UFC and UFC 4-010-01, the requirements of UFC 4-010-01 take precedence.

1-3 **REFERENCES**. The following Tri-Service publications have valuable information on the subject of this UFC. When the full text UFC is developed for this subject, applicable portions of these documents will be incorporated into the text. The designer is encouraged to access and review these documents as well as the references cited in Appendix A.

1. US Army Corps of Engineers
Commander
USACE Publication Depot
ATTN: CEIM-IM-PD
2803 52nd Avenue
Hyattsville, MD 20781-1102
(301) 394-0081 fax: 0084

karl.abt@hq02.usace.army.mil
http://www.usace.army.mil/inet/usace-docs/

AFJMAN 32-10139, Children's Outdoor Play Areas, 30 May 1997

USACE TM 5-803-11, Children's Outdoor Play Areas, 30 May 1997

USACE TM 5-803-12, Planning of Outdoor Recreation Areas, 03 September 1986

APPENDIX A

MIL-HDBK 1037/3
OUTDOOR SPORTS AND RECREATION FACILITIES

INCH-POUND
MIL-HDBK-1037/3
30 JUNE 1989
SUPERSEDING
DM-37.3
AUGUST 1976

MILITARY HANDBOOK

OUTDOOR SPORTS AND RECREATIONAL FACILITIES

AMSC N/A

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AREA FACR

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ABSTRACT

This military handbook provides the planning and guidance necessary for the construction of outdoor sports facilities. It is intended for use by experienced architects and engineers. This handbook covers those sports commonly played for competition and/or recreation by Navy and civilian personnel.

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FOREWORD

This military handbook is one of a series developed from an evaluation of facilities in the shore establishment, from surveys of the availability of new materials and construction methods, and from selection of the best design practices of the Naval Facilities Engineering Command (NAVFACENGOM), and other Government agencies, and the private sector. This handbook uses, to the maximum extent feasible, national professional society, association, and institute standards in accordance with NAVFACENGCOM policy. Deviations from these criteria in the planning, engineering, design, and construction of Naval shore facilities, cannot be made without prior approval of NAVFACENGCOM HQ Code 04.

Design cannot remain static any more than can the functions it serves or the technologies it uses. Accordingly, recommendations for improvement of this handbook are encouraged from within the Navy, Government agencies, and from the private sector and should be furnished on the form DD 1426 provided to: Commanding Officer, Pacific Division (Code 406C), Naval Facilities Engineering Command, Pearl Harbor, HI 96869.

THIS HANDBOOK SHALL NOT BE USED AS A REFERENCE DOCUMENT FOR PROCUREMENT OF FACILITIES CONSTRUCTION. IT IS TO BE USED IN THE PURCHASE OF FACILITIES ENGINEERING STUDIES AND DESIGN (FINAL PLANS, SPECIFICATIONS, AND COST ESTIMATES). DO NOT REFERENCE IT IN MILITARY OR FEDERAL SPECIFICATIONS OR OTHER PROCUREMENT DOCUMENTS.

CRITERIA MANUALS

Criteria Manual	Title	PA
DM-37.1	Swimming Pools (Interim)	CHESDIV
MIL-HDBK-1037/2	Child Development Centers	PACDIV
MIL-HDBK-1037/3	Outdoor Sports & Recreational Facilities	PACDIV
MIL-HDBK-1037/4	Brigs and Detention Facilities (Interim)	HDQTRS
DM-37.5	Family Service Centers	PACDIV
DM-37.06	Chapels and Religious Educational Facilities	PACDIV
MIL-HDBK-1037/7	Officers, Non-Commissioned Officers Dining Facilities; Open Enlisted Dining Facilities	CHESDIV

OUTDOOR SPORTS AND RECREATIONAL FACILITIES

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Section 1: INTRODUCTION

1.1 Purpose. This handbook contains site planning information pertaining to outdoor sports facilities. Some design information and details are included as planning aids and general guidance.

1.2 Scope. Sections 2 through 8 provide detailed information for most recreational activities commonly played at military installations. Each sport has an outline text page of site planning and design criteria. The typical criteria categories are: Source of Information; Recommended Area; Size and Dimension; Orientation; Surface and Drainage; and Special Considerations. It also provides corresponding details and site layout diagrams.

1.3 Application. Layouts and construction details in this handbook are based on the published rules for the sport and will serve as guidance material. Design professionals will prepare actual construction drawings through selection of the appropriate layouts and details and site adaptation with proper grading and drainage to fit local conditions. Changes in playing rules may affect the dimensions and shapes of outdoor sports facilities. Therefore, the latest official rules of the governing body for each sport will be verified with the project drawings prepared in conformance with those rules.

1.4 Planning and Design Considerations. Some general planning and design considerations are given in paras. 1.4.1 through 1.4.4 to complement the specific information found in this handbook for each sport. Additional minor construction details are shown in Figures 62a through 66.

1.4.1 Lighting Requirements. When lighting is required for extending the playing time of a sports facility, it must be justifiable in view of the Government Energy Reduction Program. Refer to the Illuminating Engineering Society (IES) publication, Recommended Practice for Sports Lighting, and pending illumination levels given in the rules and regulations of the various classes of sports.

1.4.2 Support Facilities. The availability of support facilities may influence the site planning and design of the facilities given in this handbook.

1.4.2.1 Bleachers. The number of seats and location will depend on the particular sport and service requirements. The structure may be portable.

1.4.2.2 Storage Facilities. The equipment required for the support of a sport activity shall be housed near the playing area. This unit may also house pertinent maintenance equipment.

1.4.2.3 Handicapped. All facilities shall be designed to meet the needs of the handicapped, especially spectators, in accordance with Federal Standard FED-STD-795, Uniform Federal Accessibility Standards.

1.4.3 Soil Conditions. Soils affect site planning, design and maintenance of sports facilities for that area. Soils information and technical advice is available from local representatives of U.S. Army Corps of Engineers or U.S. Navy Engineering Field Divisions.

a) For sports played on natural turf surfaces, obtaining the best possible playing surface requires that special consideration be given to the nutrient qualities of the topsoil and irrigation as well as to the drainage characteristics of the subsoils.

b) For sports requiring a paved surface of concrete, bituminous or other hard material, the subbase for the paving type required will be of inorganic material, well drained, and of sufficient depth to prevent frost heave.

c) For any structures such as the one-, three-, and four-wall handball walls, the bearing capacity of the soils must be determined before the structures can be properly designed. The facility may have to be built on another site if the soil bearing capacity at the first site is too low.

1.4.4 Metric Dimensions. Some sports facilities shown are dimensioned in metric units. Metric units are used when the governing body of the sport has specified metric units in the rules and regulations. Many sports organizations do not yet recognize the metric system in their official rules and regulations and therefore, their playing areas are dimensioned in English units.

1.5 Cancellation. This handbook, MIL-HDBK-1037/3, cancels and supersedes NAVFAC DM-37.3, Outdoor Sports and Recreational Facilities, August 1976, and NAVFAC P-457, Planning and Design of Outdoor Sports Facilities, October 1975.

1.6 Referenced Organizations. The list of references provides names and addresses of organizations whose rules, regulations, layout designs, and construction details were used in the development of this handbook. Consult these organizations for additional information as required.

Section 2: OUTDOOR SPORTS FACILITIES

2.1 Sports Courts

2.1.1 Badminton. Badminton courts (see Figure 1) shall meet the following criteria.

a) Source of Information: American Badminton Association (ABA).

b) Recommended Area: Ground space shall be 1,620 ft² (150.5 m²) minimum to edge of pavement.

c) Size and Dimension: Single court shall be 17 x 44 ft (5.18 x 13.41 m), doubles court shall be 20 x 44 ft (6.1 x 13.4 m) with a 6-ft (1.83 m) minimum unobstructed area on all sides.

d) Orientation: The preferred orientation is for the long axis to be north-south.

e) Surface and Drainage: Surface and drainage shall meet the following criteria:

(1) The surface shall be concrete or bituminous material with optional protective colorcoating for permanent installation. Turf may be used for general recreation use with surface drainage as described in the paragraph below except a slope of 2 percent (minimum) and adequate underdrainage will be used.

(2) Drainage shall be end-to-end, side-to-side or corner-to-corner diagonally at a minimum slope of 1 in. (25.4 mm) in 10 ft (2.05 m) (0.8 percent).

2.1.2 Basketball (American). Basketball courts (see Figures 3a and 3b) shall meet the following criteria.

a) Source of Information: American Basketball Association, USA (ABAUSA).

b) Recommended Area: The ground space shall be 0.11 acre (0.045 ha) minimum to 0.13 acre (0.054 ha) maximum, including unobstructed space.

c) Size and Dimension: The playing court shall be 14 x 26 m (45 ft-11 1/4 in. x 85 ft-3 1/2 in.) with an unobstructed space of 3.28 ft (1 m) minimum to 6.56 ft (2 m) recommended on all sides.

d) Orientation: The preferred orientation is for the long axis to be north-south.

e) Surface and Drainage: Surface and drainage shall meet the following criteria.

(1) The surface shall be concrete or bituminous material with optional protective colorcoating.

(2) Drainage shall be end-to-end, side-to-side or corner-to-corner diagonally at a minimum slope of 1 in. (25.4 mm) in 10 ft (0.8 percent).

2.1.3 Basketball (Collegiate). Basketball courts (see Figure 3a and 3b) shall meet the following criteria.

a) Source of Information: National Collegiate Athletic Association (NCAA).

b) Recommended Area:

(1) For high school the ground space shall be 5,040 ft^2 (468 m^2) minimum to 7,280 ft^2 (676 m^2) maximum.

(2) For colleges the ground space shall be 5,600 ft^2 (520 m^2) minimum to 6,980 ft^2 (648 m^2) maximum.

c) Size and Dimension:

(1) The recommended court size for high schools is 84 x 50 ft (25.6 x 15.2 m) with a 10-ft (3.05 m) unobstructed space on all sides 3-ft (0.9 m).

(2) The recommended court size for colleges is 94 ft (28.6 m) x 50 ft with a 10-ft unobstructed space on all sides (3-ft minimum).

d) Orientation: The preferred orientation is for the long axis to be north-south.

e) Surface and Drainage: Surface and drainage shall meet the following criteria.

(1) Surface shall be concrete or bituminous material with optional protective colorcoating.

(2) Drainage shall be end-to-end, side-to-side or corner-to-corner diagonally at a minimum slope of 1 in. in 10 ft (0.8 percent).

2.1.4 Biddy Basketball. The Biddy Basketball court (see Figure 4) shall meet the following criteria.

a) Source of Information: Biddy Basketball Association, Inc.

b) Recommended Area: The ground space shall be 4,680 ft^2 (435 m^2) to 5,040 ft^2 (468 m^2) including clear space.

c) Size and Dimension: The playing court shall be 46 to 50 ft (14 to 15.2 m) wide and 84 ft (25.6 m) long with an unobstructed space of at least 3 ft recommended on all sides.

d) Orientation: The preferred orientation is for the long axis to be north-south.

e) Surface and Drainage: The surface and drainage shall meet the following criteria.

(1) The surface shall be concrete or bituminous materials with optional protective colorcoating.

(2) Drainage shall be end-to-end, side-to-side or corner-to-corner diagonally at a minimum slope of 1 in. in 10 ft (0.8 percent).

2.1.5 Goal-Hi Basketball. Goal-hi basketball courts (see Figure 5) shall meet the following criteria.

a) Source of Information: AMF Voit Corporation.

b) Recommended Area: The ground space shall be 1,256 ft^2 (117 m^2) minimum; 2,827 ft^2 (263 m^2) maximum.

c) Size and Dimension: The playing court shall be an outer court circle with a radius of 20 ft (6.1 m) minimum and 30 ft (9.1 m) maximum, surrounding a concentric inner court circle with a radius of 10 ft (3.05 m) minimum and 15 ft (4.6 m) maximum.

d) Orientation: Optional.

e) Surface and Drainage: The surface and drainage shall meet the following criteria.

(1) A resilient synthetic surface shall be preferred for safety and comfort. However, concrete or bituminous surface may be used for minimum maintenance.

(2) The minimum slope shall be 1 in. in 10 ft (0.8 percent) for drainage in any direction.

2.1.6 Boccie. The boccie court (see Figure 6) shall meet the following criteria.

a) Source of Information: General Sportcraft Company, Ltd.

b) Recommended Area: The ground space shall be 1,824 ft^2 (169 m^2) to 2,805 ft^2 (261 m^2).

c) Size and Dimension: The overall court dimensions shall range from 13 to 19.5 ft (3.96 to 5.94 m) wide x 78 ft to 92 ft (23.7 to 28.04 m) long. An additional space of at least 3 ft (0.9 m) on each side and 9 ft (2.7 m) on each end is recommended.

d) Orientation: The preferred orientation is for the long axis to be north-south. It may be adjusted to suit local topographic conditions.

e) Surface and Drainage: Surface and drainage shall meet the following criteria.

(1) The preferred surface is turf, although a mixture of sand and clay may be used.

(2) Drainage may be in any direction at a recommended slope of 1 percent for turf and level for sand-clay with subdrainage.

f) Special Considerations: An optional low wooden barrier may be provided at each end and/or side of court.

2.1.7 Croquet. The croquet playing areas (see Figure 7) shall meet the following criteria.

a) Source of Information: National Croquet Association, Inc. (NCA).

b) Recommended Area: The ground space shall be 3,000 ft² (278.8 m² acre).

c) Size and Dimension: The playing area shall be 35 ft (10.7 m) x 70 ft (21.3 m) plus 2.5 ft (0.76 m) minimum on each end and side.

d) Orientation: Orientation may be adjusted to suit local topographic conditions.

e) Surface and Drainage: The playing surface shall be turf, closely cropped and rolled, with a maximum 2 percent slope (preferably level) and adequate subdrainage.

2.1.8 One-Wall Handball. The one-wall handball court (see Figure 8) shall meet the following criteria.

a) Source of Information: United States Handball Association (USHA).

b) Recommended Area: The ground space shall be 1,665 ft² (155 m²) plus walls and footings.

c) Size and Dimension: The playing court shall be 20 ft (6.09 m) wide x 34 ft (10.36 m) long plus a required 11 ft (3.35 m) minimum width of surfaced area to the rear and a recommended 8.5 ft (minimum) width on each side. Courts in battery shall have a minimum of 6 ft (1.83 m) between courts.

d) Orientation: The preferred orientation is for the long axis to be north-south with the wall at the north end.

e) Surface and Drainage: The floor surface shall be smooth concrete with a minimum slope of 1 in. (25.4 mm) in 10 ft (0.8 percent) from the wall to the rear of the court. The wall shall be of concrete with a very smooth finish, free of irregularities.

f) Special Considerations: The court area shall be fenced with a 10-ft high (3.05 m) chain link fence which shall conform to NAVFAC Guide Specification NFGS-02444, Fence, Chain Link.

2.1.9 Three- and Four-Wall Handball. Three- and four-wall handball courts (see Figure 9) shall meet the following criteria.

a) Source of Information: U.S. Handball Association (USHA).

b) Recommended Area: The ground space for four-wall handball shall be 800 ft^2 (74.3 m^2), plus walls and footing. Allow an additional 200 ft^2 (18.6 m^2) for three-wall handball.

c) Size and Dimension: The playing court shall be 20 in. (508 mm) wide x 40 ft (12.2 m) long plus 10 ft (minimum) to the rear of the three-wall court. The overhead clearance shall be 20 ft (6.4 m) (minimum).

d) Orientation: The preferred orientation is for the long axis to be north-south with the front wall at the north end.

e) Surface and Drainage: The floor surface shall be smooth concrete preferably with a minimum slope of 1 in. in 10 ft (0.8 percent) from front to rear of the court. Walls shall be of concrete with a very smooth finish, free of irregularities.

f) Special Considerations:

(1) Alternative Four-Wall Court. The layout shall be the same as for three-wall with the exception of 12-ft (3.65 m) minimum high back wall at the rear of the court (long line) and necessary wall footings.

(2) Drainage. Special provisions shall be made for drainage and access provided through the back wall of four-wall courts.

(3) Fencing. An optional 10-ft (3.02 m) high chain link fence, conforming to NFGS-02444, may be provided at the rear of the pavement for three-wall courts.

2.1.10 Hopscotch. The hopscotch playing area (see Figure 10) shall meet the following criteria.

a) Source of Information: AMF Voit Corporation.

b) Recommended Area: The ground space shall be 62.5 ft^2 (5.8 m^2).

c) Size and Dimension: The playing court shall be 5 ft (1.5 m) wide x 12.5 ft (3.8 m) long.

d) Orientation: Optional.

e) Surface and Drainage: The surface shall be of concrete or bituminous material with a lateral slope of 1 in. in 10 ft (0.8 percent) and a longitudinal slope of 1 in. in 10 ft (0.8 percent) minimum.

2.1.11 Horseshoes. The horseshoe playing area (see Figure 11a) shall meet the following criteria.

a) Source of Information: National Horseshoe Pitchers' Association of America (NHPAA).

b) Recommended Area: The ground space shall be 1,540 ft² (143 m²), including clear space.

c) Size and Dimension: The playing court shall be 12 x 50 ft (3.66 x 15.24 m) plus a recommended 10-ft unobstructed area on each end and a 5-ft (1.52 m) wide (minimum) zone on each side.

d) Orientation: The recommended orientation is for the long axis to be north-south.

e) Surface and Drainage: The surface of the playing area, except for boxes and optional concrete walkways, shall be turf. The area shall be pitched to the side at a maximum slope of 2 percent. The elevation of the top of the steel pegs shall be equal.

f) Special Considerations: For safety, a 1-ft 10-in. (558 mm) high (minimum) backstop shall be constructed at the end of the box to intercept overthrown or bounding shoes.

2.1.12 Ice Hockey. The ice hockey playing area (see Figure 12) shall meet the following criteria.

a) Source of Information: Amateur Hockey Association of the United States (AHA).

b) Recommended Area: The ground space shall be 22,000 ft² (2044 m²), including support area.

c) Size and Dimension: The playing rink shall be 85 ft (25.9 m) wide x 200 ft (61 m) long, plus an additional 5,000 ft² (464.5 m²) of support area.

d) Orientation: The preferred orientation is for the long axis to be north-south.

e) Surface and Drainage: The ice surface shall be level over either sand-clay or bituminous surface. Provisions for drainage shall be made on the surface beneath the ice and around the rink.

f) Special Considerations: Unless situated in northern climates, provisions for artificial ice will be required.

2.1.13 Lawn Bowling. The lawn bowling playing area (see Figure 13) shall meet the following criteria.

a) Source of Information: American Lawn Bowls Association (ALBA).

b) Recommended Area: The square green with six rinks shall be 15,376 ft² (1428.4 m²) minimum to 19,321 ft² (1795 m²) maximum.

c) Size and Dimension: The rink length ranges from 120 ft (36.6 m) minimum to 132 ft (40.2 m) maximum on each side. An additional width of 2 ft (0.61 m) minimum to 3.5 ft (1.07 m) maximum shall be required on all sides for ditch and backslope. The rink width ranges from 14 ft (4.27 m) minimum to 19 ft (5.79 m) maximum.

d) Orientation: Optional.

e) Surface and Drainage: Surface and drainage shall meet the following criteria.

(1) The surface shall be closely cropped bent grass or sand-clay. If grass surface is to be used, contact ALBA for specific information about construction and maintenance.

(2) The entire green shall be level, with adequate subdrainage.

f) Special Considerations: Ditch depth ranges from 2 in. (50.8 mm) (minimum) to 8 in. (maximum) below surface of green; width ranges from 8 in. (203.2 mm) minimum to 15 in. (388 mm) maximum.

2.1.14 Roque. The roque playing area (see Figure 14) shall be as follows.

a) Source of Information: The American Roque League Incorporated (ARL).

b) Recommended Area: The ground space shall be 1,800 ft² (minimum) (167.2 m²), plus curb.

c) Size and Dimension: The playing court shall be 30 ft (9.1 m) wide x by 60 ft (18.3 m) long.

d) Orientation: The preferred orientation is for the long axis to be north-south.

e) Surface and Drainage: Surface and drainage shall meet the following criteria.

(1) The surface shall be level and of sand-clay mixture.

(2) Drainage shall be through perimeter system and/or through underdrains.

f) Special Considerations. A concrete curb shall be provided on all sides.

2.1.15 Shuffleboard. The shuffleboard playing area (see Figure 15) shall be as follows.

a) Source of Information: General Sportcraft Co., Ltd.

b) Recommended Area: The ground space shall be 312 ft² (0.01 acre) minimum.

c) Size and Dimension: The playing court shall be 6 x 52 ft (1.82 x 15.8 m) plus a recommended 2 ft (minimum) on each side or 4 ft between courts in battery.

d) Orientation: The recommended orientation is for the long axis to be north-south.

e) Surface and Drainage: Surface and drainage shall be as follows:

(1) The surface shall be concrete with a burnished finish.

(2) The court surface shall be level with drainage away from the playing surface on all sides.

2.1.16 Deck Tennis. The deck tennis playing area (see Figure 16) shall be as follows.

a) Source of Information. General Sportcraft Company, Ltd.

b) Recommended Area: The ground space shall be 1,300 ft² (120.8 m²) including clear space.

c) Size and Dimension: The singles court shall be 12 x 40 ft (3.6 x 12.2 m) The doubles court shall be 18 ft x 40 ft. An additional paved area of 4 ft (1.22 m) minimum on sides and 5 ft (1.52 m) on ends is recommended for both.

d) Orientation: The preferred orientation is for the long axis to be north-south.

e) Surface and Drainage: Surface and drainage shall be as follows:

(1) The surface shall be concrete or bituminous material with optional protective coating.

(2) Drainage shall be end-to-end, side-to-side, or corner-to-corner diagonally at a minimum slope of 1 in. in 10 ft (0.8 percent).

f) Special Considerations: Fencing is recommended, on all sides of the court, of 10-ft (3.05 m) high chain link fence conforming to NFGS-02444.

2.1.17 Paddle Tennis. The paddle tennis playing area (see Figure 17) shall be as follows.

a) Source of Information: United States Paddle Tennis Association (USPTA).

b) Recommended Area: The ground space shall be 3,200 ft² (297.3 m²) minimum to edge of pavement.

c) Size and Dimension: The playing court shall be 20 x 50 ft (6.1 x 15.24 m) plus a 15-ft (minimum) space on each end and a 10-ft (minimum) space on each side or between courts in battery.

d) Orientation: The preferred orientation is for the long axis to be north-south.

e) Surface and Drainage: Surface and drainage shall be as follows:

(1) The surface shall be concrete or bituminous material with optional protective colorcoating.

(2) Drainage shall be end-to-end, side-to-side or corner-to-corner diagonally at a minimum slope of 1 in. in 10 ft (0.8 percent).

f) Special Considerations: Fencing is recommended, on all sides of the court, of 10-ft high chain link fence which shall conform to NFGS-02444.

2.1.18 Platform Tennis. The platform tennis playing area (see Figure 18) shall be as follows.

a) Source of Information: American Platform Tennis Association (APTA).

b) Recommended Area: The ground space shall be 1,800 ft² (167 m²) to the playable perimeter fence.

c) Size and Dimension: The playing court shall be 20 x 44 ft (6.1 x 13.4 m) plus an 8 ft (2.44 m) space on each end and a 5 ft (1.5 m) space on each side.

d) Orientation: The preferred orientation is for the long axis to be north-south.

e) Surface and Drainage: Surface and drainage shall be as follows:

(1) The raised level platform shall be constructed of pressure treated wood or aluminum superstructure with carriage set on concrete piers to permit construction on slopes.

(2) Drainage shall be provided by a 1/4-in. (6.35 mm) space between 6-in. (152.4 mm) deck planks or channels. Snow removal shall be facilitated by hinged panels (snow gages) between posts around bottom of perimeter fence.

f) Special Considerations:

(1) Tension fencing shall be provided on all sides of the court.

(2) Prefabricated pre-engineered courts are available from several manufacturers.

2.1.19 Tennis. The tennis playing area (see Figure 19) shall be as follows.

a) Source of Information: United States Tennis Association (USTA).

b) Recommended Area: The ground space shall be 7,200 ft² (668.9 m²) minimum.

c) Size and Dimension: The playing court shall be 36 x 78 ft (10.97 x 23.7 m) plus 12 ft (3.66 m) minimum clearance on both sides or between courts in battery and 21 ft (6.4 m) clearance on each end. The minimum distance between baselines of end-to-end courts shall be 42 ft (12.8 m).

d) Orientation of long axis is to be north-south.

e) Surface and Drainage: Surface and drainage shall be as follows:

(1) The surface may be concrete, or bituminous material with specialized protective colorcoating, or sand-clay.

(2) Drainage may be from end-to-end, side-to-side, or corner-to-corner diagonally at a minimum slope of 1 in. in 10 ft (0.8 percent) for pavement and level for sand-clay with subdrainage.

f) Special Considerations: Fencing is recommended, on all sides of the court, of 10-ft high (3.05 m) chain link fence which shall conform to NFGS-02444.

2.1.20 Tetherball. The tetherball playing area (see Figure 20) shall be as follows.

a) Source of Information: General Sportcraft Company, Ltd.

b) Recommended Area: The ground space shall be 314 ft² (29.17 m²) minimum to circumference of outer circle.

c) Size and Dimension: The playing court shall be a circle 20 ft (6.1 m) in diameter and the pole height shall be 10 ft.

d) Orientation: The recommended axis through playing zone is north-south.

e) Surface and Drainage. Concrete or bituminous surface may be used for minimum maintenance, but a resilient synthetic surface or wood chips with adequate subdrainage shall be preferred for safety and comfort. The minimum slope shall be 1 in. in 10 ft (0.8 percent) for drainage in any direction.

2.1.21 Volleyball. The volleyball playing area (see Figures 21a and 21b) shall be as follows.

a) Source of Information: United States Volleyball Association (USVBA).

b) Recommended Area: The ground space shall be 3,935 ft^2 (365.56 m^2).

c) Size and Dimension: The playing court shall be 29.5 x 59 ft (9 m x 17.98 m) plus 10-ft unobstructed space on all sides.

d) Orientation: The preferred orientation is for the long axis to be north-south.

e) Surface and Drainage: Recommended surface for intensive use shall be bituminous material or concrete, but sand-clay or turf may be used for informal play. Drainage shall be end-to-end, side-to-side or corner-to-corner at a minimum slope of 1 in. in 10 ft (0.8 percent).

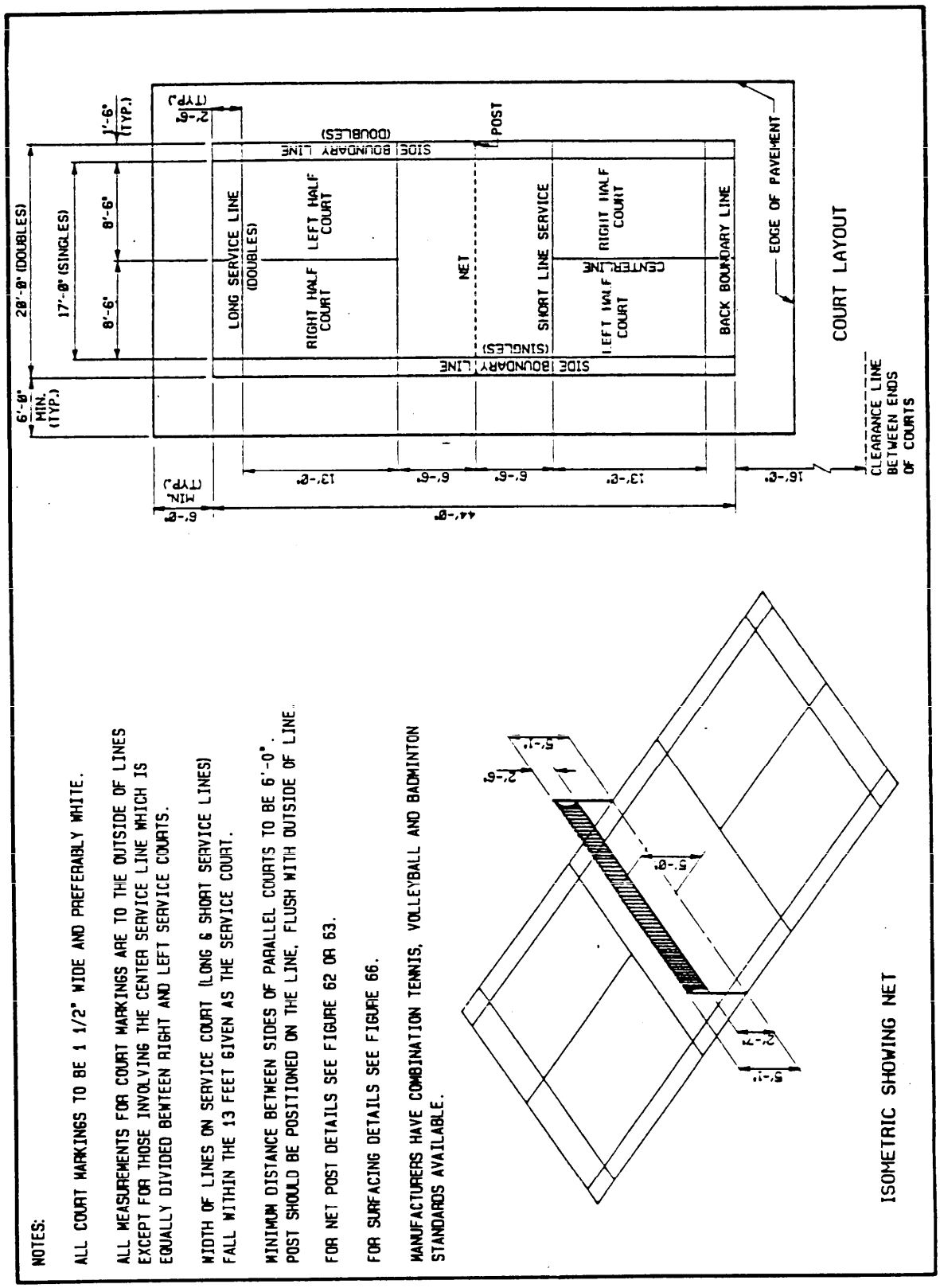


Figure 1
Badminton Courts

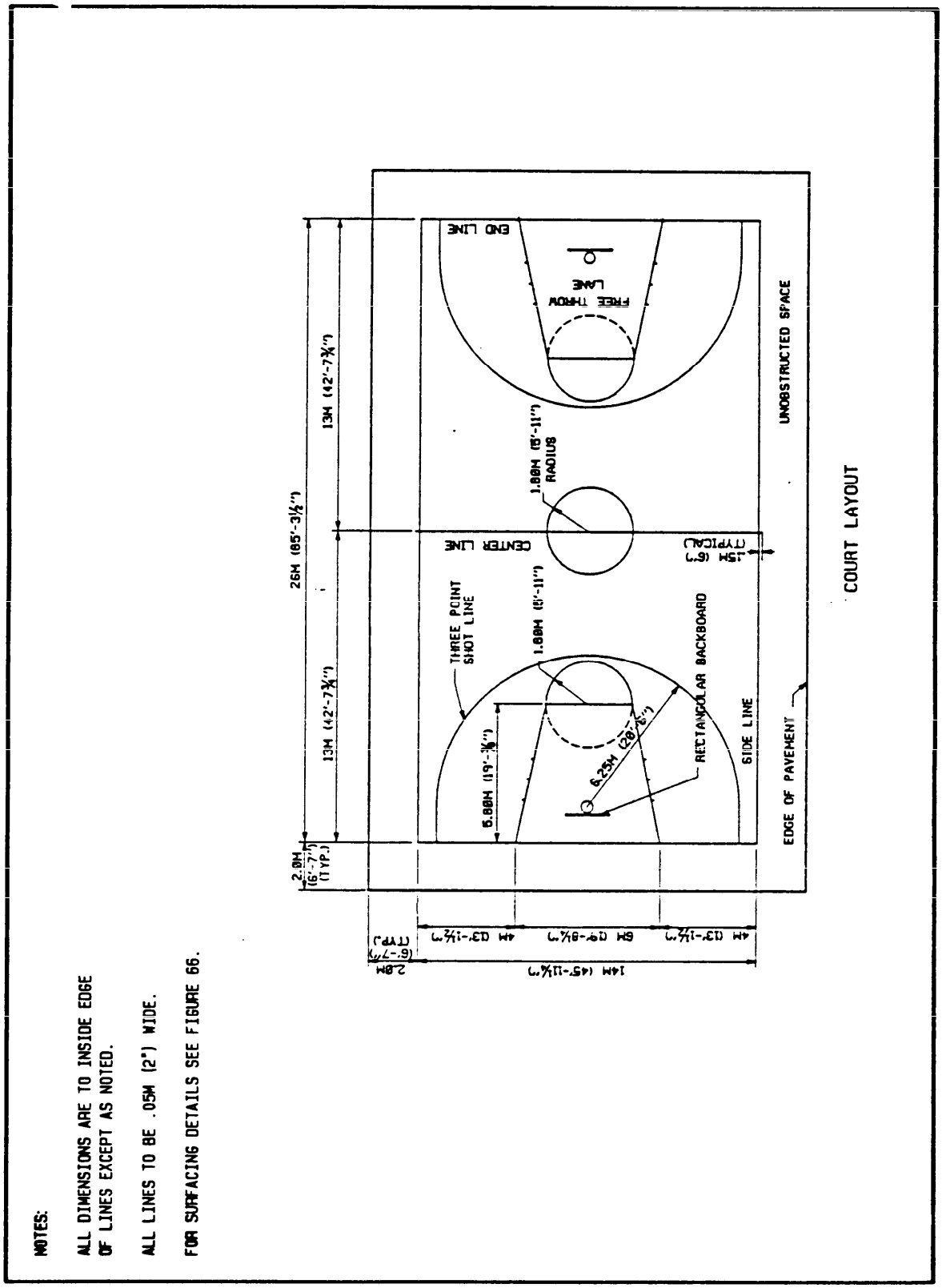


Figure 2a
Basketball (ABAUSA) -- Court Layout

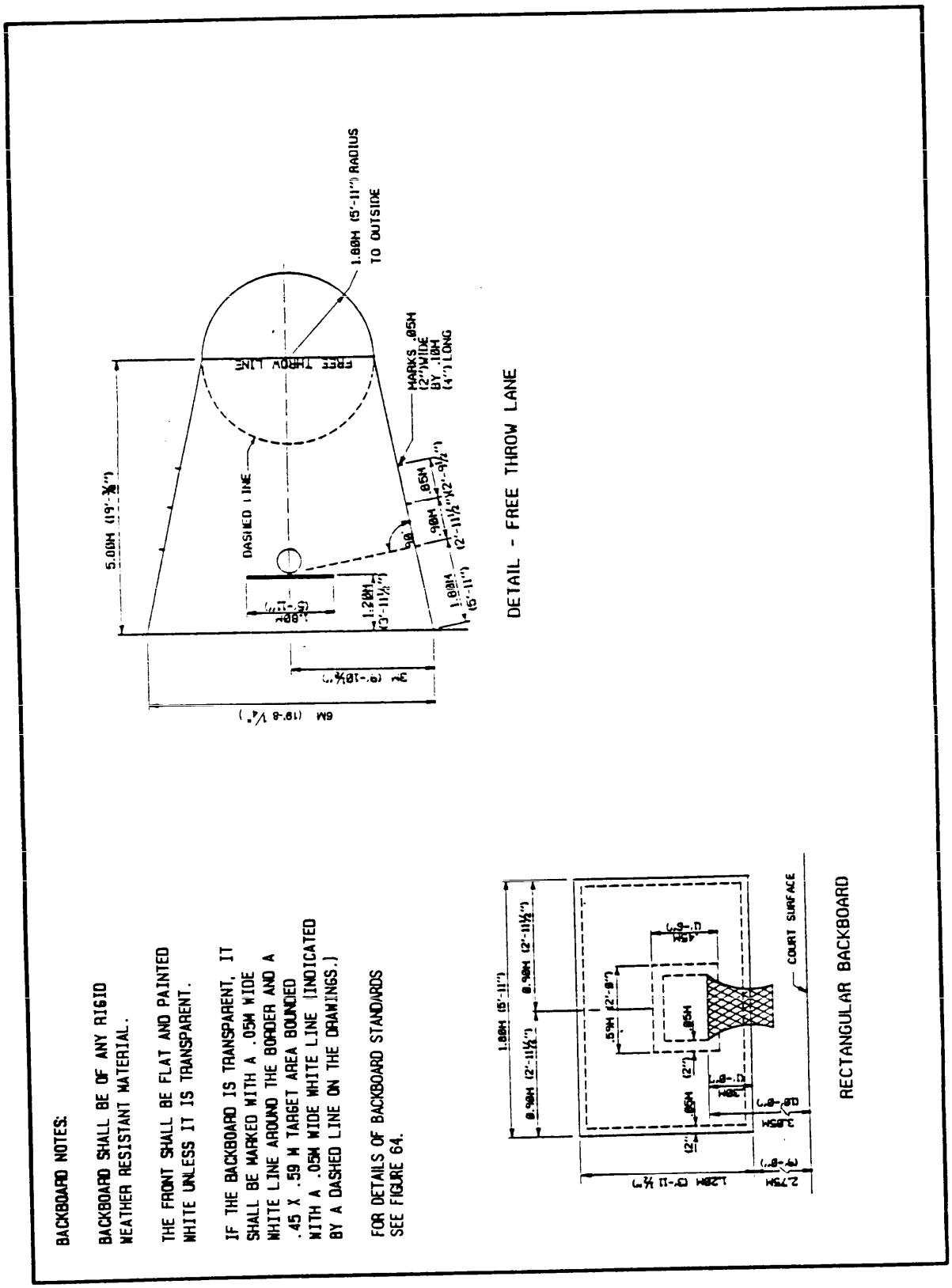


Figure 2b
Basketball (ABAUSA) -- Backboard and Free Throw Lane

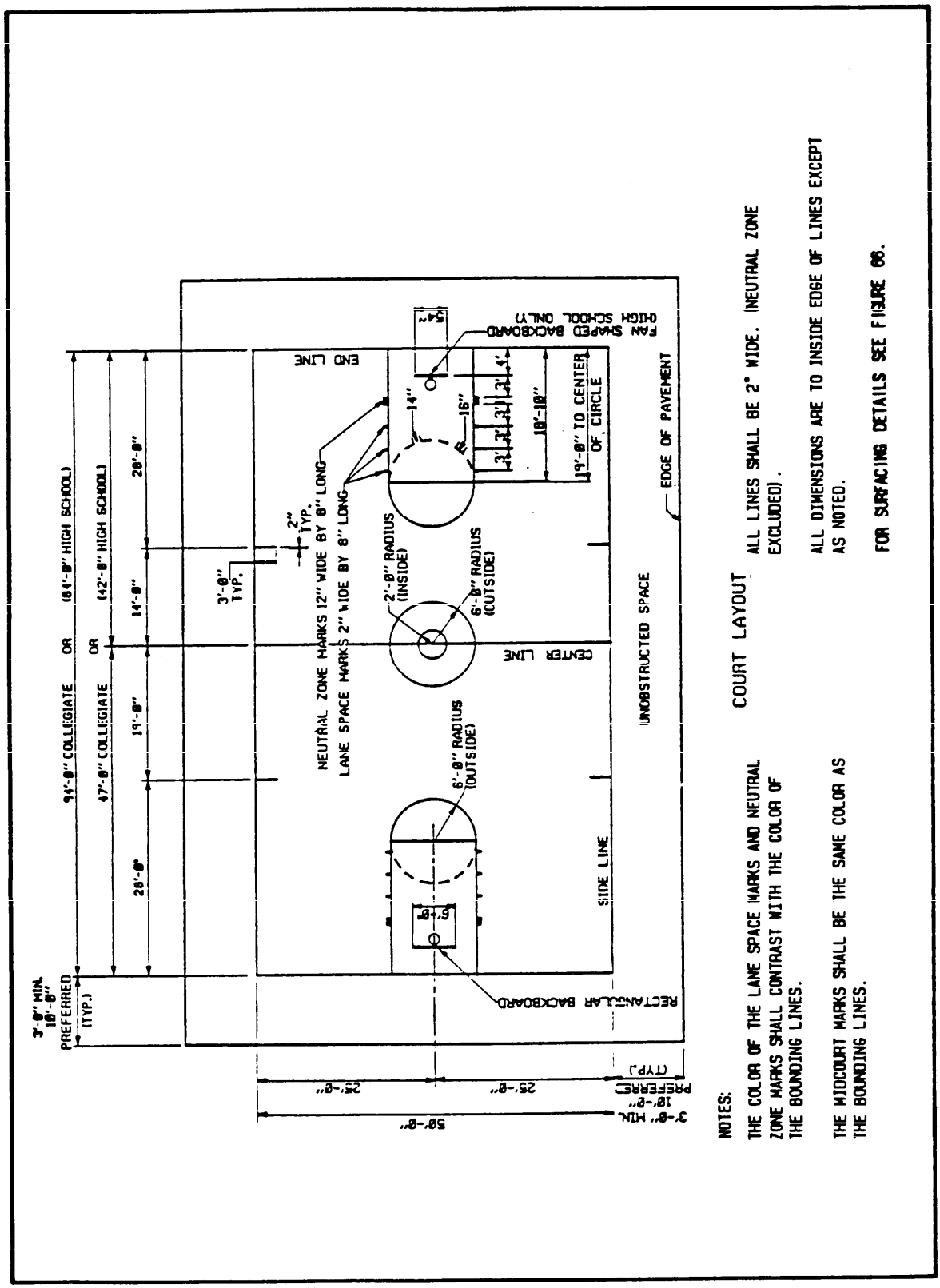


Figure 3a
Basketball (NCAA) -- Court Layout

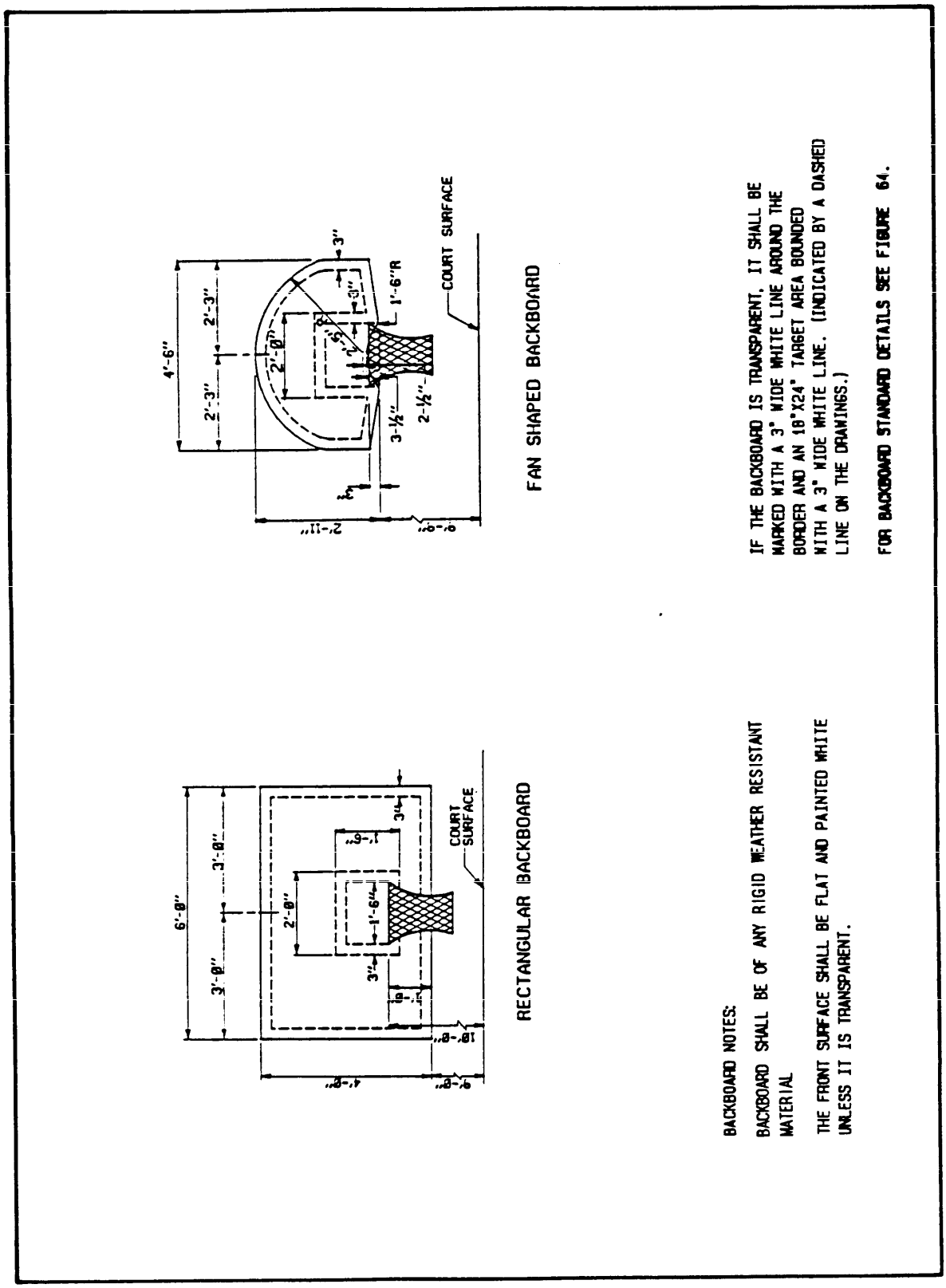


Figure 3b
Basketball (NCAA) -- Backboards

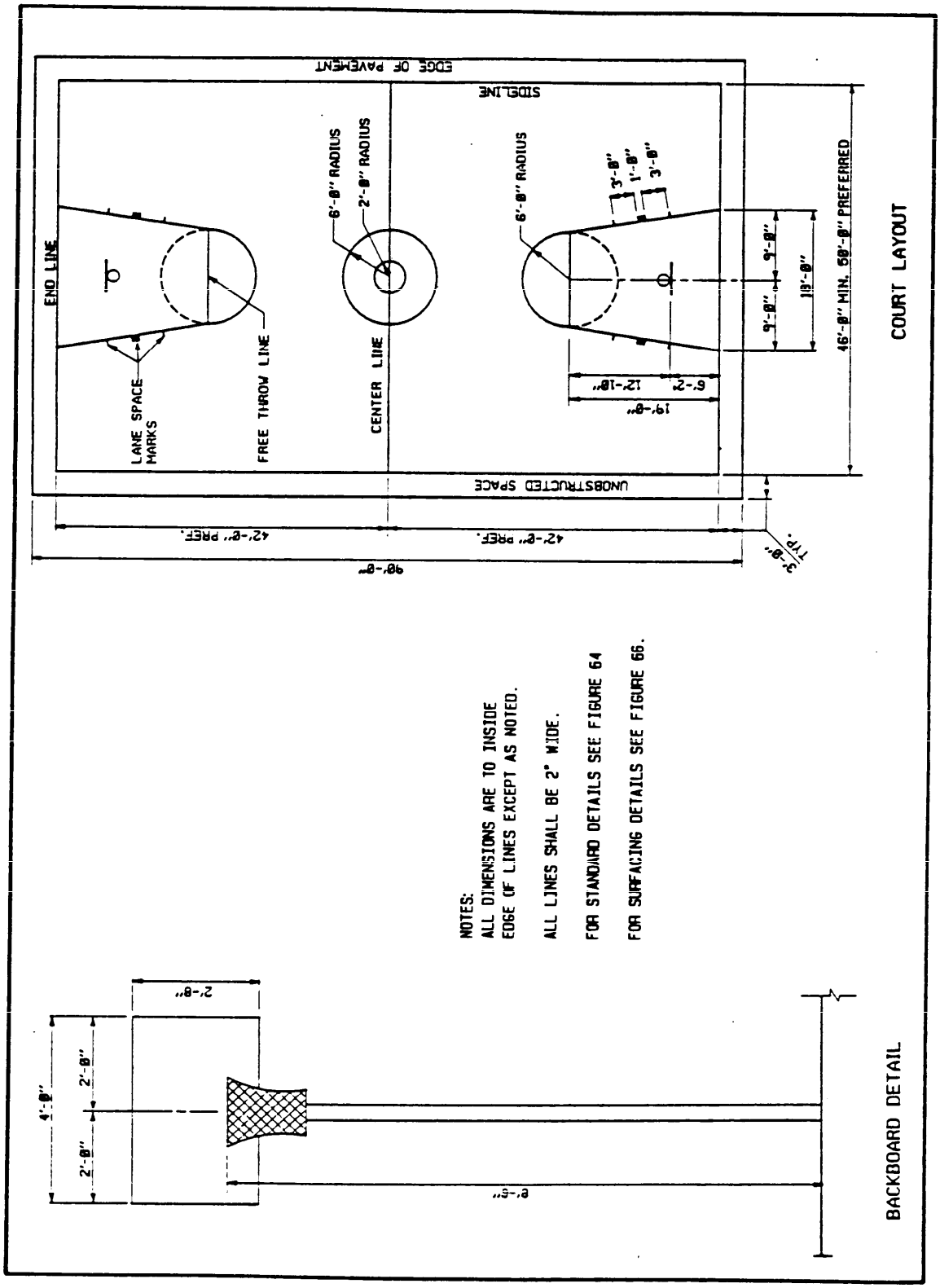


Figure 4
Biddy Basketball Court

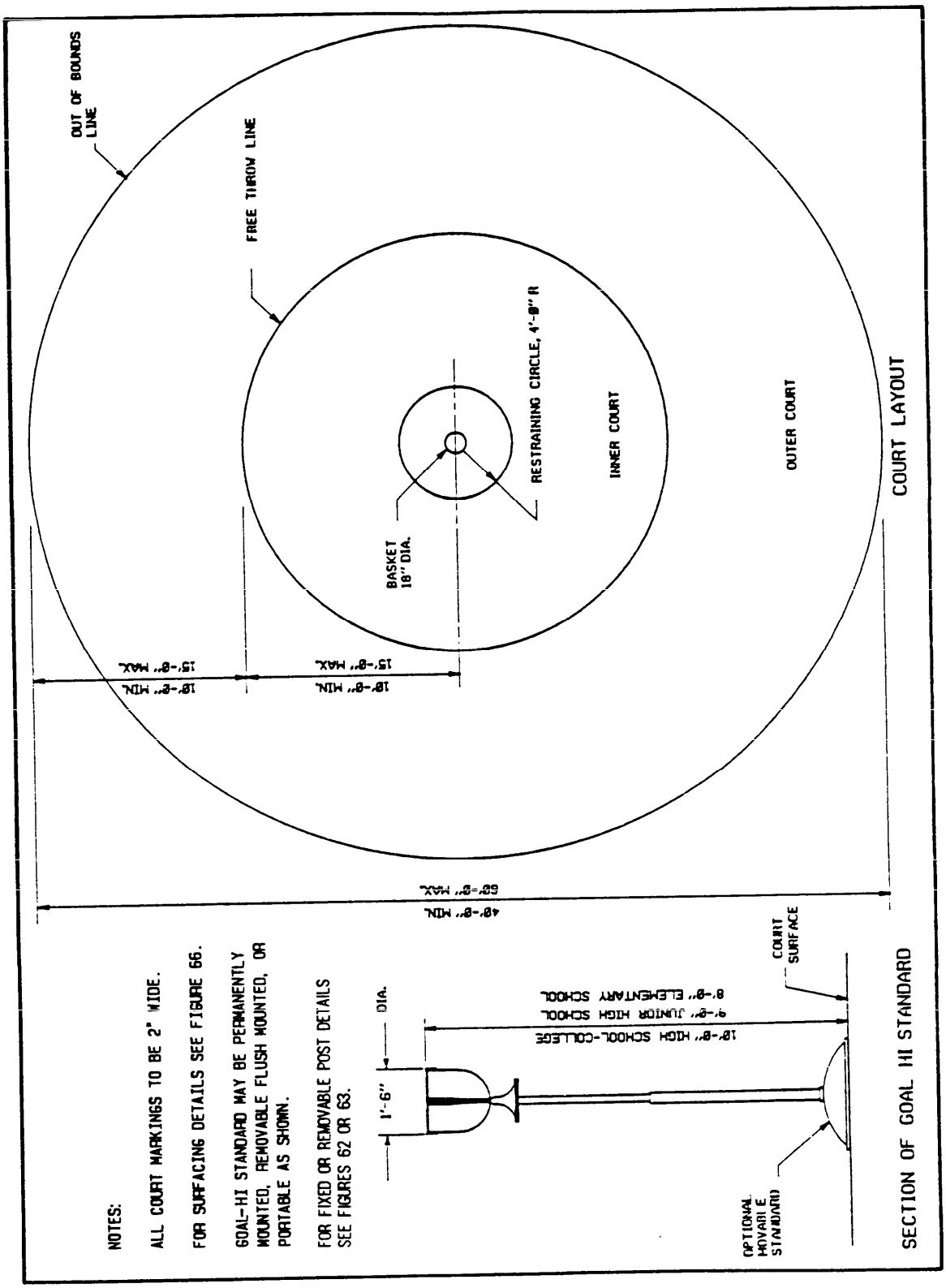


Figure 5
Goal-Hi Basketball Court

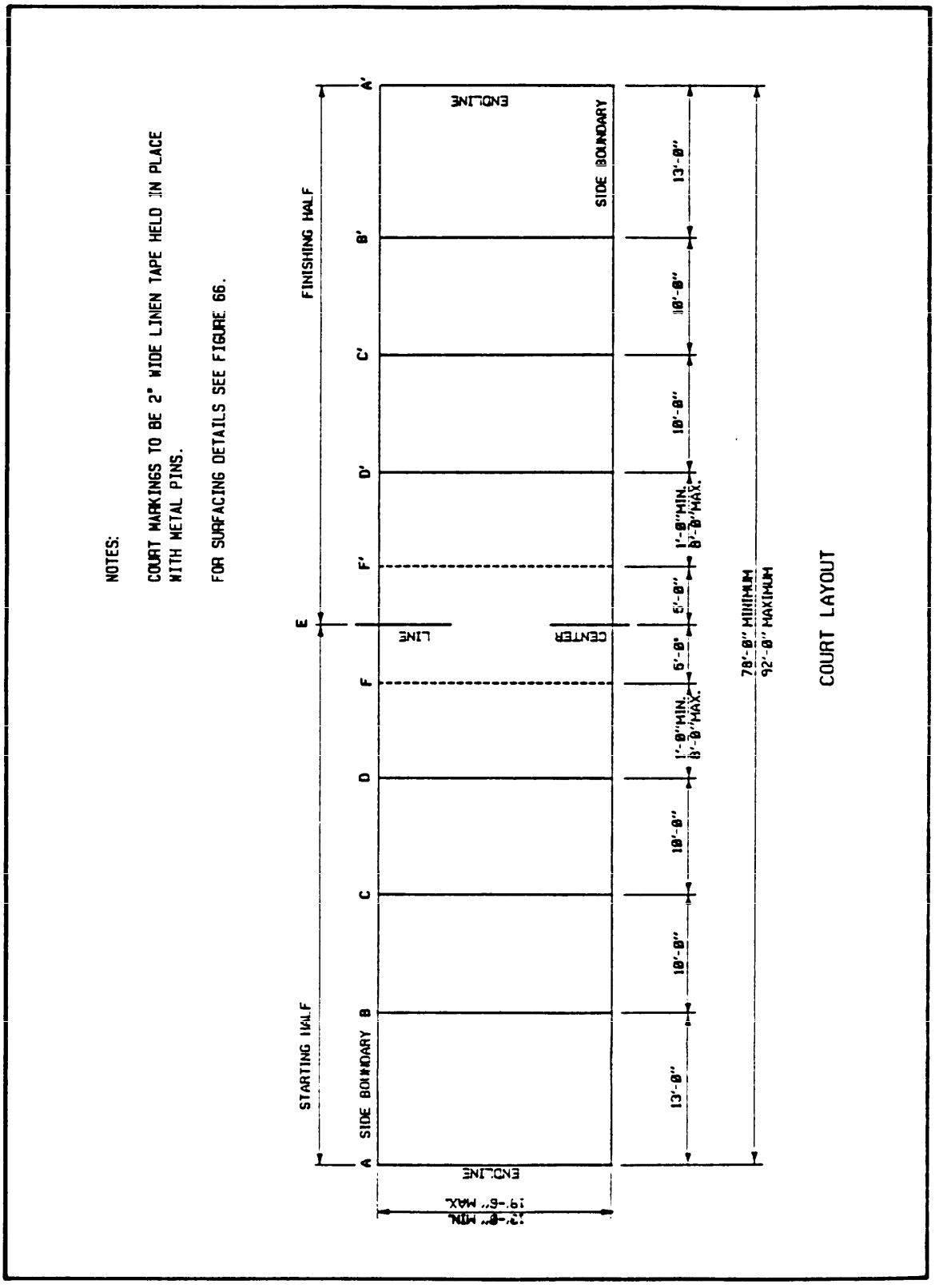


Figure 6
Boccie Court

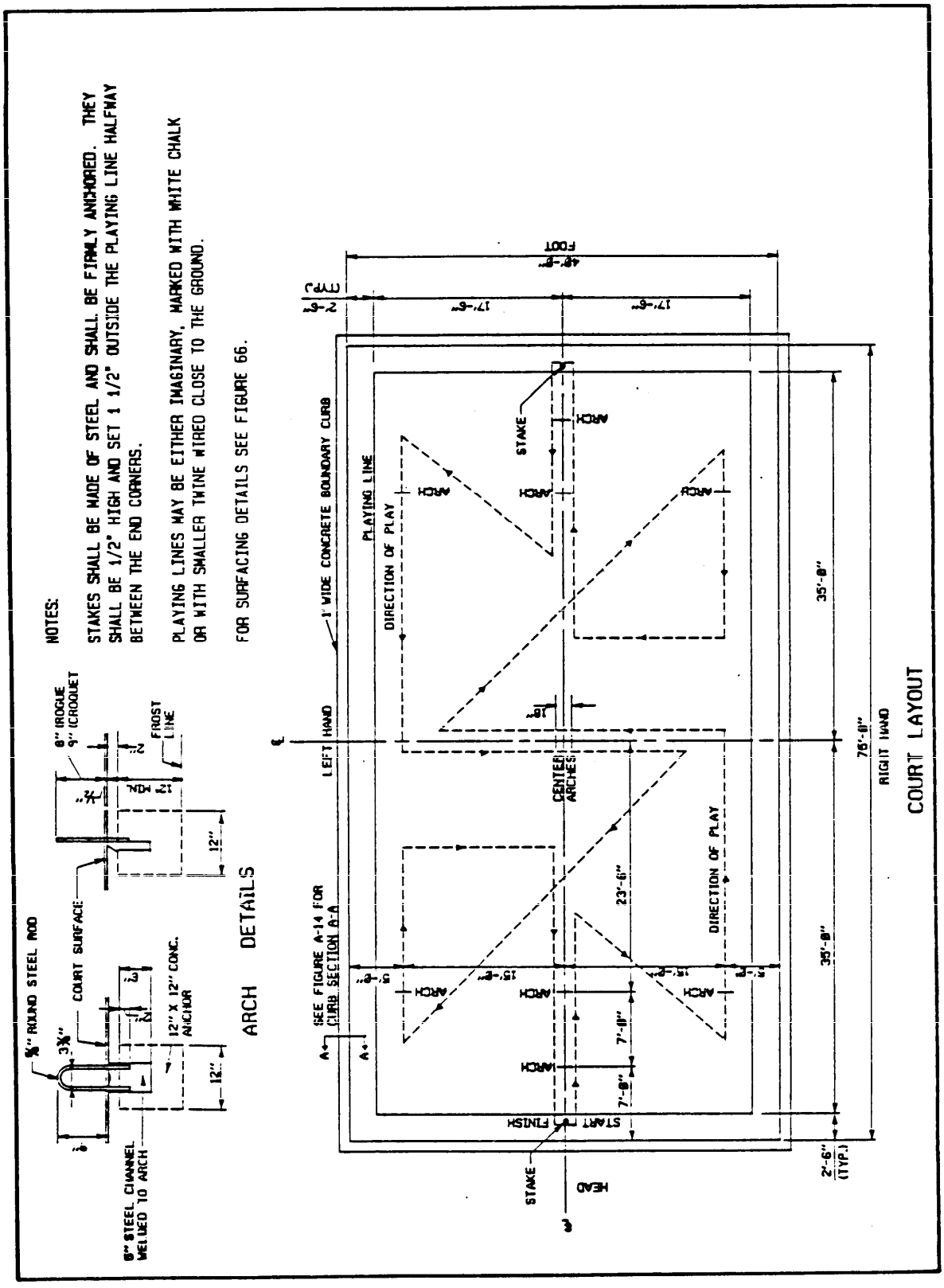


Figure 7
Croquet Court

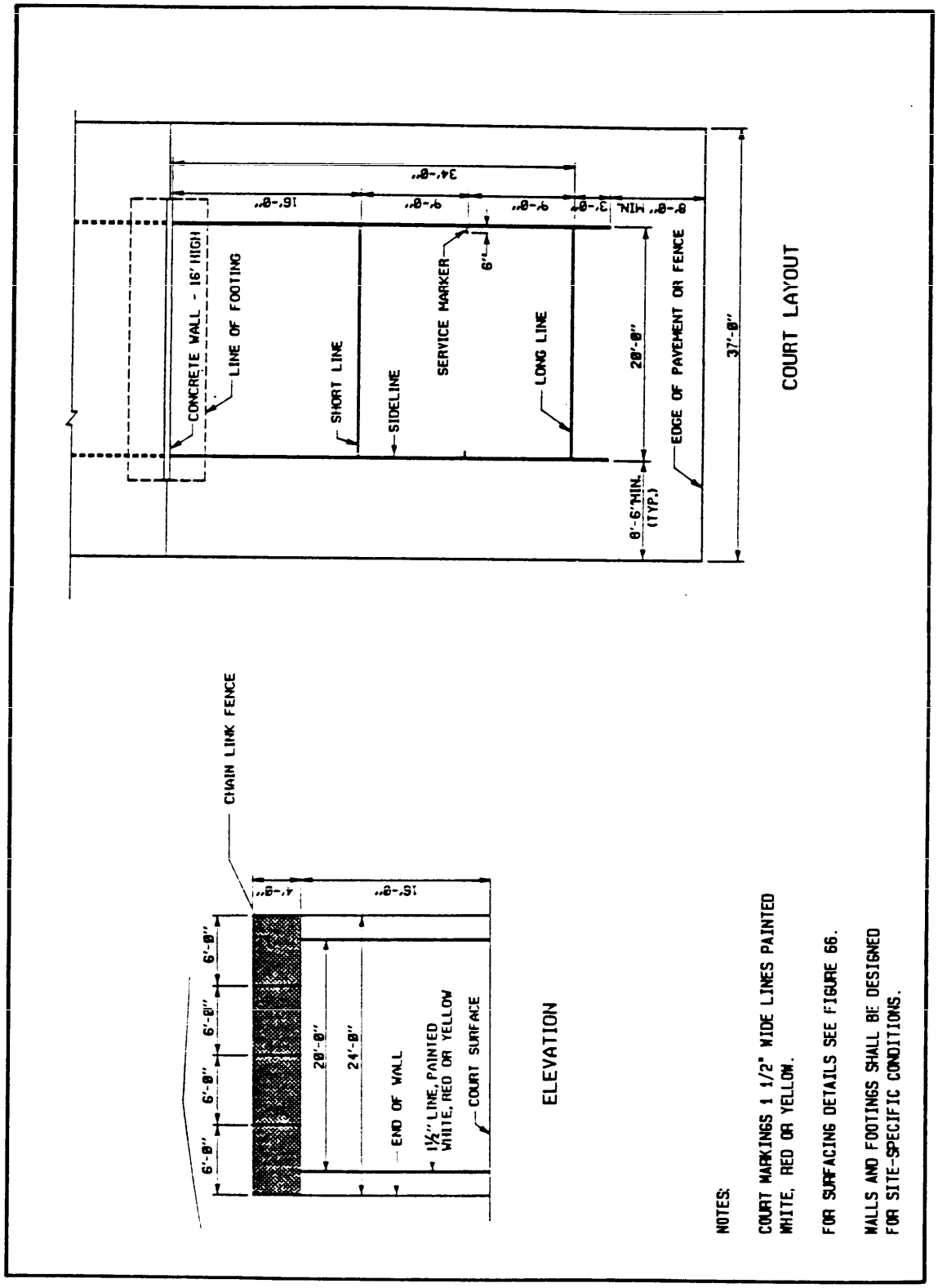


Figure 8
One-Wall Handball Court

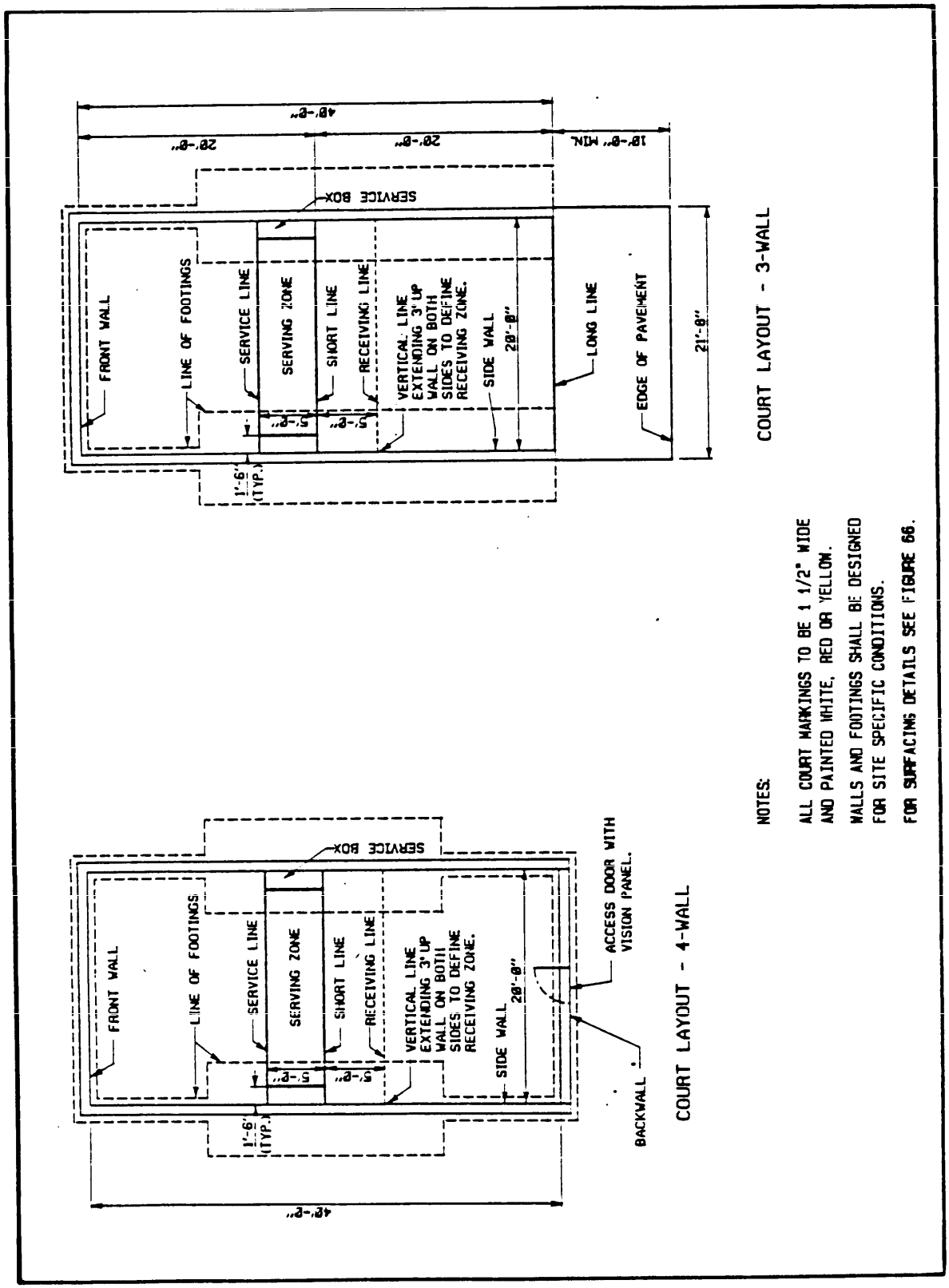
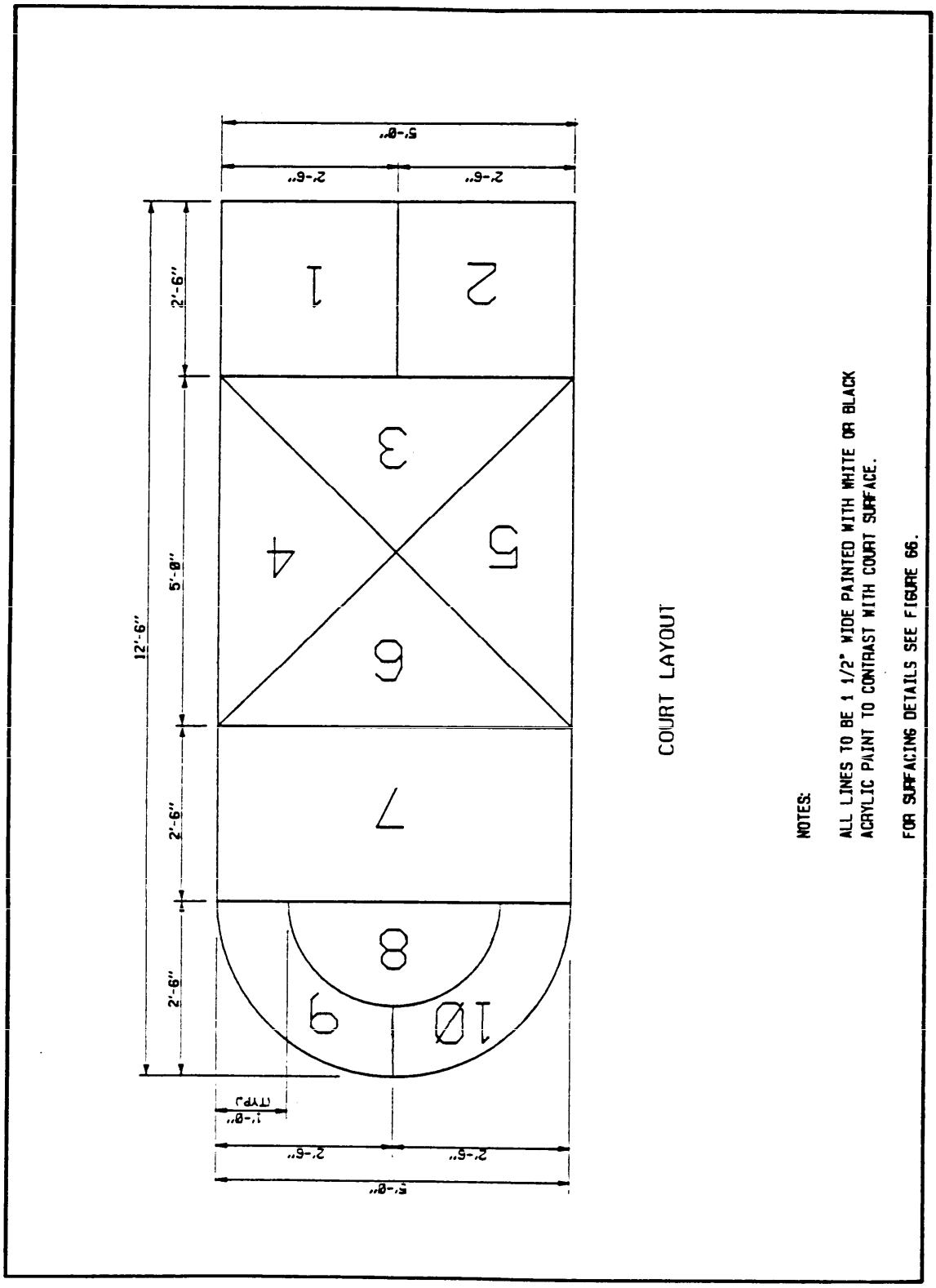


Figure 9
Three- and Four-Wall Handball Court



COURT LAYOUT

NOTES:

ALL LINES TO BE 1 1/2" WIDE PAINTED WITH WHITE OR BLACK ACRYLIC PAINT TO CONTRAST WITH COURT SURFACE.

FOR SURFACING DETAILS SEE FIGURE 66.

Figure 10
Hopscotch Court

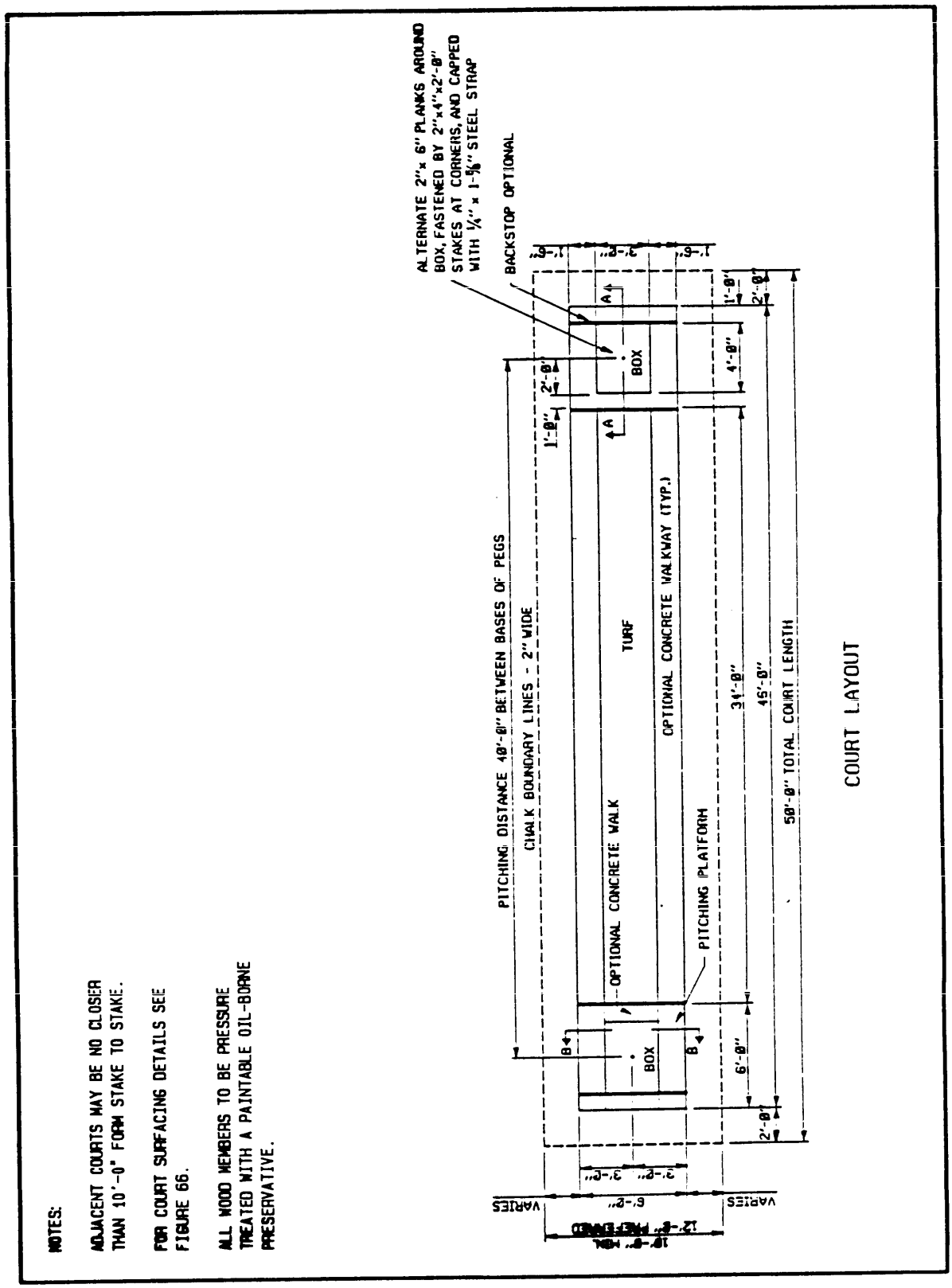


Figure 11a
Horseshoes Court -- Layout

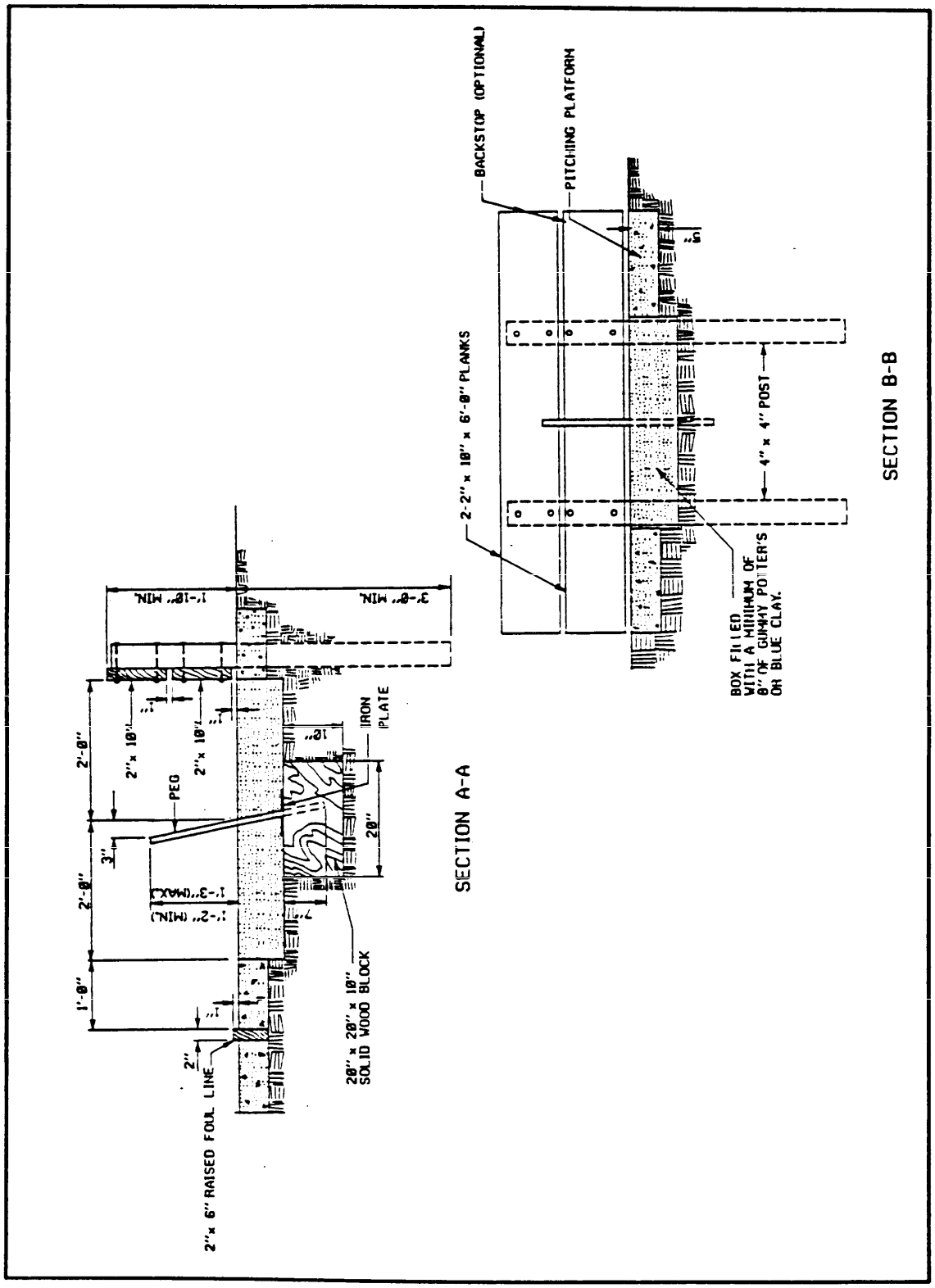


Figure 11b
Horseshoes Court -- Construction Details

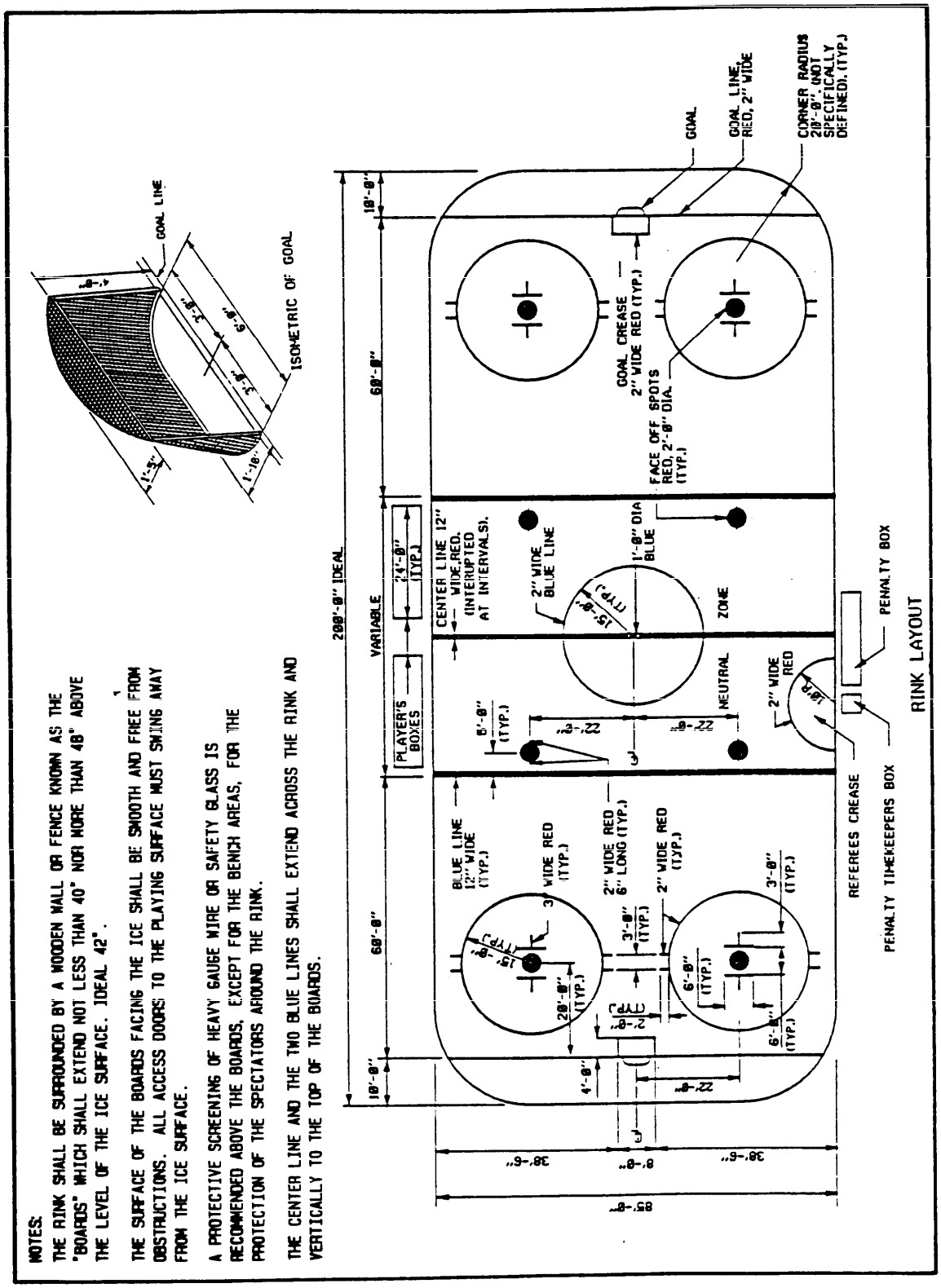


Figure 12
Ice Hockey Rink

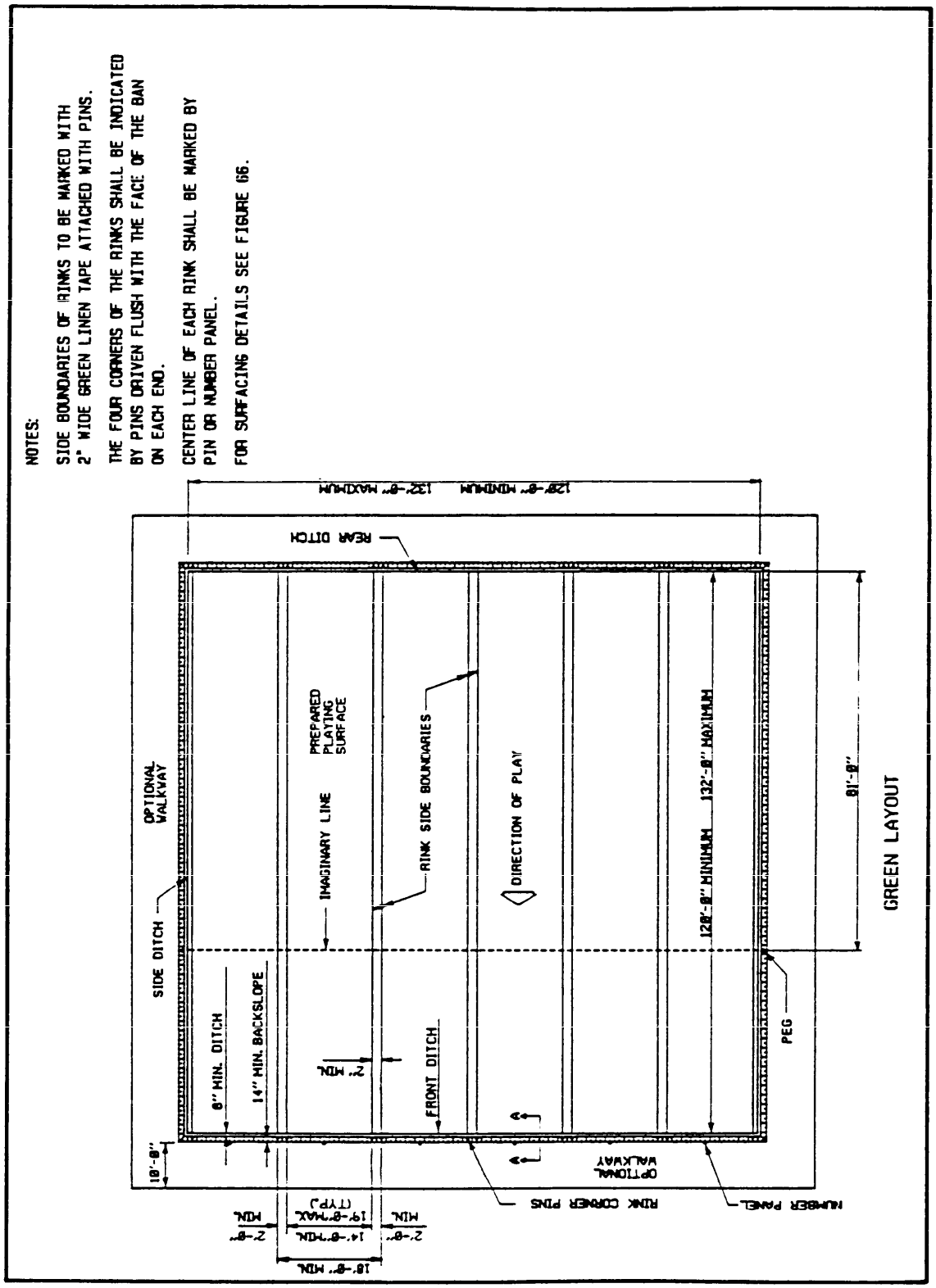


Figure 13a
Lawn Bowling Green -- Layout

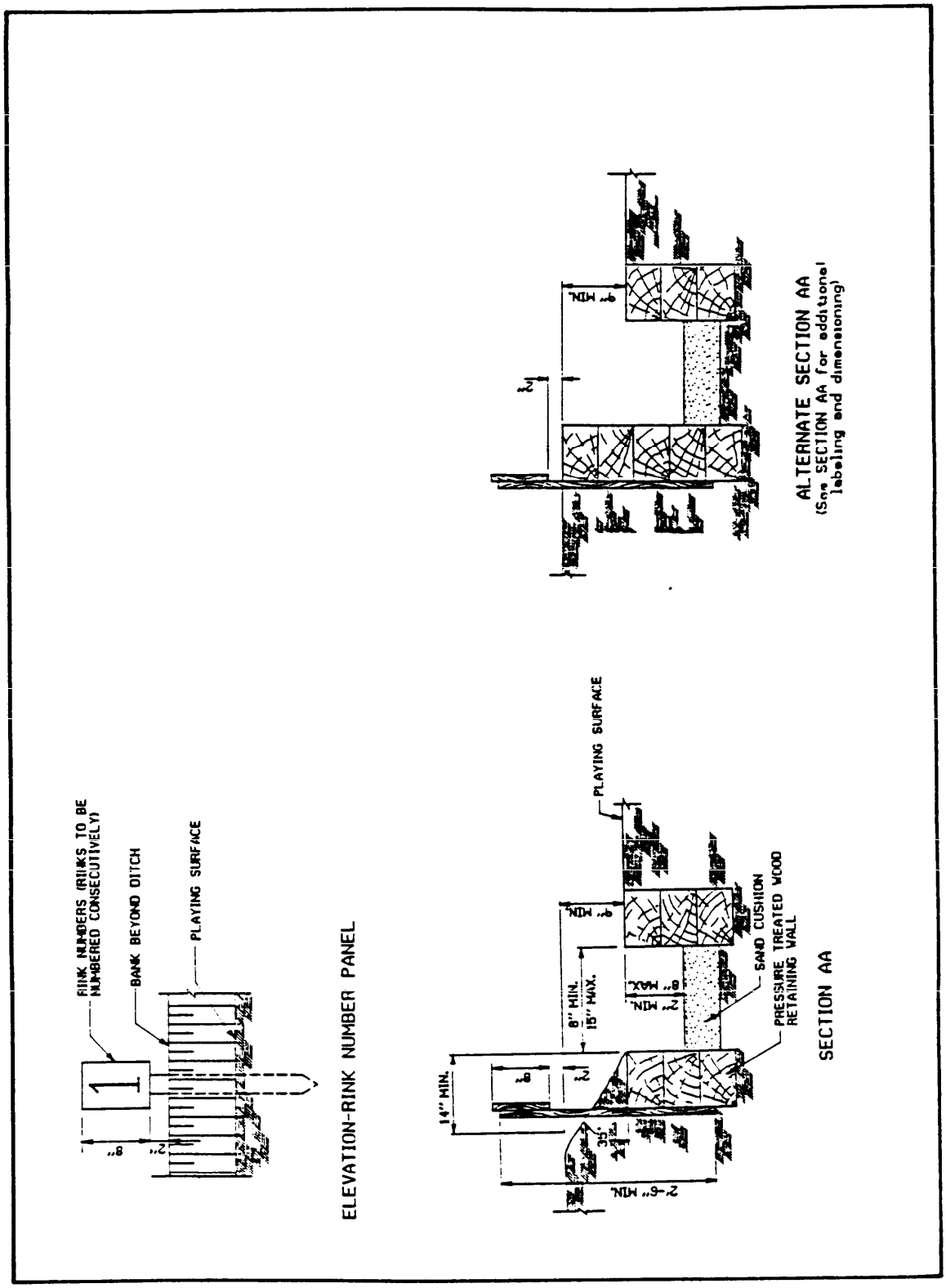


Figure 13b
Lawn Bowling Green -- Construction Details

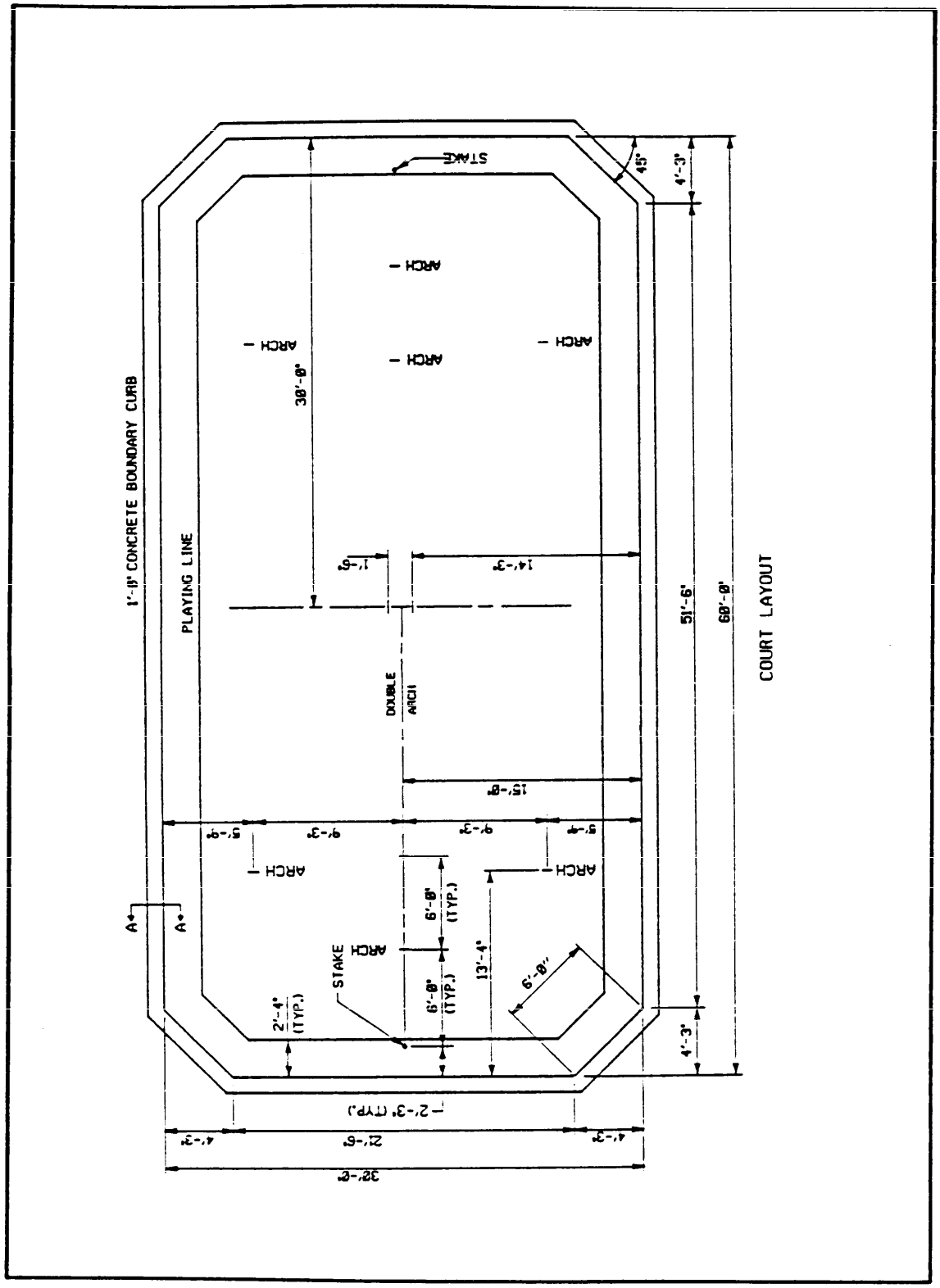


Figure 14a
Roque Court -- Layout

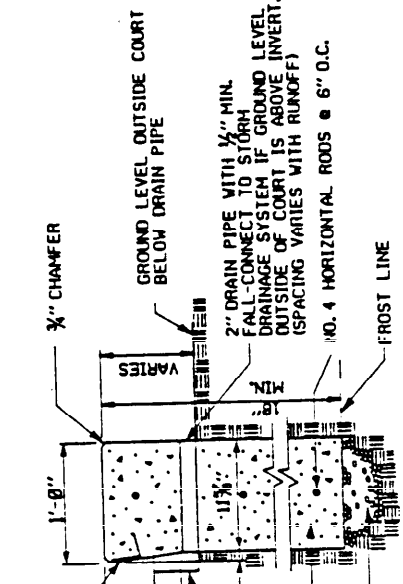
tailoring of technical data. TABLE V. Methodology for the abbreviation and

NOTES:

PLAYING LINES ARE MARKED BY A LIGHT DEPRESSION IN PLAYING SURFACE WITHOUT RAISING ADJACENT SOIL.

STAKES ARE 3/4" DIA. STEEL, SET RIGIDLY IN THE GROUND AND EXTENDING 2" ABOVE THE SURFACE.

SEE DETAIL ON FIGURE 7 FOR ARCH DETAILS.



CURB SECTION A-A

Figure 14b
Roque Court -- Construction Details

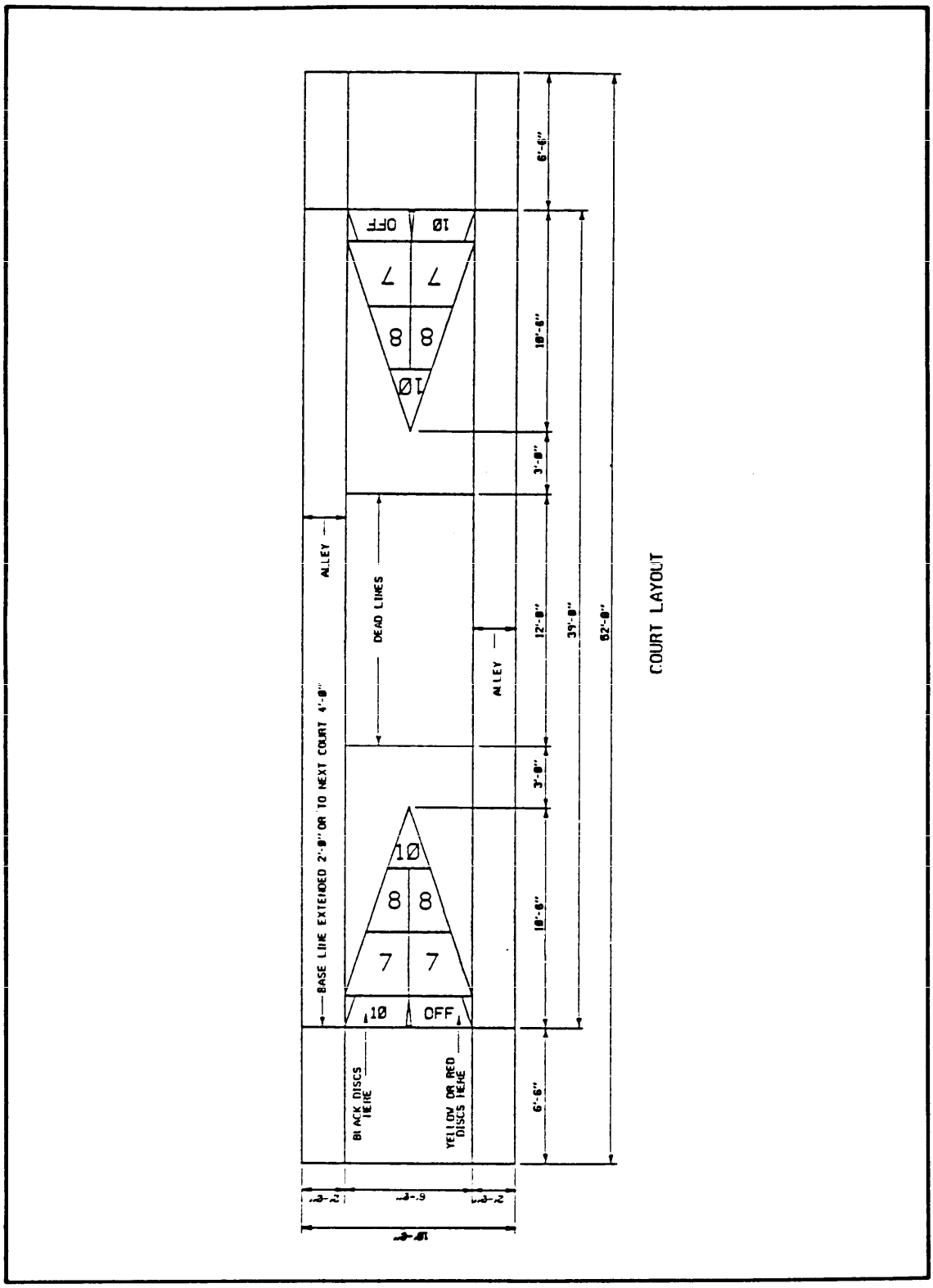


Figure 15a
Shuffleboard Court -- Layout

NOTES:

ALL DIMENSIONS ARE TO CENTERS OF LINES AND TO EDGE OF COURT.

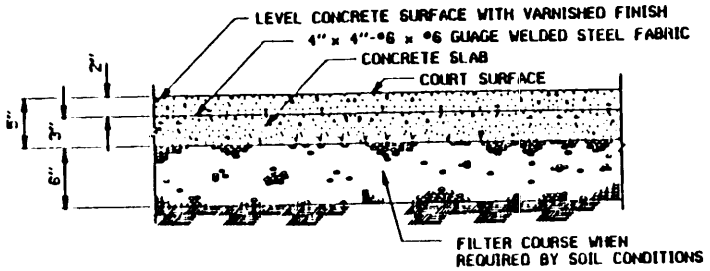
MAXIMUM LINE WIDTH 1 1/2", MINIMUM 3/4".

LINES AND FIGURES SHALL BE MARKED WITH BLACK SHOE DYE OR BLACK ACRYLIC PAINT.

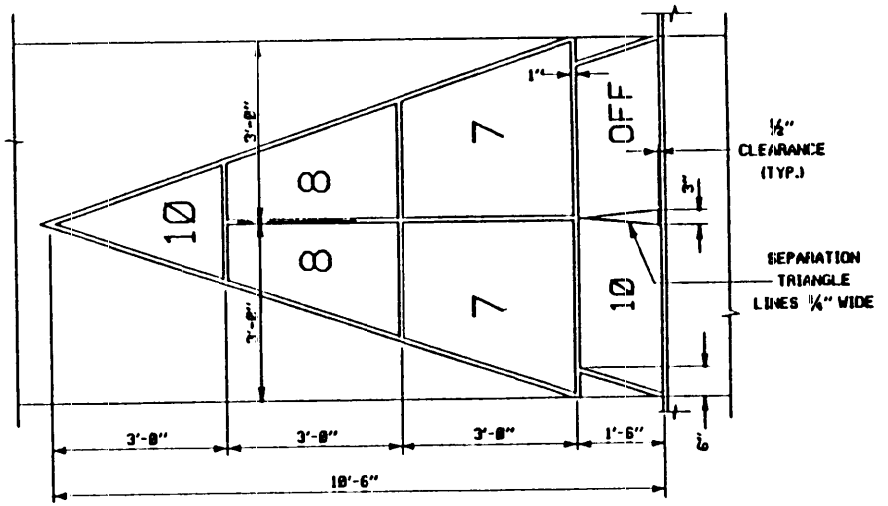
COURT TO BE CONSTRUCTED OF CONCRETE WITHOUT EXPANSION JOINTS.

A DEPRESSED ALLEY AT LEAST 24" WIDE AND NOT LESS THAN 4" DEEP AT MIDCOURT, SHOULD BE CONSTRUCTED BETWEEN COURTS AND ON THE OUTSIDE OF END COURTS.

THE ALLEY SHOULD SLOPE 1" IN THE FIRST 6' OF THE LENGTH OF THE ALLEY FROM EACH BASE LINE, THEN SLOPE TO A MINIMUM DEPTH OF 4" AT MIDCOURT WHERE A SUITABLE WATER DRAIN SHOULD BE PROVIDED.



TYPICAL SECTION



COURT MARKING DETAIL

Figure 15b
Shuffleboard Court -- Construction Details

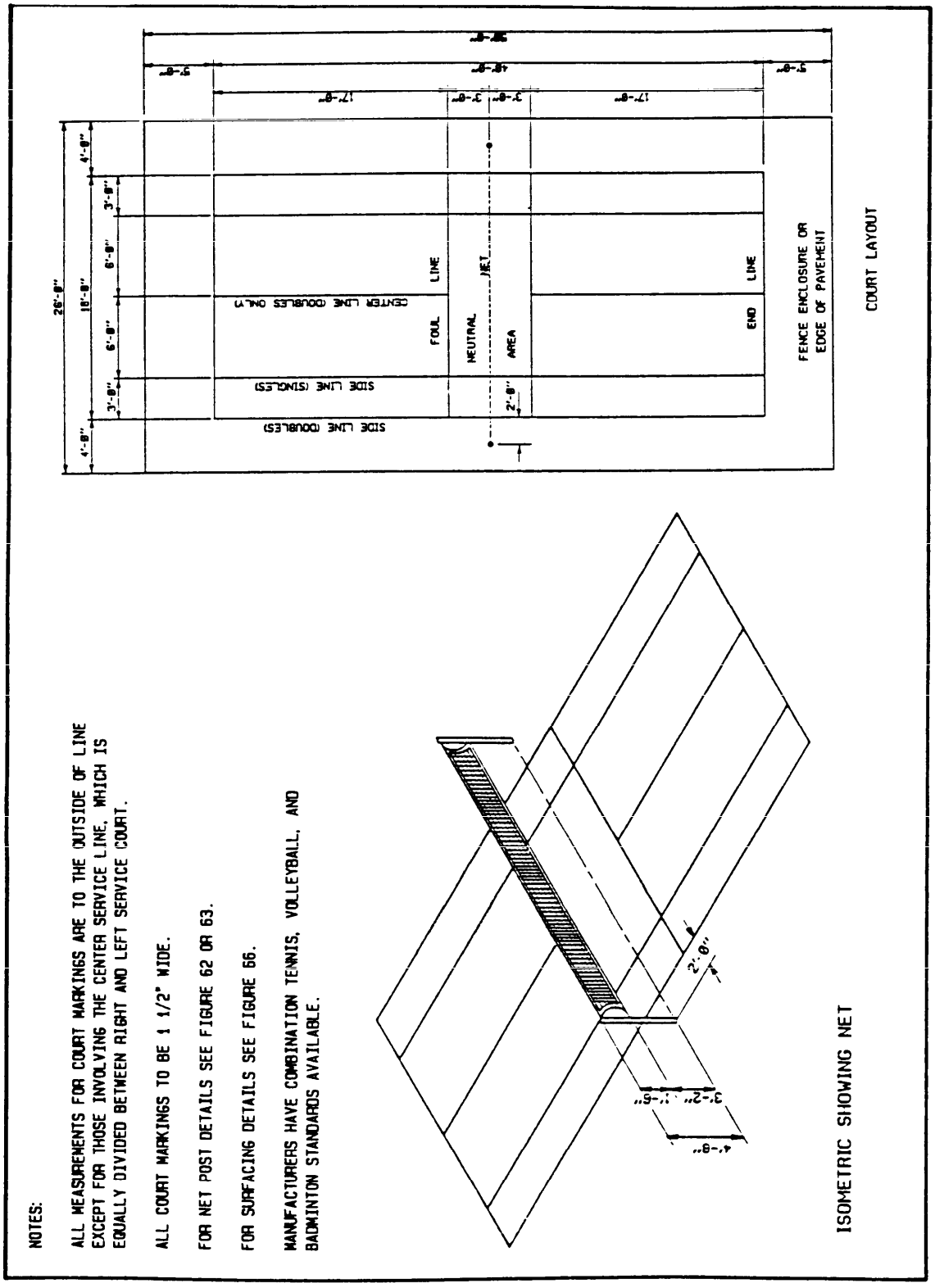


Figure 16
Deck Tennis Court

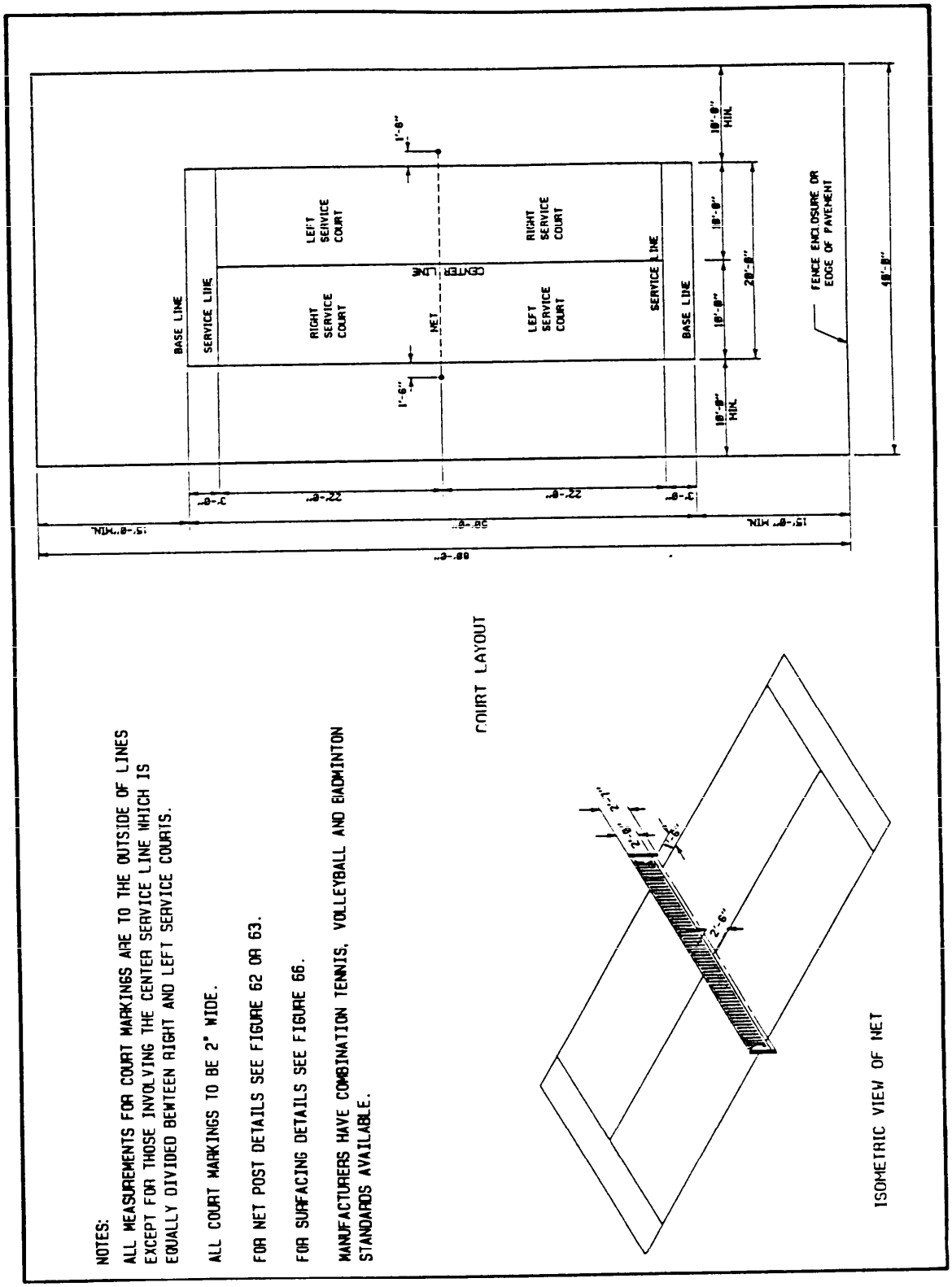


Figure 17
Paddle Tennis Court

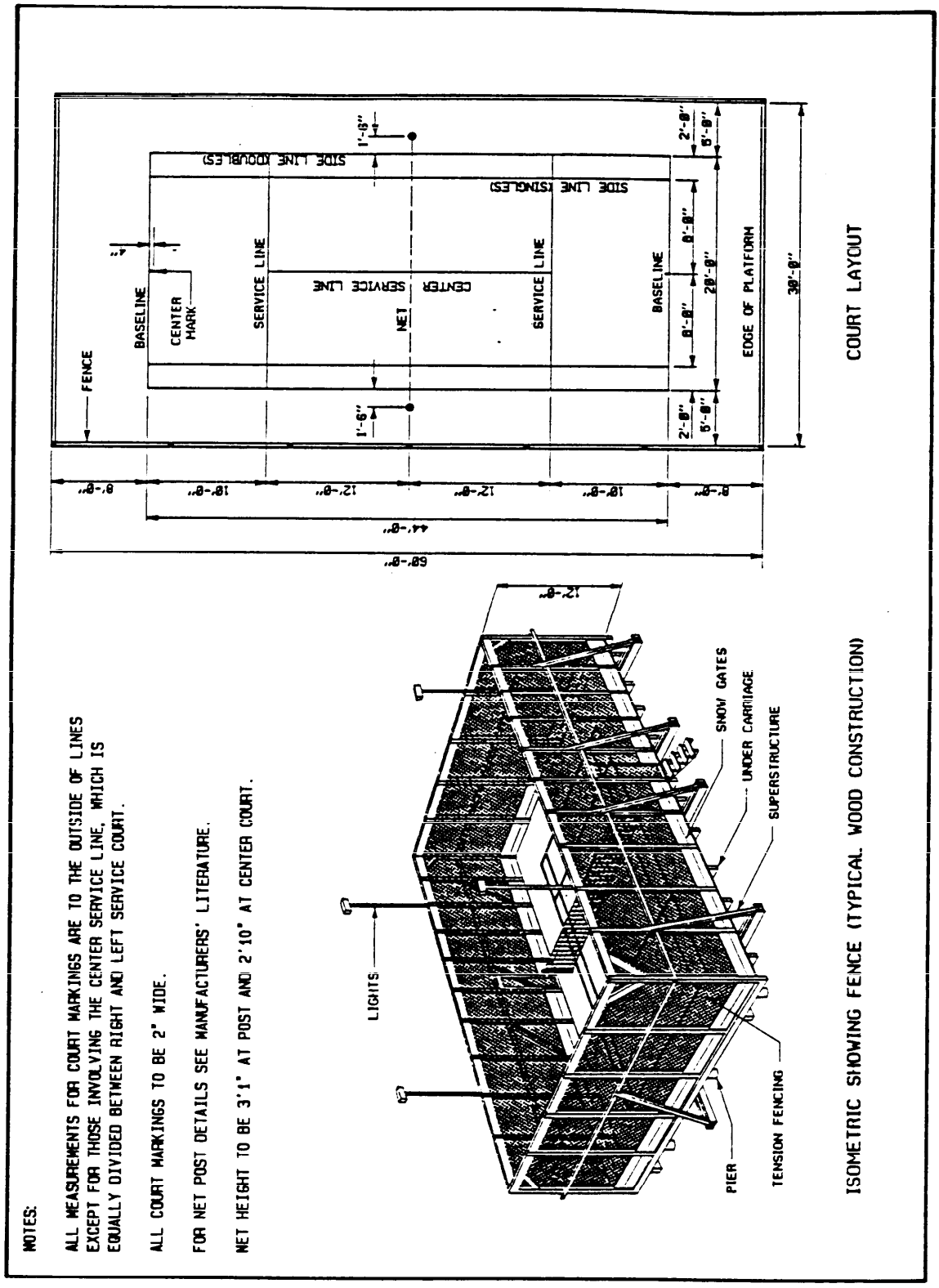


Figure 18
Platform Tennis Court

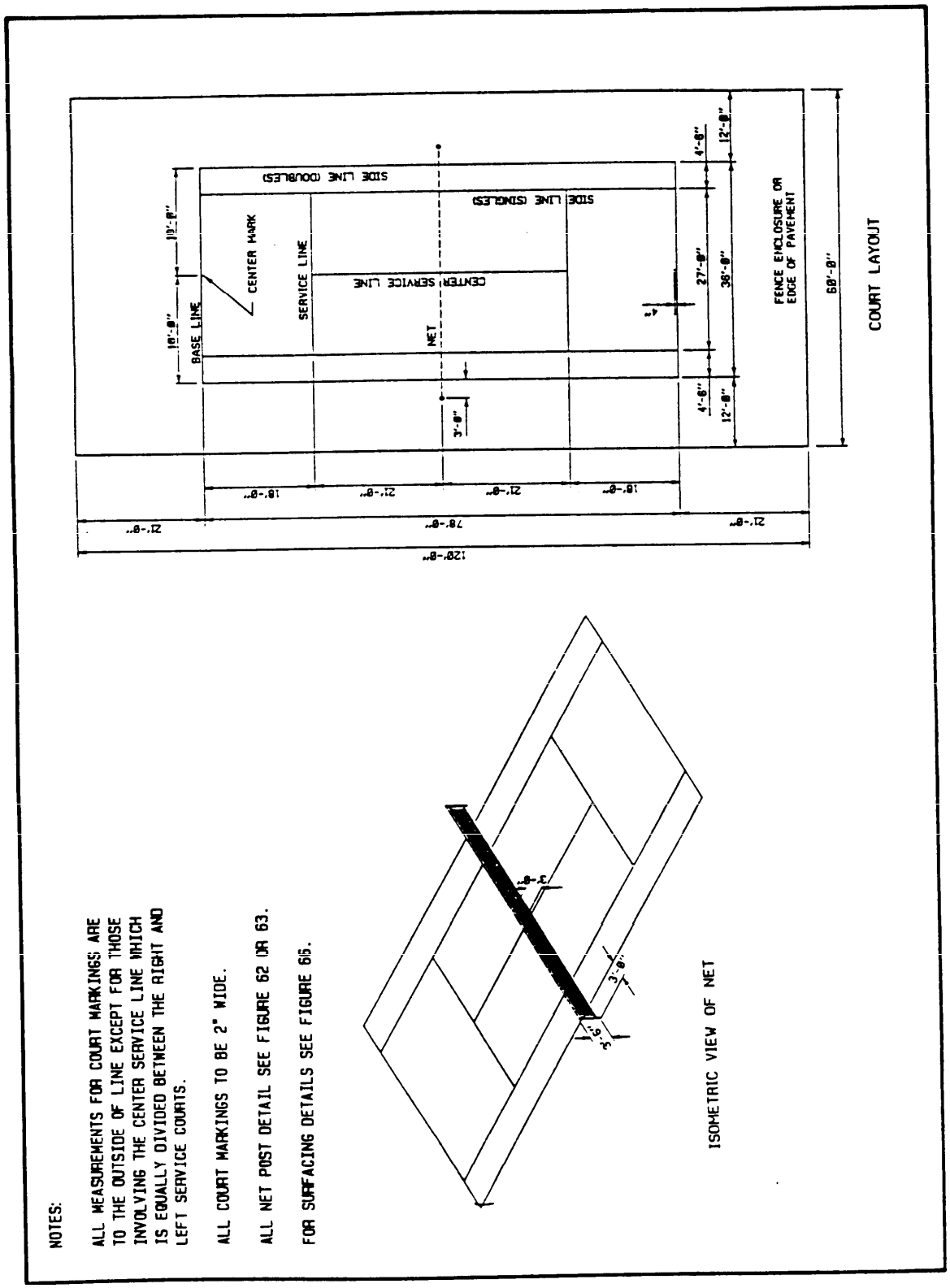


Figure 19
Tennis Court

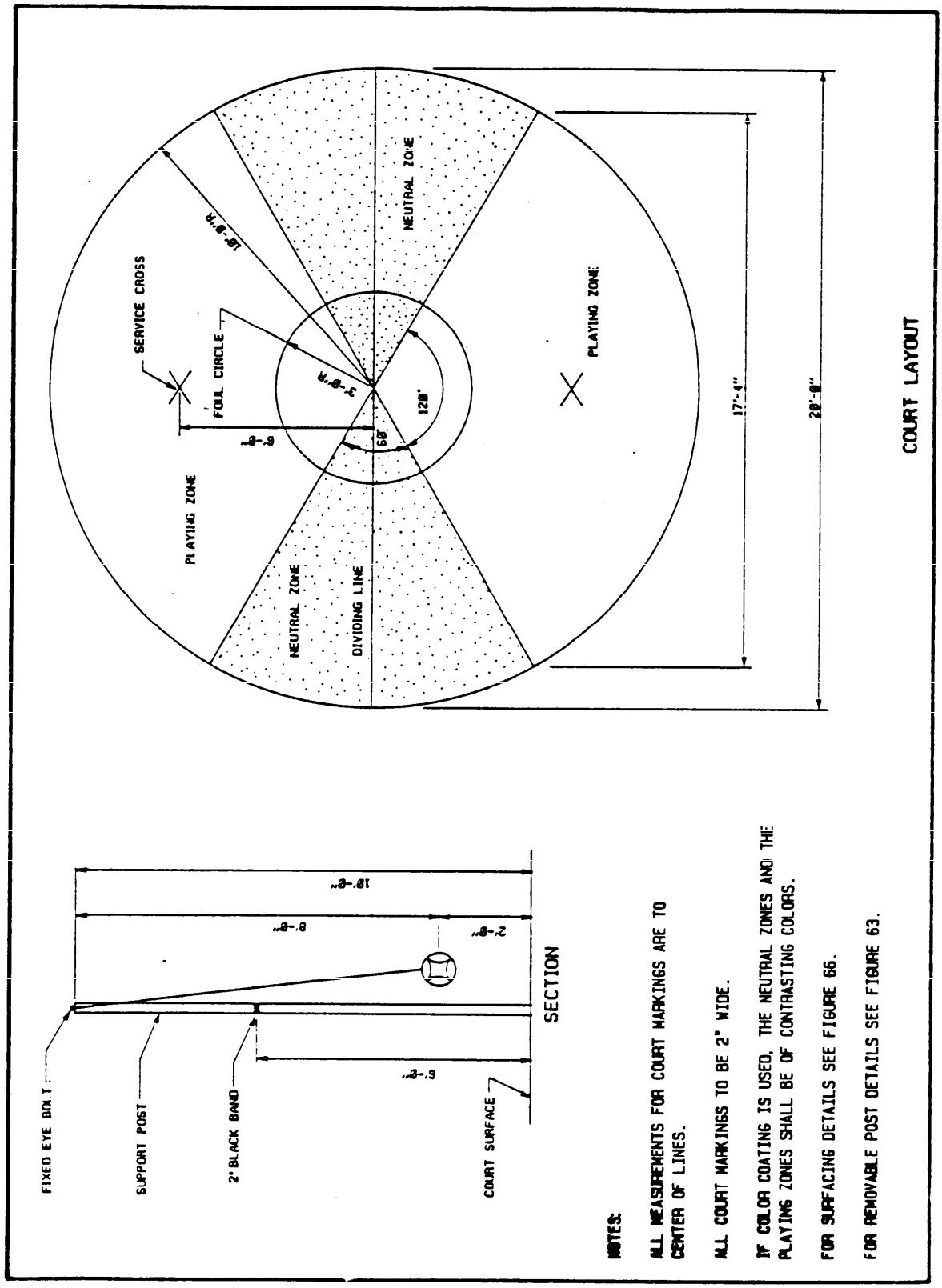
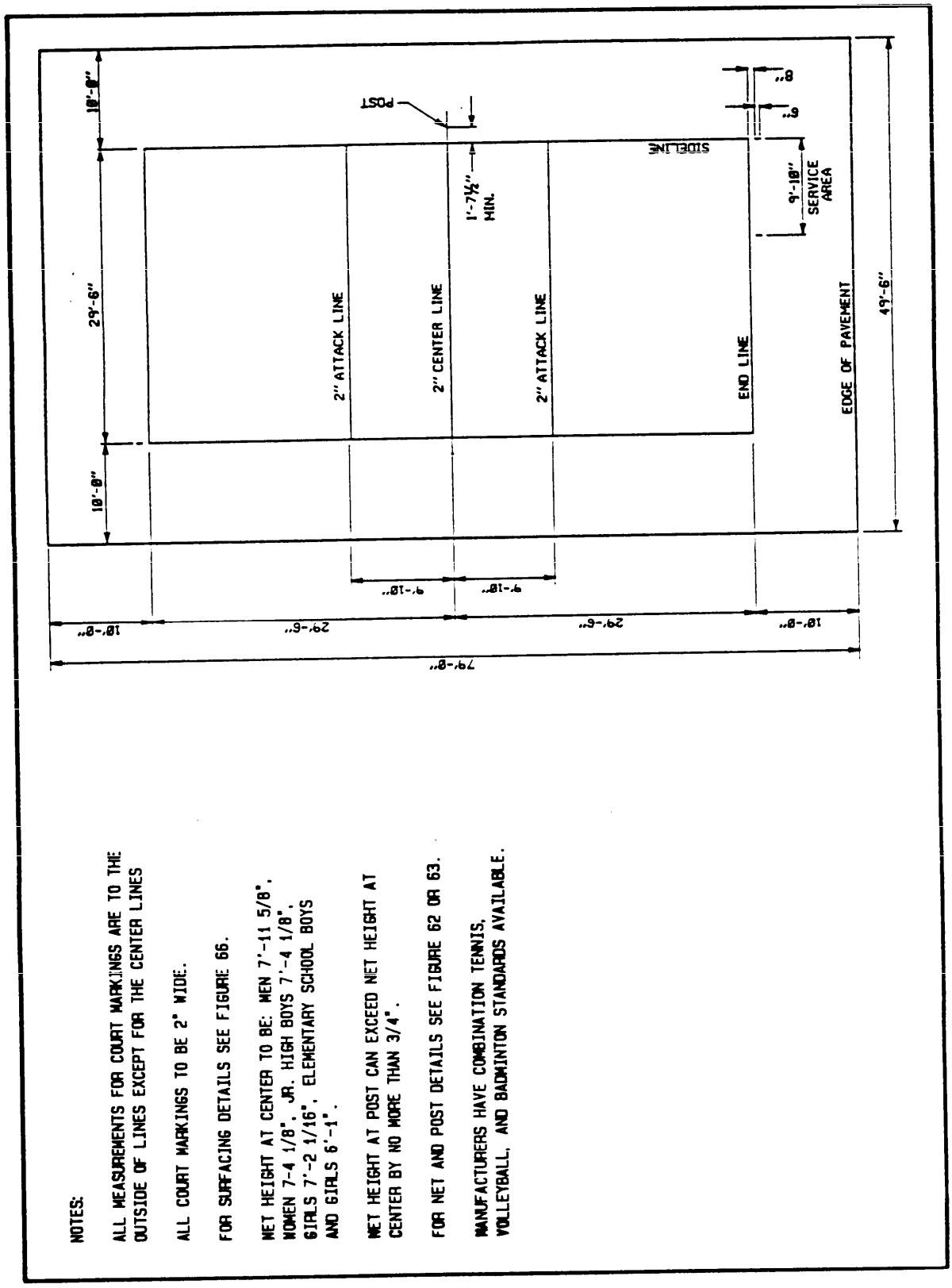


Figure 20
Tetherball Court



NOTES:

ALL MEASUREMENTS FOR COURT MARKINGS ARE TO THE OUTSIDE OF LINES EXCEPT FOR THE CENTER LINES

ALL COURT MARKINGS TO BE 2" WIDE.

FOR SURFACING DETAILS SEE FIGURE 66.

NET HEIGHT AT CENTER TO BE: MEN 7'-11 5/8", WOMEN 7-4 1/8", JR. HIGH BOYS 7'-4 1/8", GIRLS 7'-2 1/16", ELEMENTARY SCHOOL BOYS AND GIRLS 6'-1".

NET HEIGHT AT POST CAN EXCEED NET HEIGHT AT CENTER BY NO MORE THAN 3/4".

FOR NET AND POST DETAILS SEE FIGURE 62 OR 63.

MANUFACTURERS HAVE COMBINATION TENNIS, VOLLEYBALL, AND BADMINTON STANDARDS AVAILABLE.

Figure 21a
Volleyball Court -- Dimensions

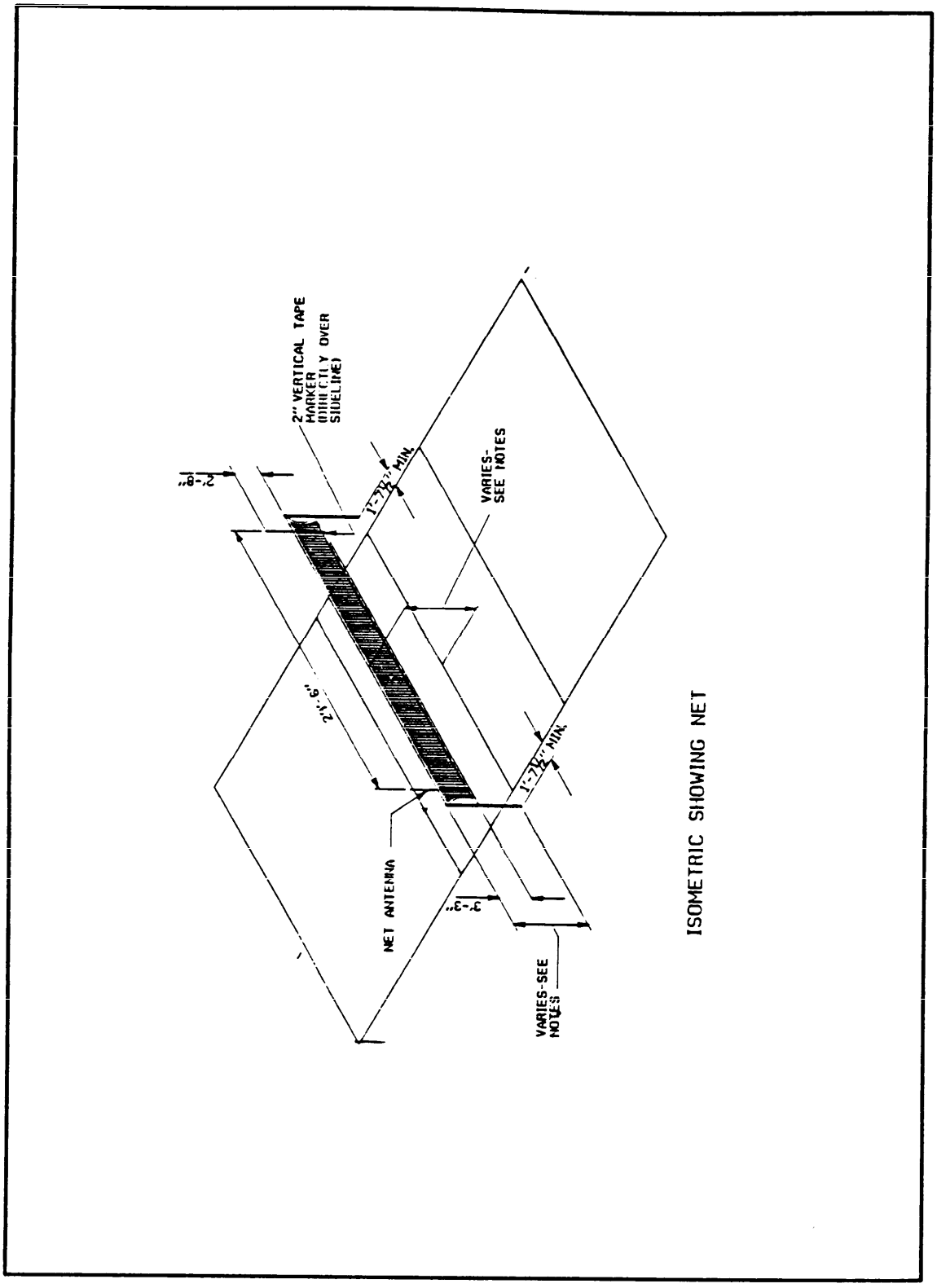


Figure 21b
Volleyball Court -- Layout and Net

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Section 3: SPORTS FIELDS

3.1 Official Baseball. The official baseball (including Babe Ruth and Senior League) playing area (see Figure 22) shall be as follows.

a) Source of Information: The Official Playing Rules Committee, 1974, Babe Ruth Baseball, Senior League Baseball, Little League Baseball, Inc.

b) Recommended Area: The minimum ground space shall be 3 to 3.5 acres (1.21 to 1.42 ha).

c) Size and Dimensions: The baselines shall be 90 ft (27.4 m), the pitching distance 60.5 ft (18.4 m) and the pitchers mound 10 in. (254 mm) above the level of homeplate. The distance down the foul lines shall be 325 ft (99.06 m) minimum, or preferably 350 ft (106.68 m). The outfield distance to center field shall be 400 ft (121.92 m). For Senior League Baseball the recommended distance from plate to outfield fence at all points shall be greater than or equal to 300 ft (91.4 m). All distances are measured from homeplate.

d) Orientation: The optimum orientation is to locate homeplate so that the pitcher is throwing across the sun and the batter is not facing it. The line from homeplate through the pitchers mound to second base should run east-northeast.

e) Surface and Drainage: The surface shall be turf. The infield may be skinned, and shall be graded so that the baselines and homeplate are level.

f) Special Considerations: A backstop shall be provided at a minimum distance of 40 ft (12.19 m) or preferably 60 ft (18.29 m) behind homeplate.

3.2 Bronco League Baseball (9-12 years). The Bronco League playing area (see Figure 23) shall be as follows.

a) Source of Information: Pony Baseball (PB)

b) Recommended Area: The ground space shall be 1 acre (minimum).

c) Size and Dimension: Baselines shall be 70 ft (21.3 m), the pitching distance 48 ft (14.6 m) and the pitcher's plate shall be 6 in. (152.4 mm) above the level of homeplate. The distance down foul line shall be 200 ft (60.96 m). The outfield distance to pocket in center field shall be 250 ft.

d) Orientation: The optimum orientation shall be to locate homeplate so that the pitcher is throwing across the sun and the batter is not facing it. The line from homeplate through the pitcher's mound and second base shall run east-northeast.

e) Surface and Drainage: The surface shall be turf. Infield may be skinned, and shall be graded so that the baselines and homeplate are level.

f) Special Considerations: A backstop shall be provided at the recommended distance of 30 ft (9.14 m) behind homeplate.

3.3 Pony League Baseball (13-14 years). The Pony League baseball playing area (see Figure 24) shall be as follows.

a) Source of Information: Pony Baseball (PB)

b) Recommended Area: The ground space shall be 2 acres (0.809 ha) minimum.

c) Size and Dimension: The baselines shall be 80 ft (24.38 m), pitching distance 54 ft (16.46 m), and the pitcher's plate shall be 8 in. (203.2 mm) above the level of homeplate. The distance down the foul line shall be 250 ft (76.2 m) and the outfield distance to pocket in center field shall be 300 ft (91.44 m).

d) Orientation: The optimum orientation shall be to locate homeplate so that the pitcher is throwing across the sun and the batter is not facing it. The line from homeplate through the pitcher's mound and second base shall run east-northeast.

e) Surface and Drainage: The surface shall be turf. The infield may be skinned, and shall be graded so that the baselines and homeplate are level.

f) Special Considerations: A backstop shall be provided at a recommended distance of 40 ft (12.19 m) behind homeplate.

3.4 Colt League Baseball (15-16 years). The Colt League baseball playing area (see Figure 25) shall be as follows.

a) Source of Information: Pony Baseball (PB)

b) Recommended Area: The ground space shall be 3 acres (1.21 ha) minimum.

c) Size and Dimension: The baselines shall be 90 ft (27.4 m), pitching distance 60 ft (18.29 m), and the pitcher's plate 10 in. (254 mm) above the level of homeplate. The distance down the foul line shall be 300 ft (91.44 m), and the outfield distance to pocket in center field shall be 350 ft (106.68 m).

d) Orientation: The optimum orientation shall be to locate homeplate so that the pitcher is throwing across the sun and the batter is not facing it. The line from homeplate through the pitcher's mound and second base shall run east-northeast.

e) Surface and Drainage: The surface shall be turf. The infield may be skinned, and shall be graded so that the baselines and homeplate are level.

f) Special Considerations: A backstop shall be provided at a recommended distance of 50 ft (15.24 m) behind homeplate.

3.5 Little League Baseball (9-12 years). The Little League Baseball playing area (see Figure 26) shall be as follows.

a) Source of Information: Little League Baseball, Inc.

b) Recommended Area: The ground space shall be 1.2 acres (0.486 ha) minimum.

c) Size and Dimension: The baselines shall be 60 ft (18.29 m), pitching distance 46 ft (14.02 m) and the pitcher's plate shall be 6 in. (152.4 mm) above the level of homeplate. The distance down the foul line shall be 200 ft (61 m) and the outfield distance to pocket in center field shall be 200 to 250 ft (61 to 76.2 m) optional.

d) Orientation: The optimum orientation is to locate homeplate so that the pitcher is throwing across the sun and the batter is not facing it. The line from homeplate through the pitcher's mound and second base shall run east-northeast.

e) Surface and Drainage: The surface shall be turf. The infield may be skinned, and shall be graded so that the baselines and homeplate are level.

f) Special Considerations: A backstop shall be provided at a recommended minimum distance of 25 ft (7.5 m) behind homeplate.

3.6 Softball, 12-Inch (304.56 mm) Fast and Slow Pitch. The 12-inch softball playing area (see Figure 27) shall be as follows.

a) Source of Information: Amateur Softball Association of America (ASA).

b) Recommended Area: The ground space shall be 40,000 ft^2 (3716 m^2) to 90,000 ft^2 (8361 m^2).

c) Size and Dimension: Field size varies depending on player's age group (refer to table on Figure 27).

d) Orientation: The optimum orientation is to locate homeplate so that the pitcher is throwing across the sun and the batter is not facing it.

e) Surface and Drainage: The surface shall be turf. The infield may be skinned and shall be graded so that the baselines and homeplate are level.

f) Special Considerations: A backstop shall be located 25 ft (7.62 m) minimum behind homeplate.

3.7 Softball, 16-Inch (406 mm) Slow Pitch. The 16-inch, slow pitch, softball playing area (see Figure 28) shall be as follows.

a) Source of Information: Amateur Softball Association of America (ASA).

b) Recommended Area: The ground space shall be 50,625 ft² (4703.06 m²) to 75,625 ft² (7025.56 m²).

c) Size and Dimension: The baselines shall be 55 ft (16.76 m) for men and women. The pitching distance shall be 38 ft (11.58 m) for men and women. Playing field radius from homeplate between foul lines shall be 250 ft (76.2 m) for men, 200 ft (61 m) for women.

d) Orientation: The optimum orientation is to locate homeplate so that the pitcher is throwing across the sun and the batter is not facing it.

e) Surface and Drainage: The surface shall be turf. The infield may be skinned and shall be graded so that the baselines and homeplate are level.

f) Special Considerations: The backstop shall be located 25 ft (7.62 m) minimum behind homeplate.

3.8 11-Man Football (NCAA), Pop Warner Junior League Football. The 11-man football playing area (see Figure 29) shall be as follows.

a) Source of Information: National Collegiate Athletic Association (NCAA), Pop Warner Junior League Football.

b) Recommended Area: The ground space shall be 70,700 ft² (6568 m²) minimum.

c) Size and Dimension: The playing field shall be 160 ft (48.77 m) wide x 360 ft (109.7 m) long. Additional area required is 12 ft (3.66 m) minimum unobstructed space on all sides. The surface shall be turf.

d) Orientation: The preferred orientation shall be for the long axis to be northwest-southeast to suit the angle of the sun during the fall playing season, or north-south for longer periods.

e) Surface and Drainage: Surface and drainage shall be as follows.

(1) Surface shall be turf.

(2) The preferred grading shall be a longitudinal crown with a 1 percent slope from center to each side and adequate subdrainage.

(3) Grading may be from side-to-side or corner-to-corner diagonally if conditions do not permit the preferred grading.

f) Special Considerations: Goal posts shall be provided at each end of the playing field. Pylons are to be provided as required by rules.

3.9 Touch and Flag Football. The touch and flag football playing area (see Figure 30) shall be as follows.

a) Source of Information: National Touch and Flag Football Rules available from The Athletic Institute.

b) Recommended Area: The ground space shall be 41,200 ft² (3827.5 m²) minimum.

c) Size and Dimension: The playing field shall be 120 ft (36.58 m) wide x 300 ft (91.4 m) long. Additional area recommended shall be 6 ft (1.8 m) minimum unobstructed space on all sides.

d) Orientation: The preferred orientation is for the long axis to be northwest-southeast to suit the angle of the sun during the fall playing season, or north-south for longer periods.

e) Surface and Drainage: Surface and drainage areas shall be provided as follows.

(1) Surface shall be turf.

(2) The preferred grading is a longitudinal crown with a 1 percent slope from center to each side and adequate subdrainage.

(3) Grading may be from side-to-side or corner-to-corner diagonally if conditions do not permit the preferred grading.

f) Special Considerations: Goal posts are to be provided at each end of the playing field. Pylons are to be provided as required by rules.

3.10 Lacrosse, Men's. The men's lacrosse playing area (see Figure 31) shall be as follows.

a) Source of Information: National Collegiate Athletic Association (NCAA).

b) Recommended Area: The ground space shall be 63,000 ft² (5853 m²) to 81,400 ft² (7562 m²).

c) Size and Dimension: The playing field width shall be from 160 ft (48.7 m) to 180 ft (54.8m); the length shall be 330 ft (100.58 m). An additional area of 10 ft (3.05 m) (minimum) of unobstructed space around entire perimeter of field, with 5 ft (1.52 m) or 6 ft (1.82 m) high barrier fence, or 20 ft (6.6 m) without fence is recommended.

d) Orientation: The preferred orientation is for the long axis to be northwest-southeast to suit the angle of the sun during the fall playing season, or north-south for longer periods.

e) Surface and Drainage: Surface and drainage areas shall be as follows.

inadvertent consequences of this sort.

(1) Surface shall be turf.

(2) The preferred grading shall be a longitudinal crown with a 1 percent slope from center to each side and adequate subdrainage.

(3) Grading may be from side-to-side or corner-to-corner diagonally if conditions do not permit the preferred grading.

3.11 Lacrosse, Women's. The women's lacrosse playing area (see Figure 32) shall be as follows.

a) Source of Information: National Association for Girls and Women in Sport (NAGWS).

b) Recommended Area: The ground space is optional 69,300 ft^2 (6438 m^2) to 75,600 ft^2 (7023 m^2).

c) Size and Dimension: The playing field width (minimum) shall be 210 ft (64 m). The length ranges from 330 to 360 ft (100.58 to 109.7 m). As in the original American Indian game, there are no definite boundaries or shape for the field of play, but before a match the officials decide on the boundaries and declare specified obstructions out of bounds.

d) Orientation: The preferred orientation is for the long axis to be northwest-southeast to suit the angle of the sun during the fall playing season, or north-south for longer periods.

e) Surface and Drainage: The surface and drainage areas shall be as follows.

(1) Surface shall be turf.

(2) The preferred grading shall be a longitudinal crown with a 1 percent slope from center to each side with adequate subdrainage.

(3) Grading may be from side-to-side or corner-to-corner diagonally if conditions do not permit the preferred grading.

3.12 Soccer (Men's and Boys'). The men's and boys' soccer playing area (see Figure 33) shall be as follows.

a) Source of Information: United States Soccer Federation (USSF).

b) Recommended Area: The ground space shall be 75,250 ft^2 (6712 m^2) to 93,100 ft^2 (8649 m^2).

c) Size and Dimension: The playing field shall be from 150 to 300 ft (45.7 to 91.4 m) wide and from 300 ft to 390 ft (118.8 m) long. An additional area recommended shall be 10 ft (3.05 m) minimum unobstructed space on all sides.

d) Orientation: The preferred orientation is for the long axis to be northwest-southeast to suit the angle of the sun during the fall playing season, or north-south for longer periods.

e) Surface and Drainage: Surface and drainage areas shall be as follows:

(1) Surface shall be turf.

(2) Preferred grading shall be a longitudinal crown with a 1 percent slope from center to each side and adequate subdrainage. Grading may be from side-to-side or corner-to-corner diagonally if conditions do not permit the preferred grading.

3.13 Soccer (Women's and Girls'). The women's and girls' soccer playing area (see Figure 34) shall be as follows.

a) Source of Information: United States Soccer Federation (USSF).

b) Recommended Area: The ground space shall be 72,250 ft^2 (6712 m^2) to 93,100 ft^2 (8649 m^2).

c) Size and Dimension: The playing field shall be from 195 to 225 ft (59.4 to 68.5 m) wide and 330 to 360 ft (100.6 to 109.7 m) long. An additional area of 15 ft (4.57 m) minimum unobstructed space on all sides is recommended.

d) Orientation: The preferred orientation shall be for the long axis to be northwest-southeast to suit the angle of the sun during the fall playing season, or north-south for longer periods.

e) Surface and Drainage: Surface and drainage areas shall be as follows:

(1) Surface shall be turf.

(2) The preferred grading is a longitudinal crown with a 1 percent slope from center to each side, and adequate underdrainage.

(3) Grading may be from side-to-side or corner-to-corner diagonally if conditions do not permit the preferred grading.

3.14 Field Hockey. The field hockey playing area (see Figure 35) shall be as follows.

a) Source of Information: United States Field Hockey Association (USFHA).

b) Recommended Area: The ground space shall be 64,000 ft^2 (5945.6 m^2) minimum.

c) Size and Dimension: The playing field shall be 180 ft (54.86 m) wide x 300 ft (91.4 m) long. The additional area recommended shall be 10 ft. (3.048 m) minimum unobstructed space on all sides.

d) Orientation: The preferred orientation shall be for the long axis to be northwest-southeast to suit the angle of the sun during the fall playing season, or north-south for longer periods.

e) Surface and Drainage: Surface and drainage areas shall be as follows:

(1) Surface shall be turf.

(2) The preferred grading shall be a longitudinal crown with a 1 percent slope from center to each side and adequate subdrainage.

(3) Grading may be from side-to-side or corner-to-corner diagonally if conditions do not permit the preferred grading.

3.15 Flickerball. The flickerball playing area (see Figure 36) shall be as follows.

a) Source of Information: United States Air Force.

b) Recommended Area: The ground space shall be 17,600 ft^2 (1635 m^2) minimum.

c) Size and Dimension: The playing field shall be 90 ft (27.4 m) wide x 160 ft (48.7 m) long. Goals shall be 15 ft (4.57 m) beyond each end line. An additional area of 6 ft (minimum) unobstructed space on all sides is recommended.

d) Orientation: The preferred orientation is for the long axis to be northwest-southeast to suit the angle of the sun during the fall playing season, or north-south for longer periods.

e) Surface and Drainage: Surface and drainage areas shall be as follows:

(1) Surface shall be turf.

(2) The preferred grading shall be a longitudinal crown with a 1 percent slope from center to each side and adequate subdrainage.

(3) Grading may be from side-to-side or corner-to-corner diagonally if conditions do not permit the preferred grading.

3.16 Speedball. The speedball playing area (see Figure 37) shall be as follows.

a) Source of Information: National Association for Girls and Women in Sports (NAGWS).

b) Recommended Area: The ground space shall be 36,400 ft² (3381.6 m²) (high school) to 76,000 ft² (7060.4 m²).

c) Size and Dimension: The playing field shall be 180 ft (54.86 m) wide x 300 ft (91.4 m) long. An additional 30 ft x 180 ft (9.14 x 54.86 m) out-of-bounds touchdown area is recommended on each end, and an unobstructed space of 10 ft (3.05 m) on all sides. The high school field shall be 120 ft (36.57 m) wide x 240 ft (73.1 m) long.

d) Orientation: The preferred orientation is for the long axis to be northwest-southeast during the fall playing season, or north-south for longer periods.

e) Surface and Drainage: Surface and drainage areas shall be as follows:

(1) Surface shall be turf.

(2) The preferred grading is a longitudinal crown with a 1 percent slope from center to each side and adequate underdrainage.

(3) Grading may be from side-to-side or corner-to-corner diagonally if conditions do not permit the preferred grading.

3.17 Team Handball. The team handball playing area (see Figure 38) shall be as follows.

a) Source of Information: United States Team Handball Federation (USTHF).

b) Recommended Area: The ground space shall be 11,120 ft² (1,033 m²).

c) Size and Dimension: The playing field shall be 20 m (65 ft 7-1/2 in.) wide x 40 m (131 ft 3 in.) long. An additional area of 2 m (6 ft 7 in.) minimum unobstructed space on all sides is recommended .

d) Orientation: The preferred orientation is for the long axis to be northwest-southeast during the fall playing season, or north-south for longer periods.

e) Surface and Drainage: Surface and drainage areas shall be as follows:

(1) Surface shall be turf.

(2) The preferred grading is a longitudinal crown with a 1 percent slope from center to each side and adequate subarainage.

(3) Grading may be from side-to-side or corner-to-corner diagonally if conditions do not permit the preferred grading.

3.18 Golf Driving Range. The golf driving range (see Figure 39) shall be as follows.

a) Source of Information: National Golf Foundation, Inc.

b) Recommended Area: The ground space for a minimum of 25 tees shall be 13.5 acres (5.46 ha).

c) Size and Dimension: The minimum length shall be 900 ft (300 yds) (274.3 m). The minimum width, including buffer area on each side, shall be 620 ft (188.97 m). Add a 12-ft (3.66 m) width per additional tee.

d) Orientation: The preferred orientation is for the long axis to run southwest to northeast with the golfer driving toward the northeast.

e) Surface and Drainage: Surface and drainage shall meet the following criteria.

(1) The surface shall be turf closely mowed in center for ball collection. Side buffer areas shall be rough cut.

(2) Drainage shall be away from raised tee area and across the axis of play. Side buffer areas may rise to help contain stray drives.

f) Special Consideration

(1) The use of tee mats reduces maintenance. Automatic ball tees enable golfers to hit more balls over a shorter period.

(2) Target greens are recommended as they give golfers something at which to aim drives.

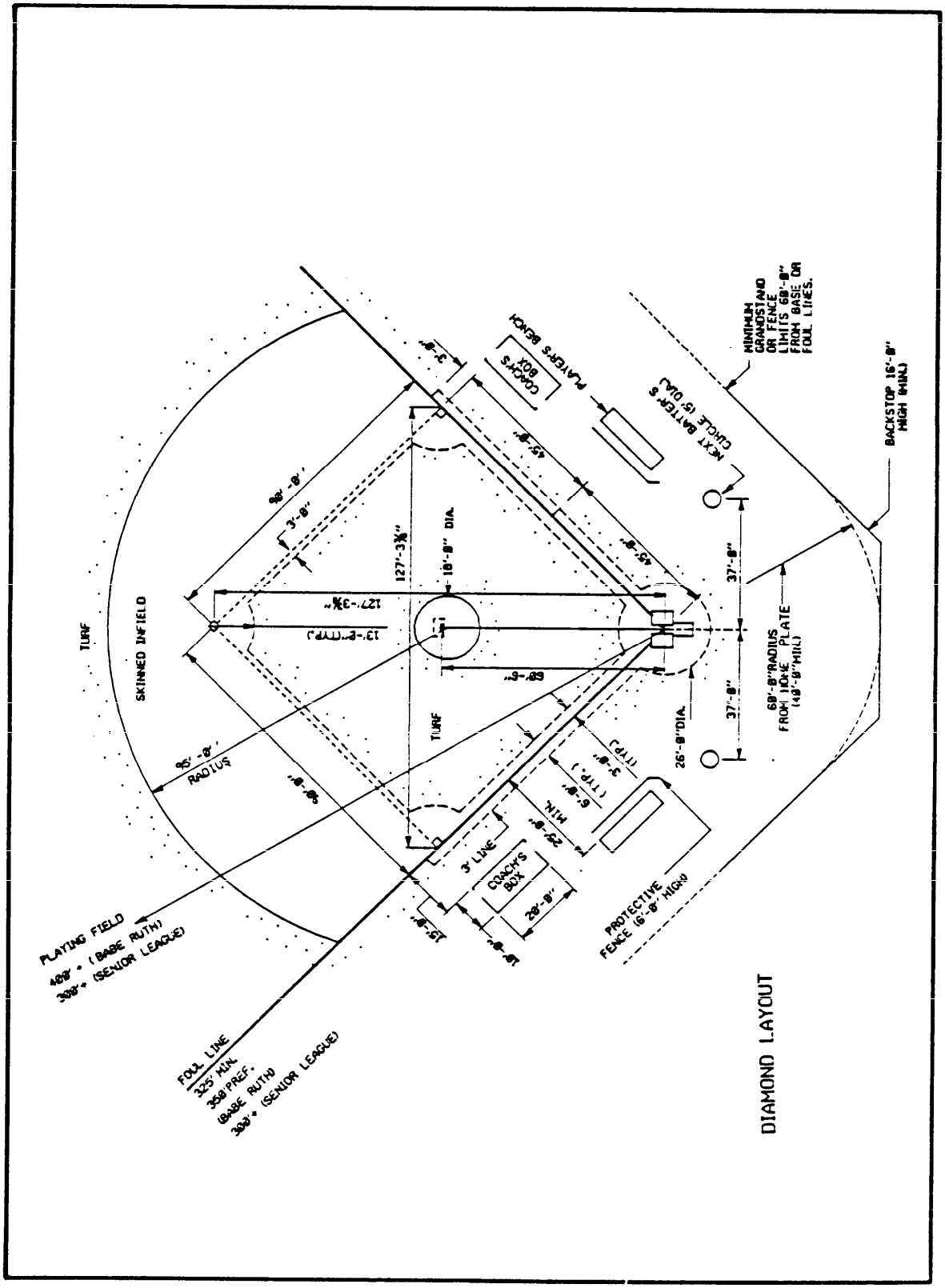

Figure 22a
Official Baseball Diamond -- Layout

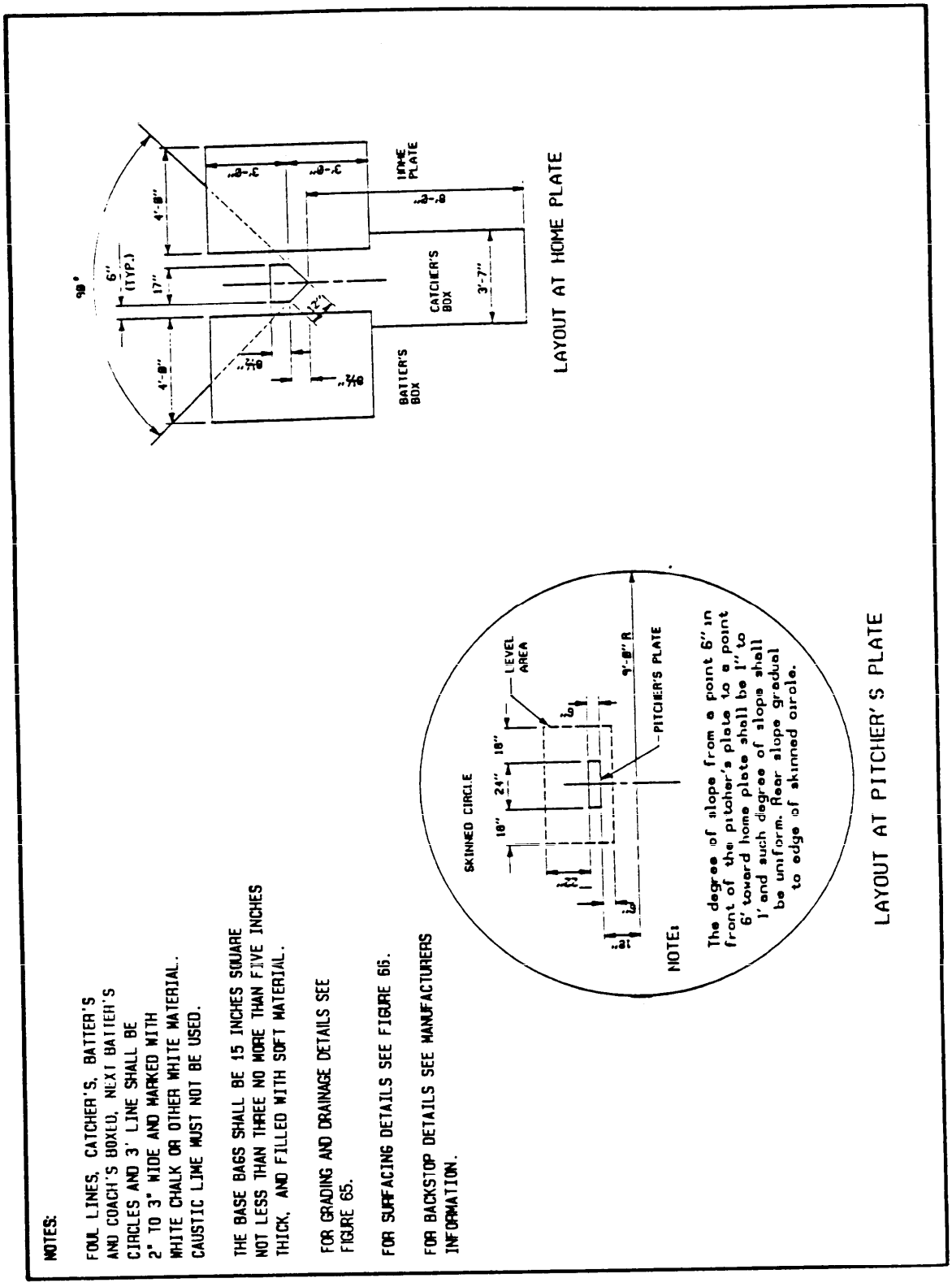

Figure 22b
Official Baseball Diamond -- Pitcher's Plate and Home Plate Details

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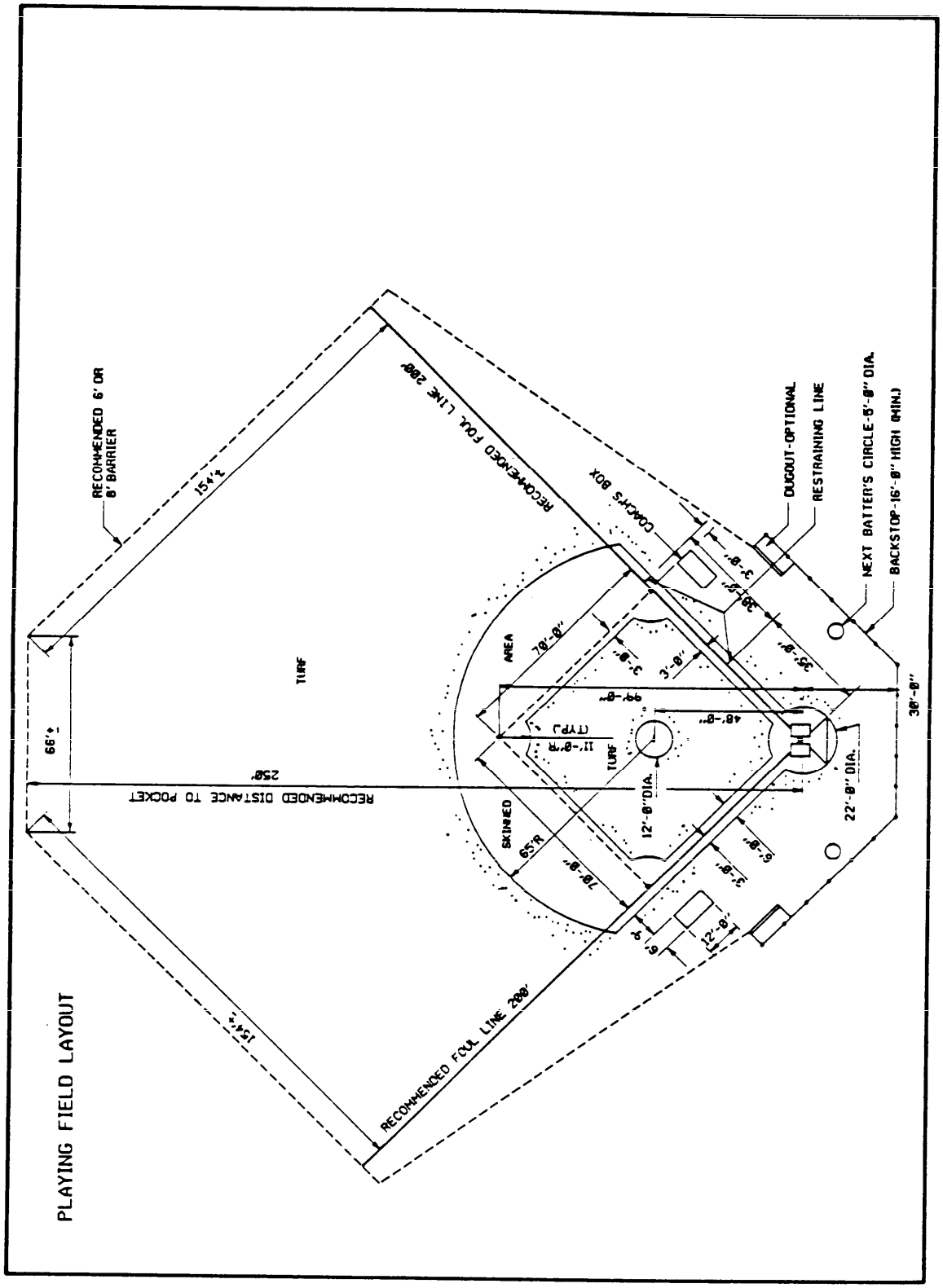


Figure 23a
Bronco League Baseball Diamond -- Layout

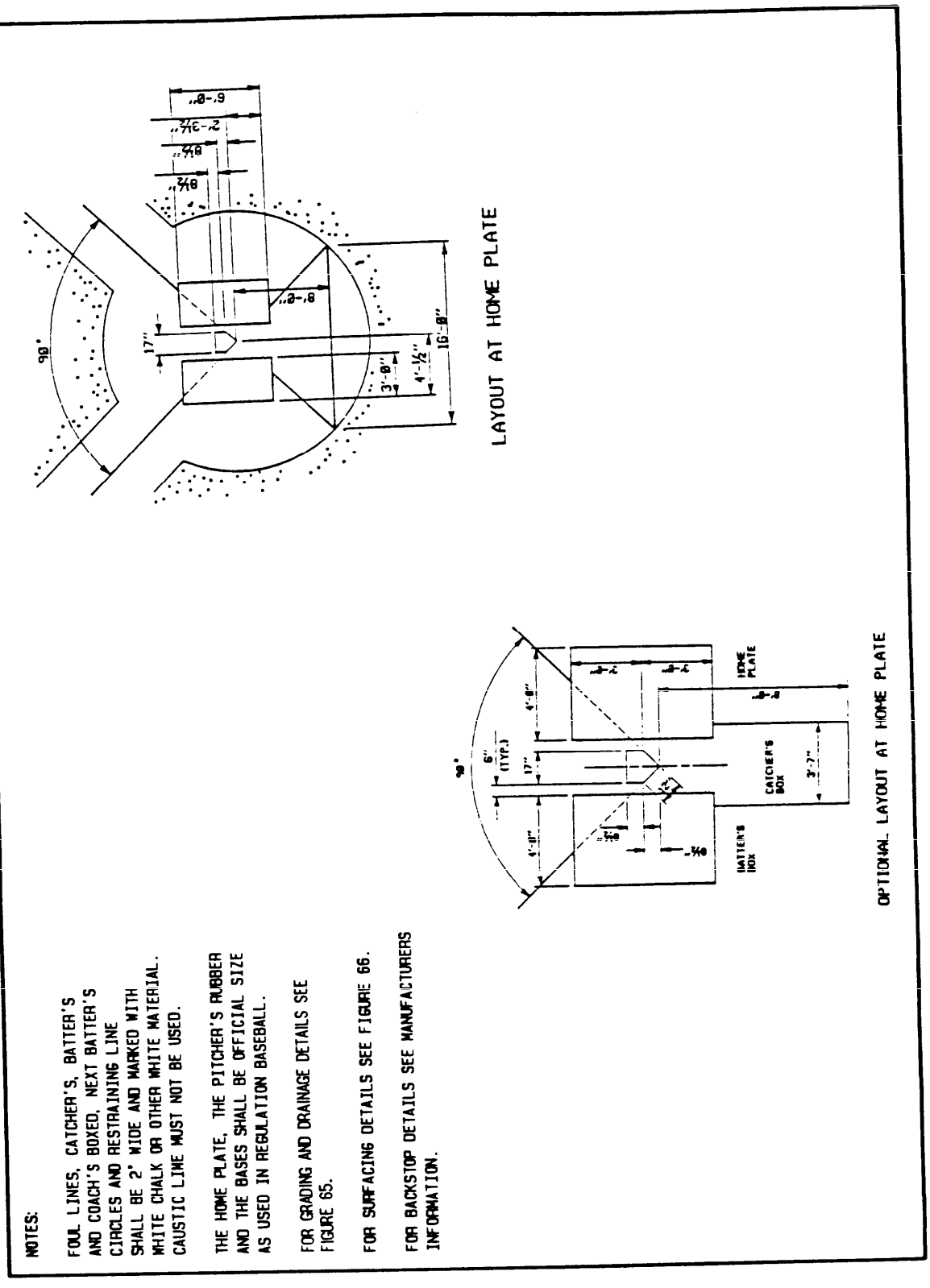


Figure 23b
Bronco League Baseball -- Home Plate Details

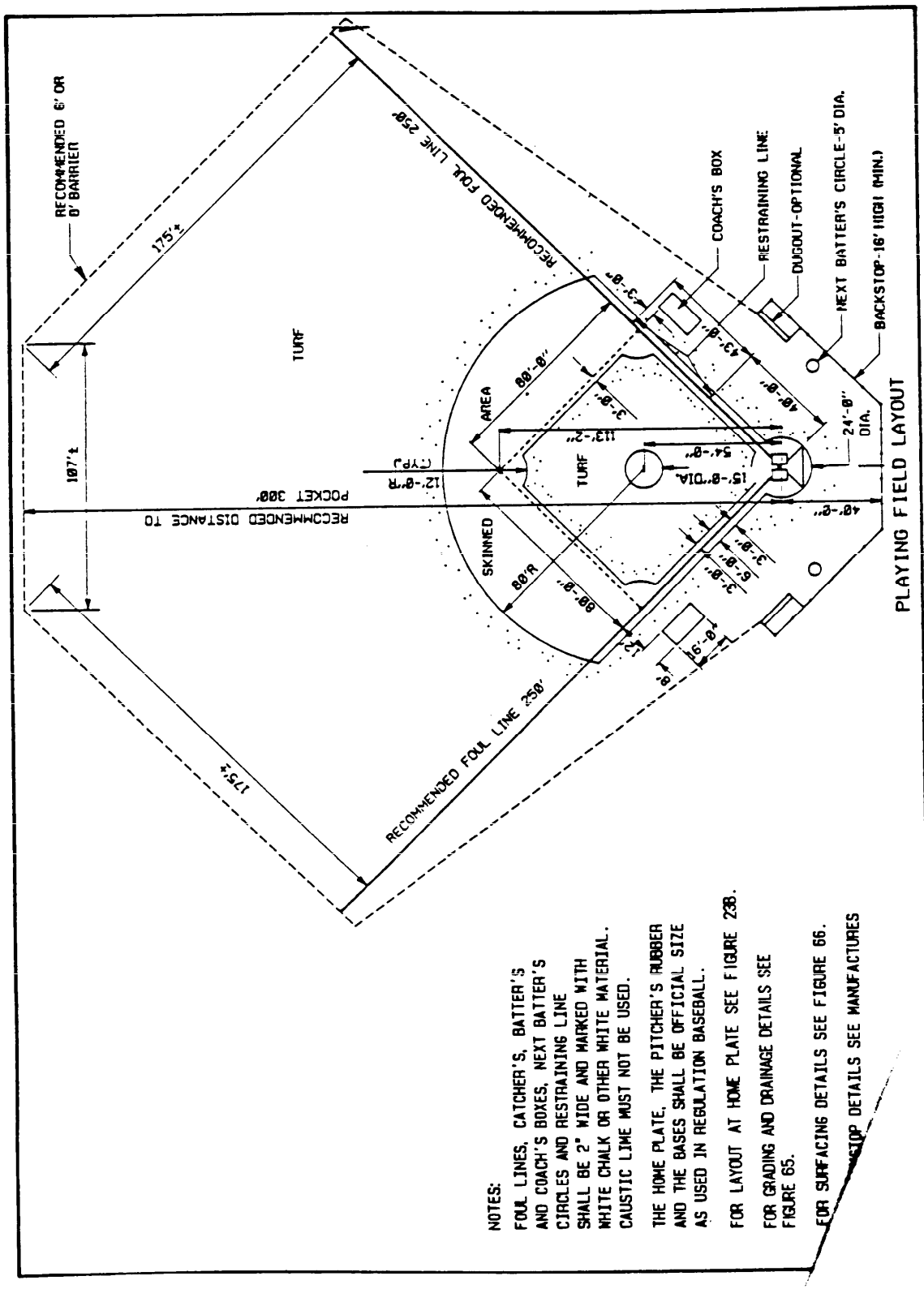


Figure 24
Pony League Baseball Field

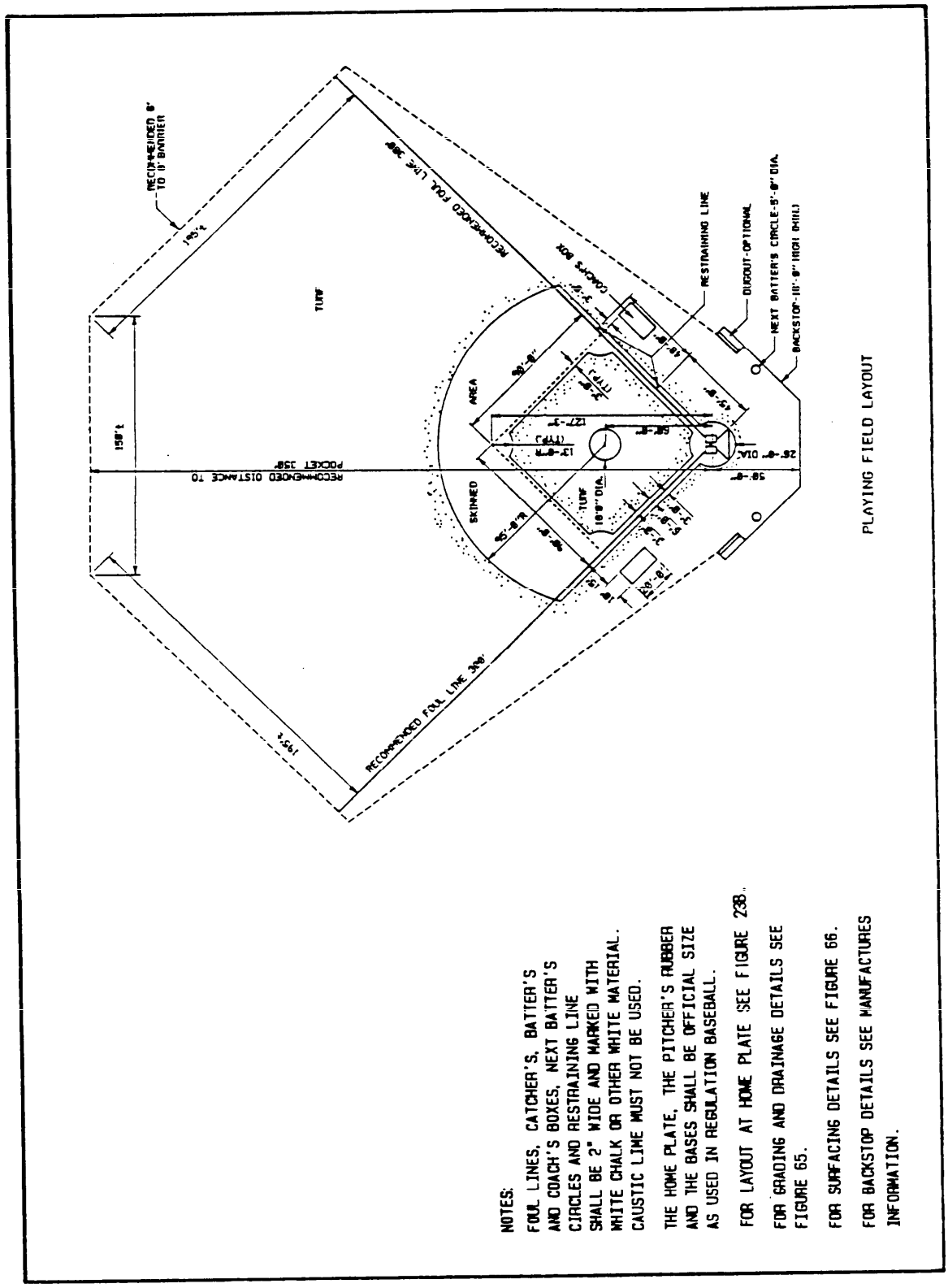


Figure 25
Colt League Baseball Field

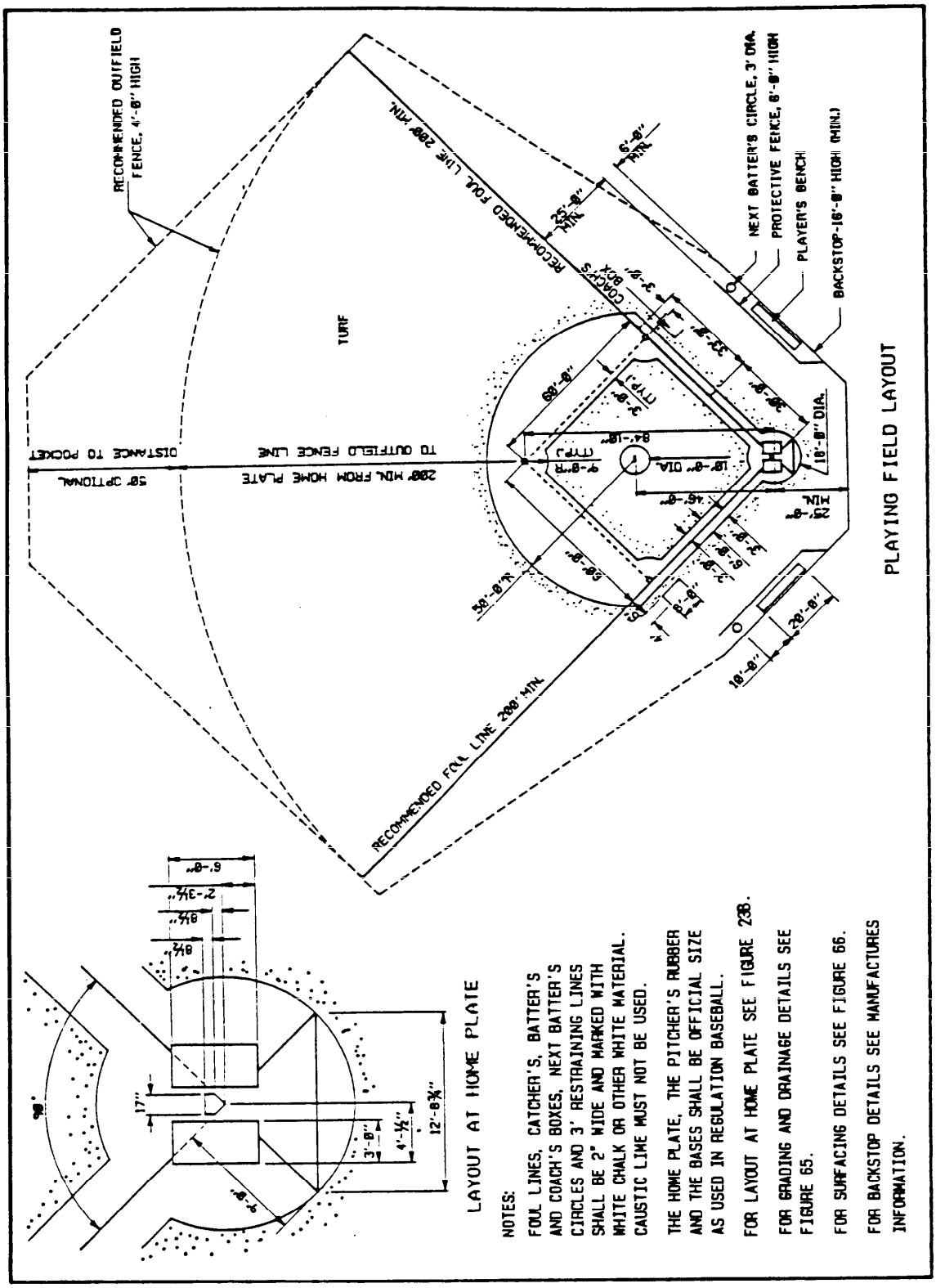


Figure 26
Little League Baseball Field

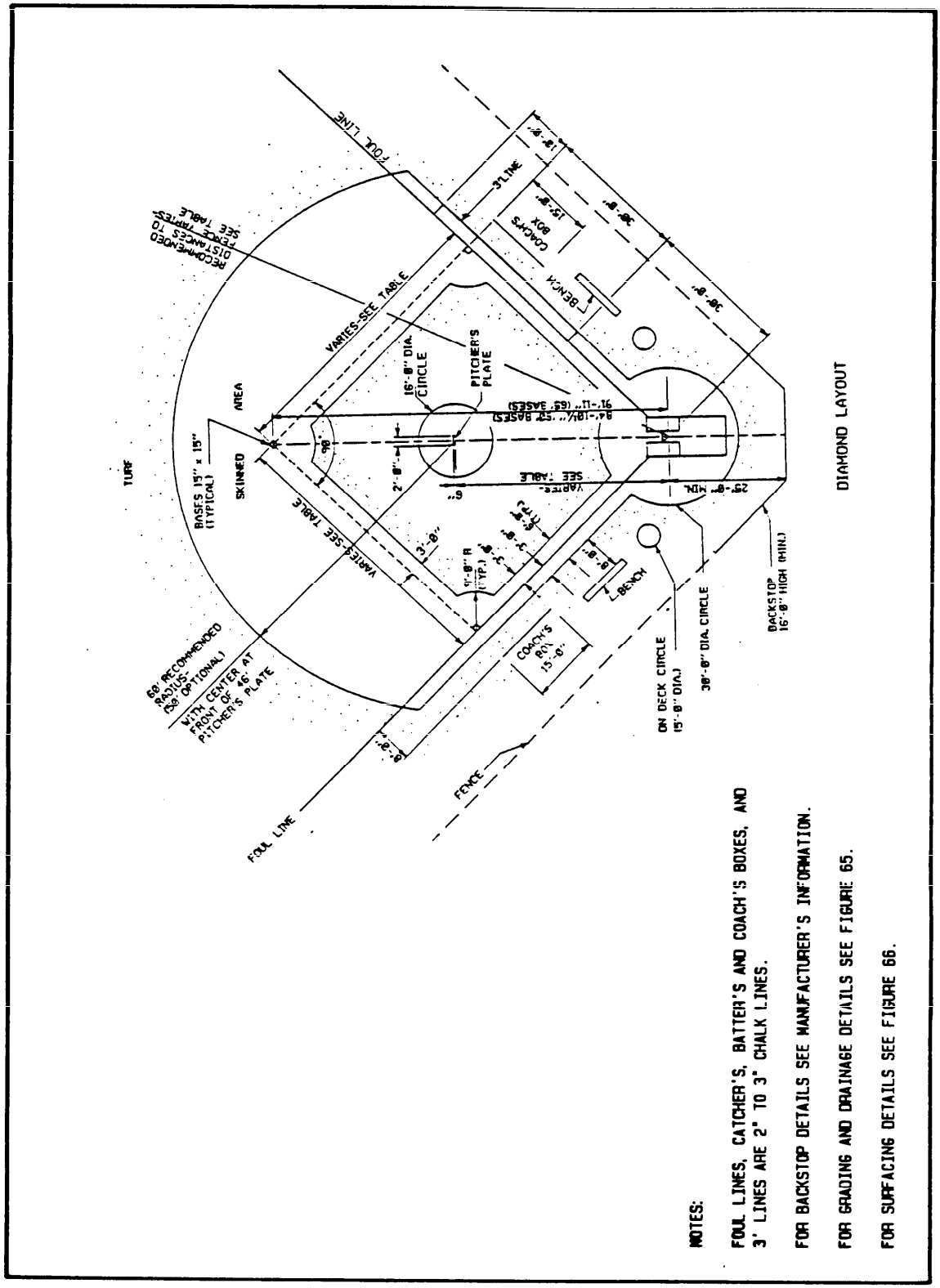


Figure 27a
Softball (12-inch, Fast and Slow Pitch) -- Diamond

TABLE OF DIMENSIONS

DIMENSION		BASES		PITCHING		FENCES	
PITCH		SLOW	FAST	SLOW	FAST	SLOW	FAST
DIVISIONS	FEMALE	60'	60'	46'	40'	250'	200'
	MALE	65'	60'	46'	46'	300'	300'
	GIRLS (16-18)	60'	60'	46'	40'	225'-250'	225'-250'
	BOYS (16-18)	65'	60'	46'	46'	275'-300'	275'-300'
	GIRLS (13-15)	60'	60'	40'	40'	175'-200'	175'-200'
	BOYS (13-15)	60'	60'	46'	46'	225'-250'	175'-200'
	GIRLS (12 & UNDER)	60'	60'	35'	35'	175'-200'	175'-200'
	BOYS (12 & UNDER)	60'	60'	40'	40'	175'-200'	175'-200'

Figure 27b
Softball (12-inch, Fast and Slow Pitch) -- Dimensions and Home Plate Layout

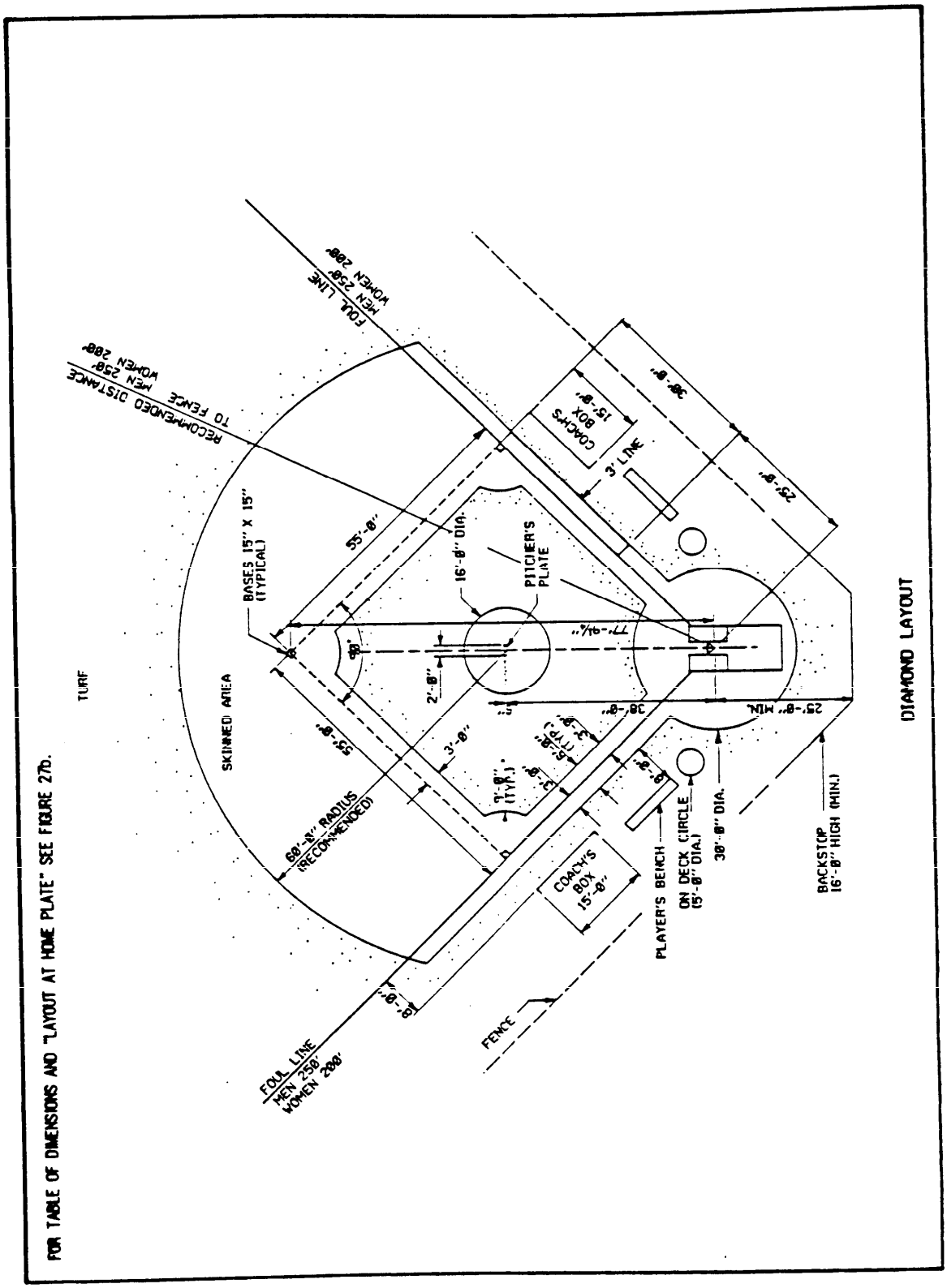


Figure 28
Softball (16-inch, Slow Pitch) -- Diamond

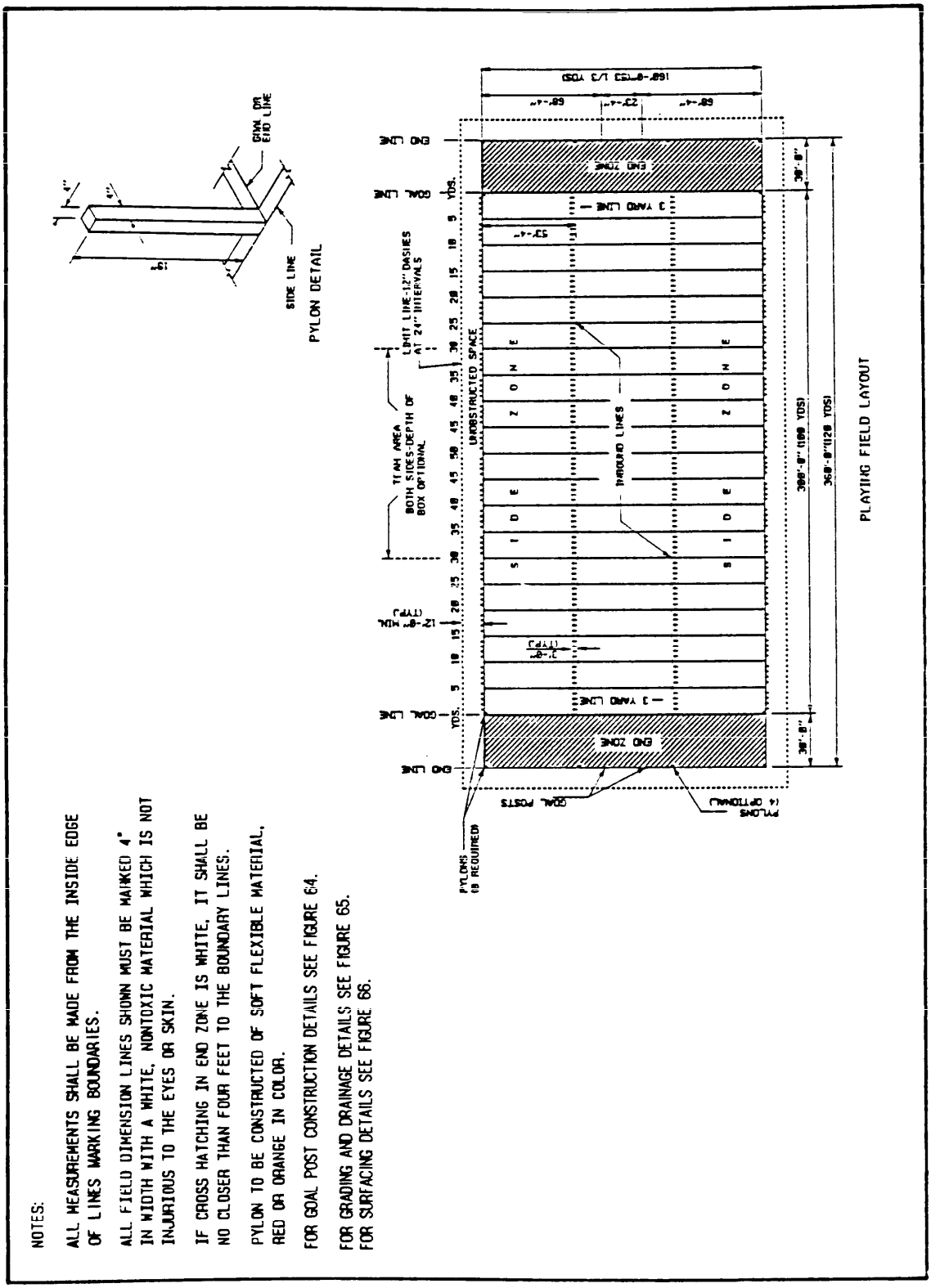


Figure 29
11-Man Football (NCAA) Pop Warner Junior League Football Field

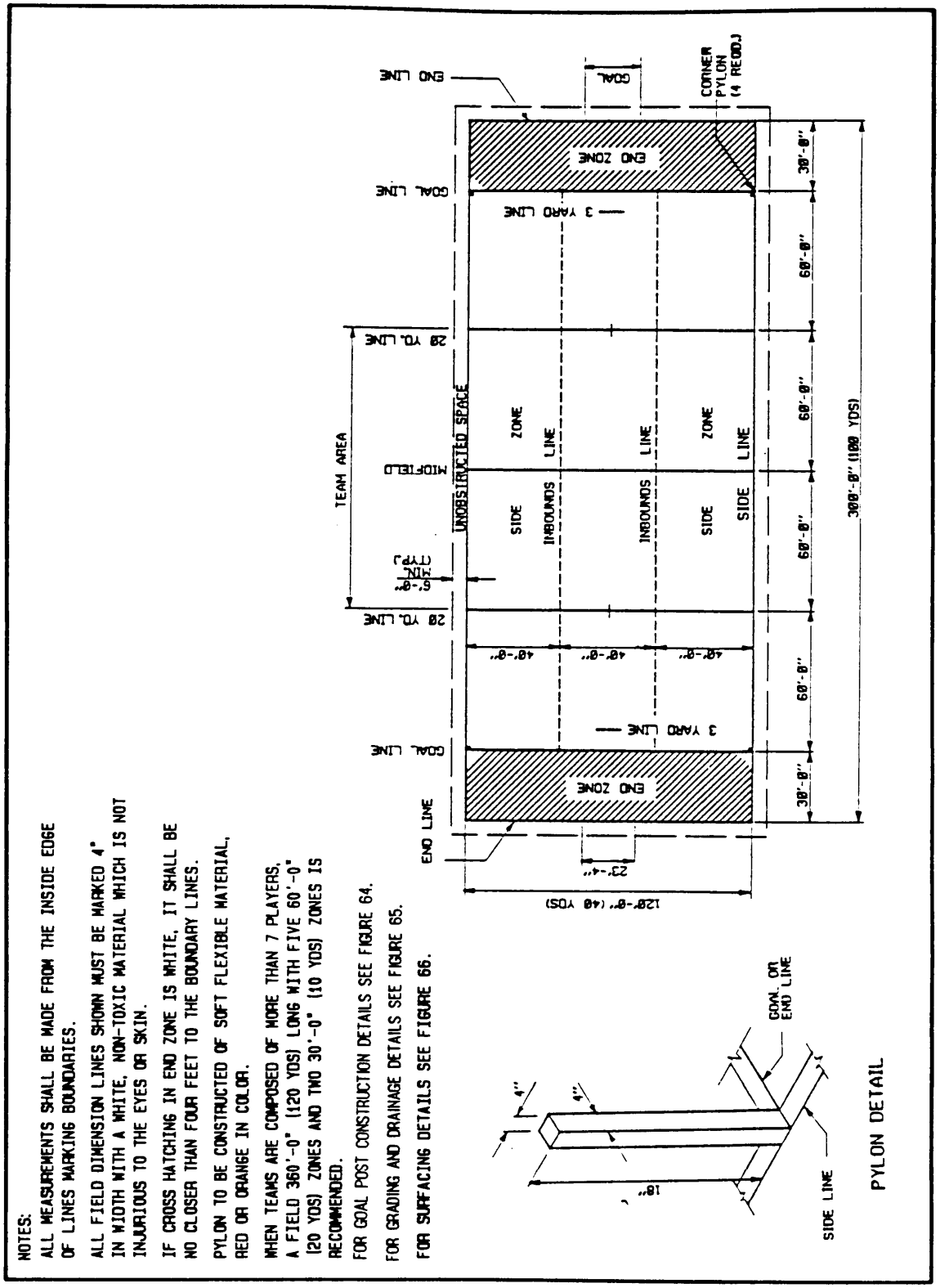


Figure 30
Touch and Flag Football Field

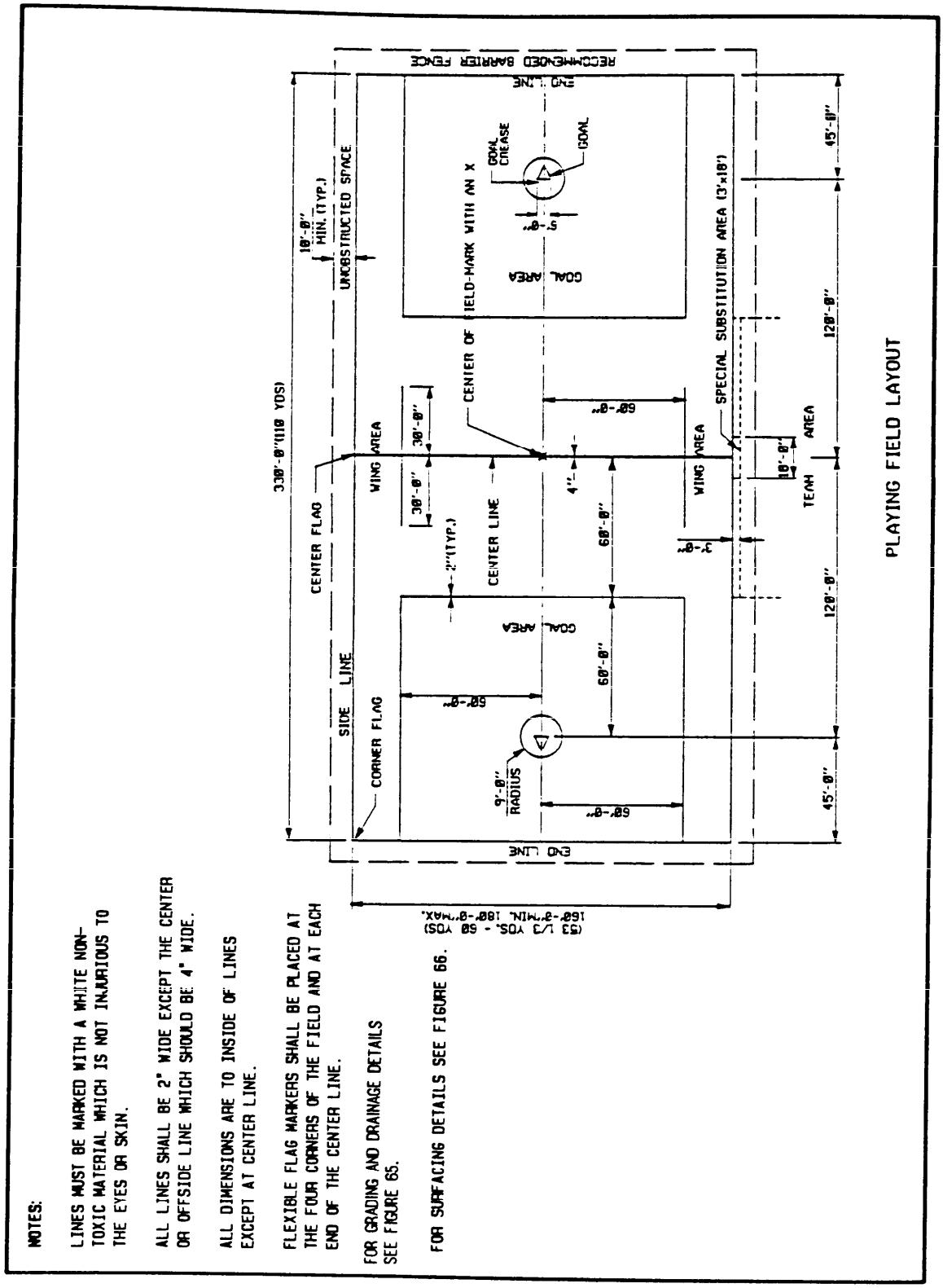


Figure 31a
Lacrosse Field (Men's) -- Layout

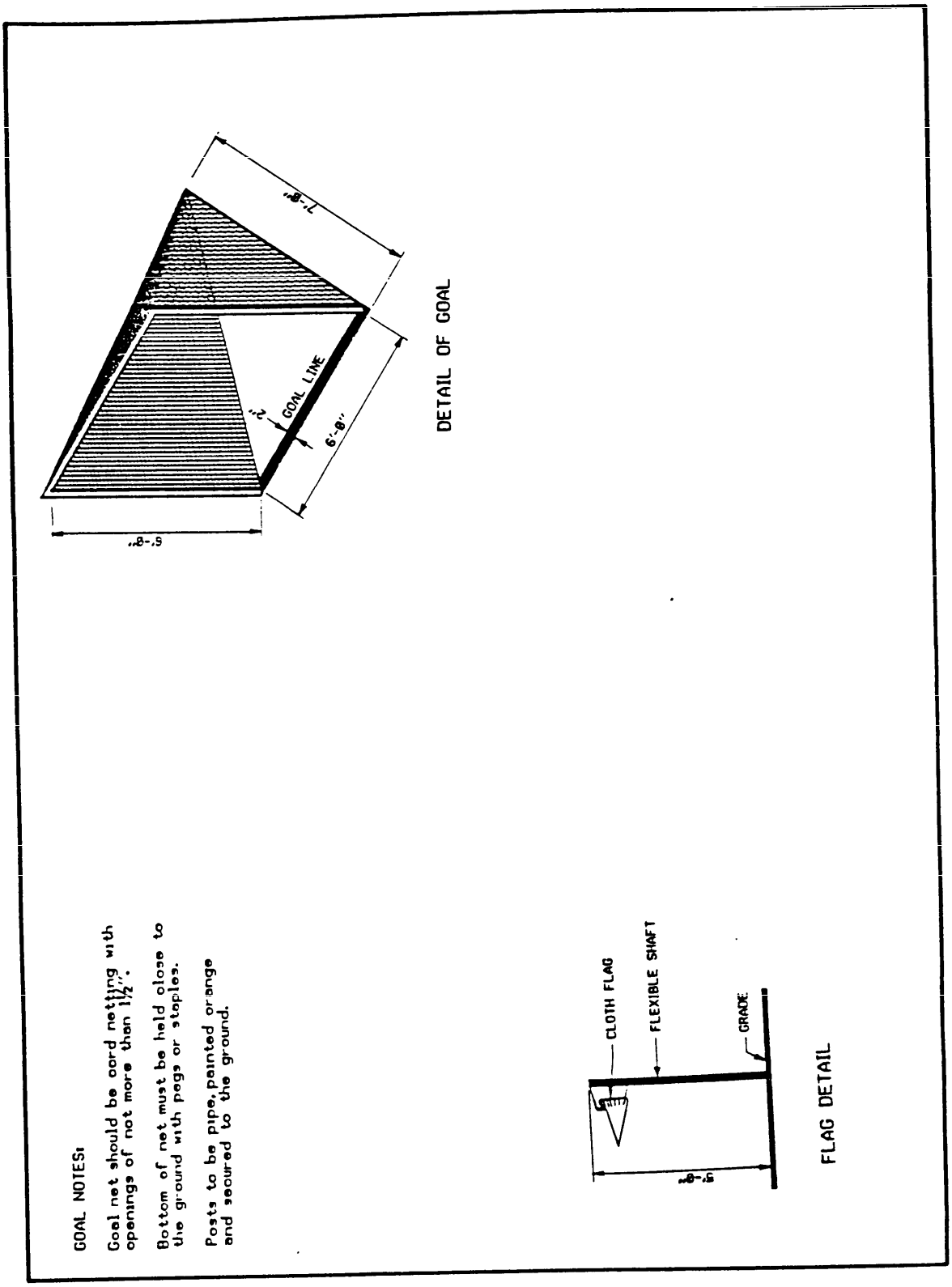


Figure 31b
Lacrosse Field (Men's) -- Flag and Goal Details

NOTES:

ALL MARKING LINES SHALL BE 2" WIDE AND MARKED WITH A WHITE NON-TOXIC MATERIAL WHICH IS NOT INJURIOUS TO THE EYES OR SKIN.

BOUNDARY LINES ARE OPTIONAL. WHEN MARKED THEY SHALL BE 2" WIDE.

OPTIONAL FLAG MAY BE PLACED AT THE FOUR CORNERS OR SELECTED BOUNDARY POINTS.

FOR FLAG DETAILS SEE FIGURE 31b.

FOR GRADING AND DRAINAGE DETAILS SEE FIGURE 65.

FOR SURFACING DETAILS SEE FIGURE 66.

GOAL NOTES:

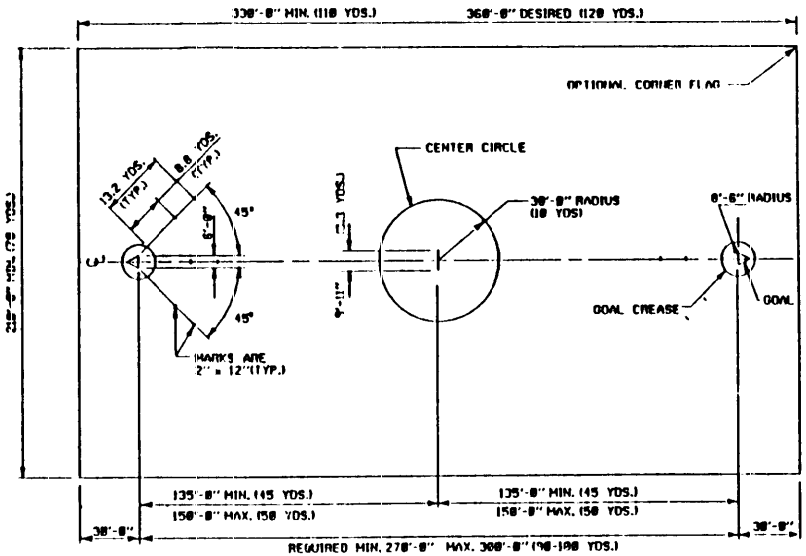
GOAL NET SHALL BE CORD NETTING WITH OPENINGS OF NOT MORE THAN 1 1/2".

BOTTOM OF NET MUST BE HELD CLOSE TO THE GROUND WITH PEGS OR STAPLES.

POSTS AND CROSSBAR SHALL BE OF PRESSURE TREATED WOOD, 2" X 2" AND SHALL BE PAINTED WHITE OR ORANGE.

GOALS MADE OF PIPE AND PAINTED ARE CONSIDERED LEGAL BUT WOODEN 2" X 2" ARE PREFERRED.

FOR DETAIL OF GOAL SEE FIGURE 31b.



PLAYING FIELD LAYOUT (SHAPE VARIES)

Figure 32
Lacrosse Field (Women's)

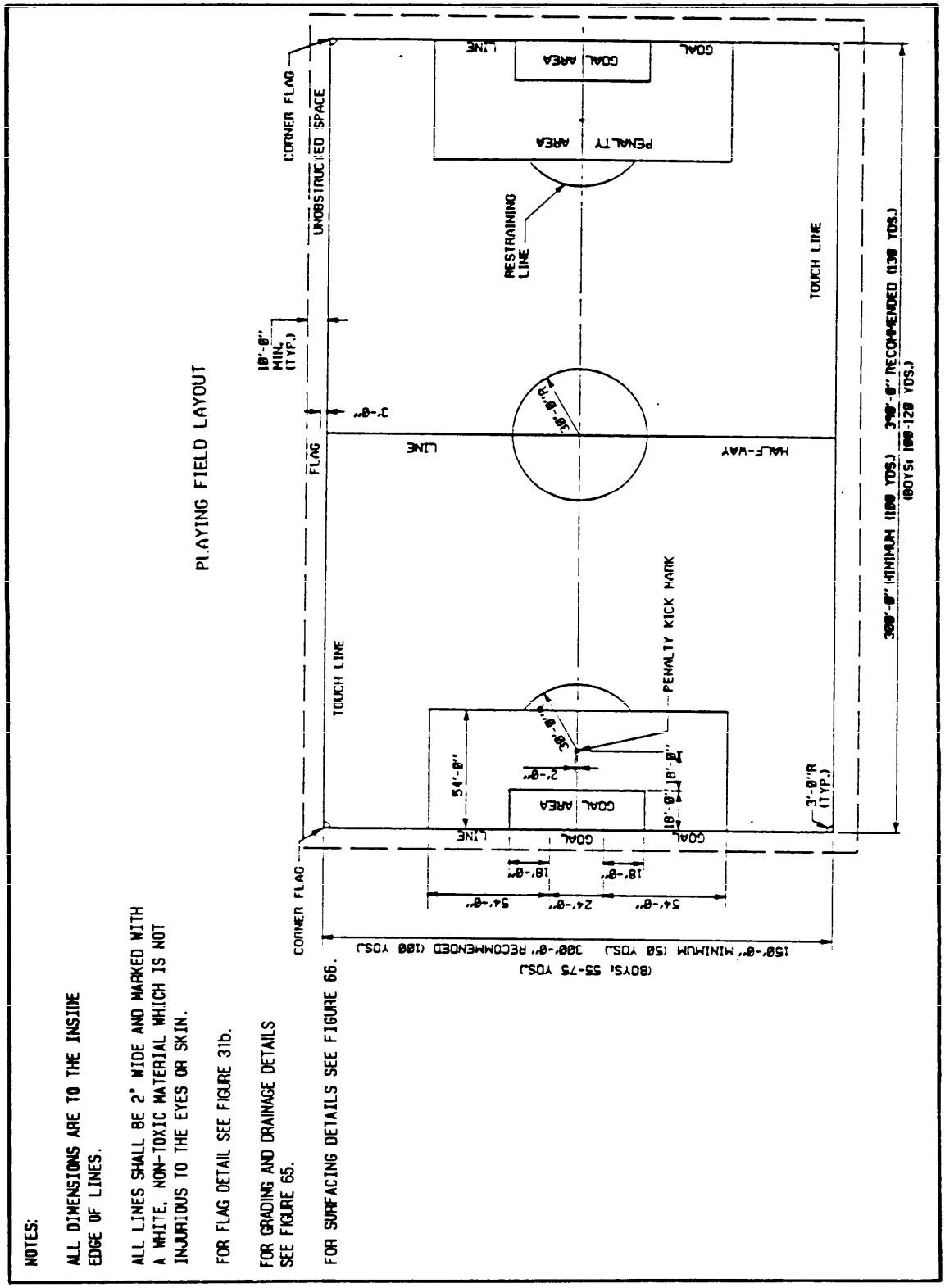


Figure 33a
Soccer Field (Men's and Boys') -- Layout

GOAL NOTES:

GOAL POSTS TO BE PRESSURE TREATED WITH PAINTED, OIL-BORNE PRESERVATIVE AND PAINTED ABOVE GROUND WITH THREE COATS OF WHITE LEAD AND OIL

THE GOAL POSTS AND CROSSBAR SHALL PRESENT A FLAT SURFACE TO THE PLAYING FIELD, NOT LESS THAN FOUR INCHES NOR MORE THAN FIVE INCHES IN WIDTH.

NETS SHALL BE ATTACHED TO THE POSTS, CROSSBAR AND GROUND BEHIND THE GOAL.

THE TOP OF THE NET MUST EXTEND BACKWARD 2'-0" LEVEL WITH THE CROSSBAR.

GOAL POSTS

Figure 33b
Soccer Field (Men's and Boys') -- Goal Detail

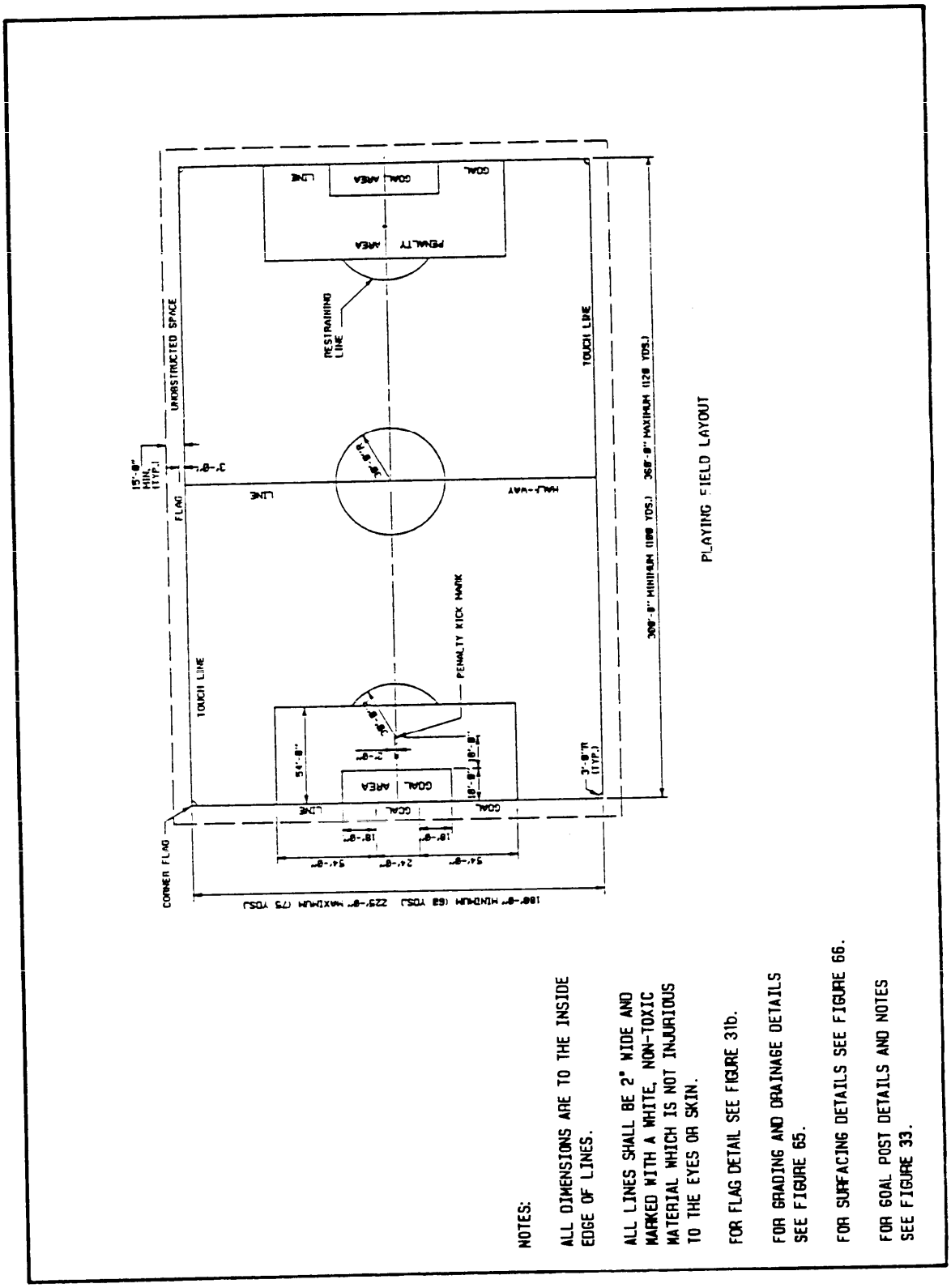


Figure 34
Soccer Field (Women's and Girls')

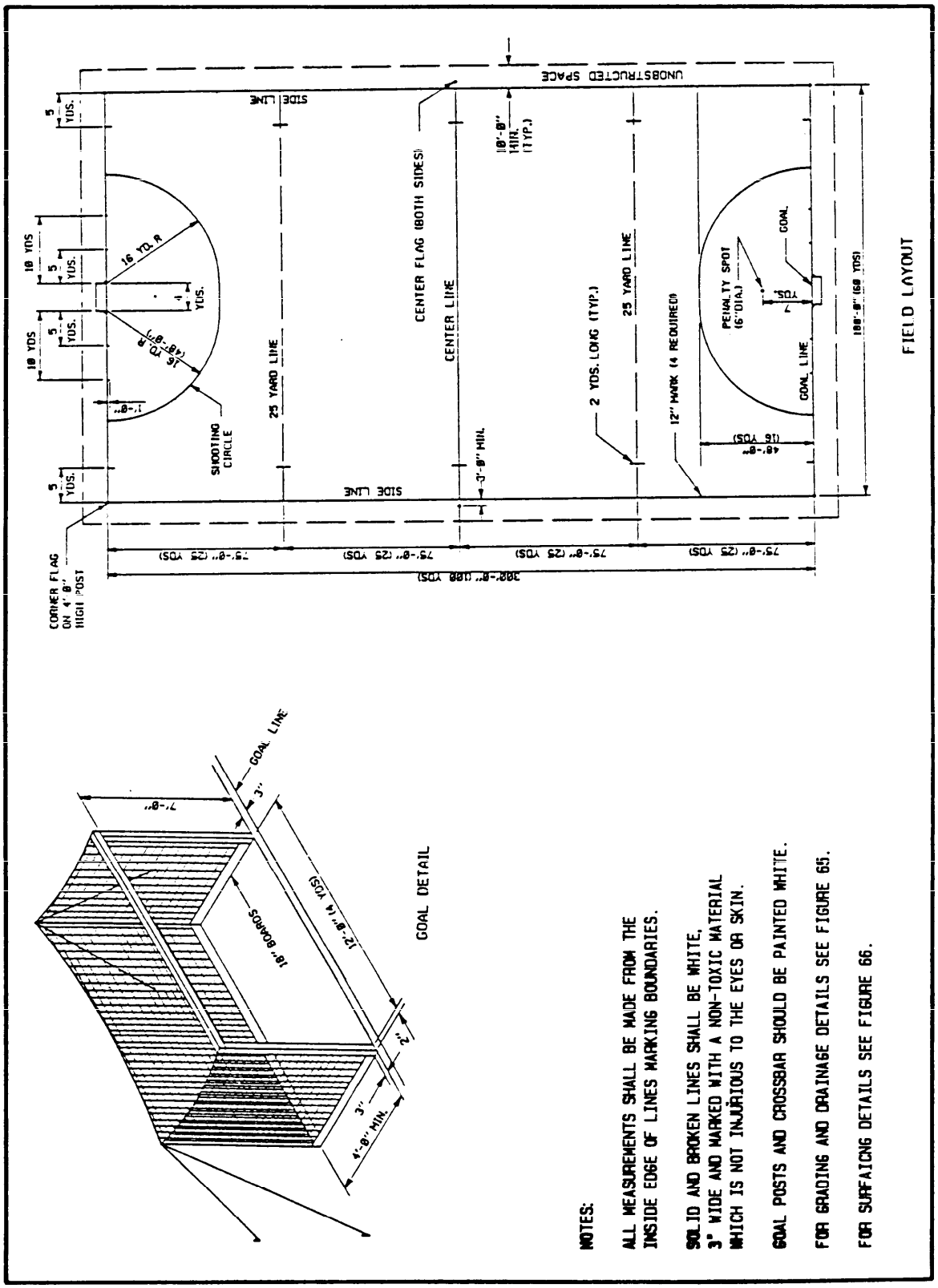


Figure 35
Field Hockey Field

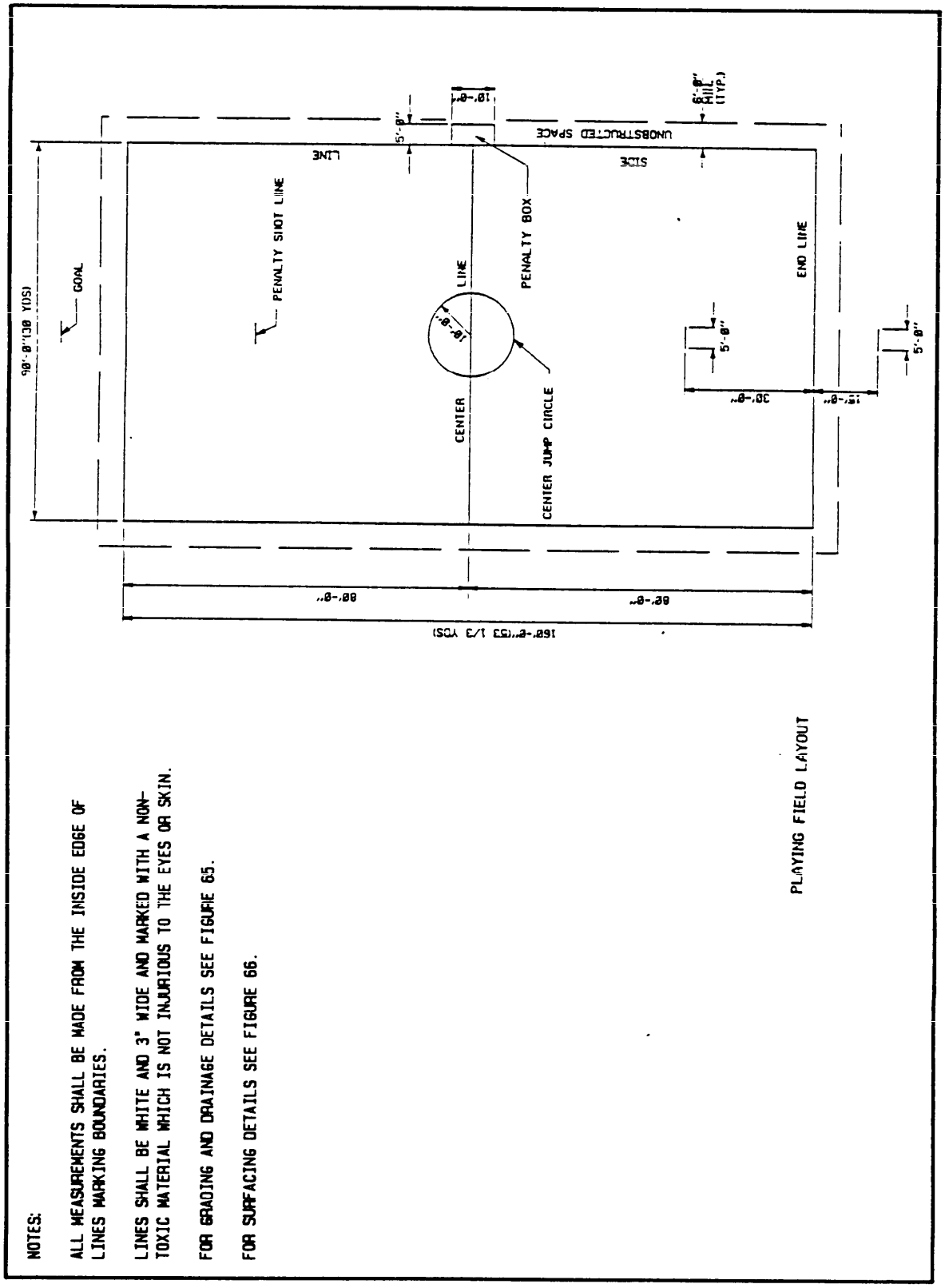


Figure 36a
Flickerball Field

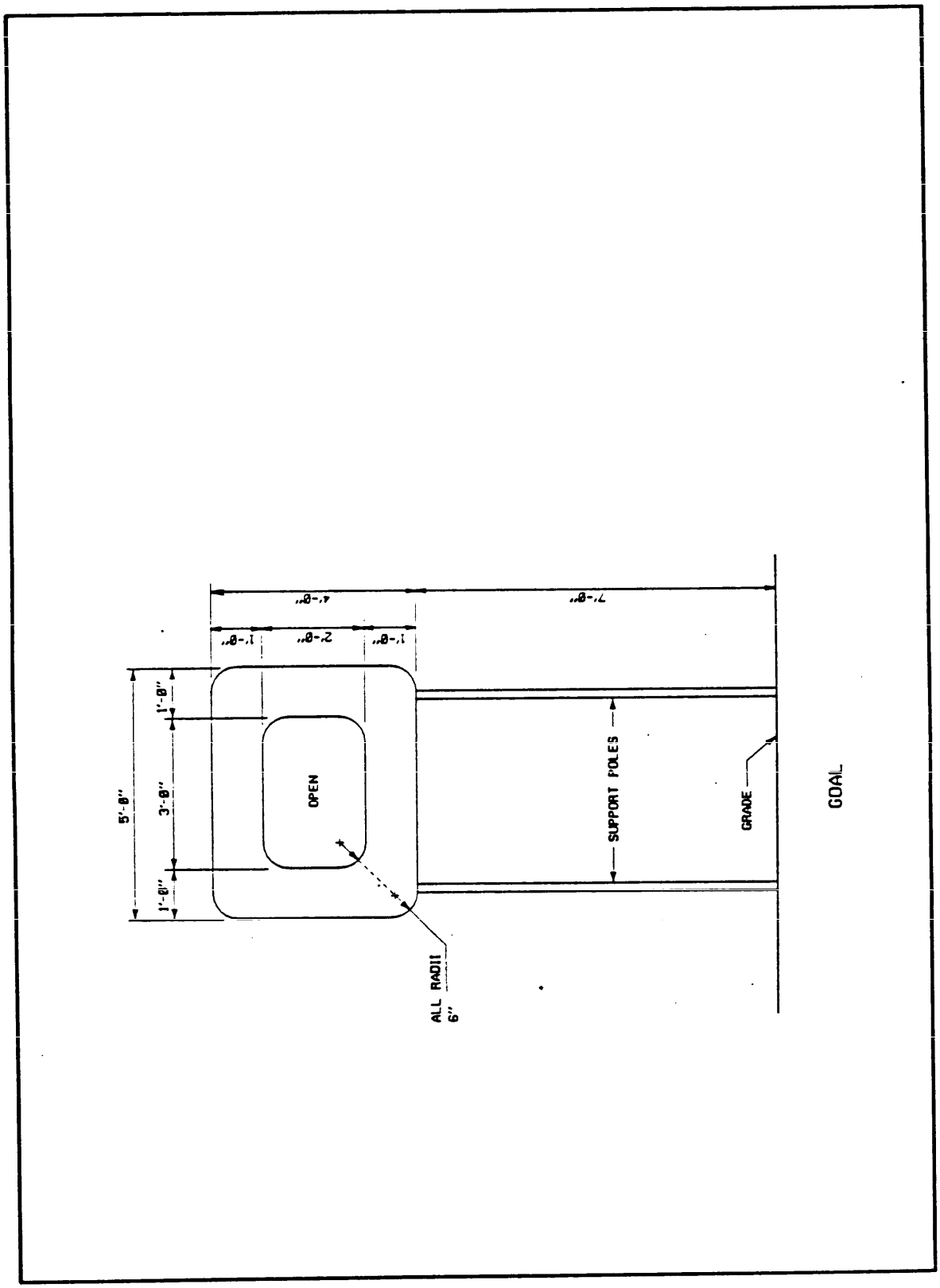


Figure 36b
Flickerball Field -- Goal Detail

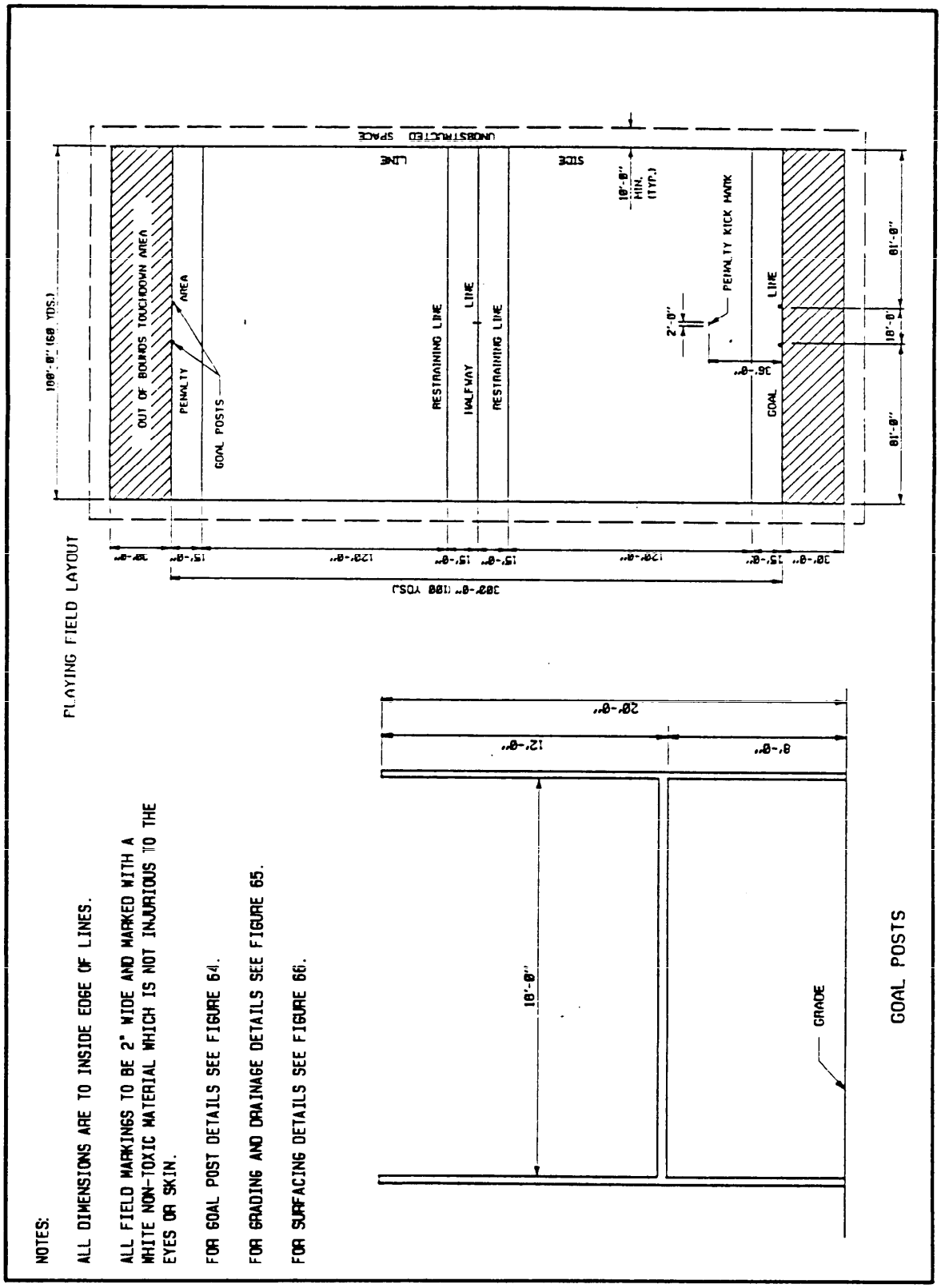


Figure 37
Speedball Field and Goal Detail

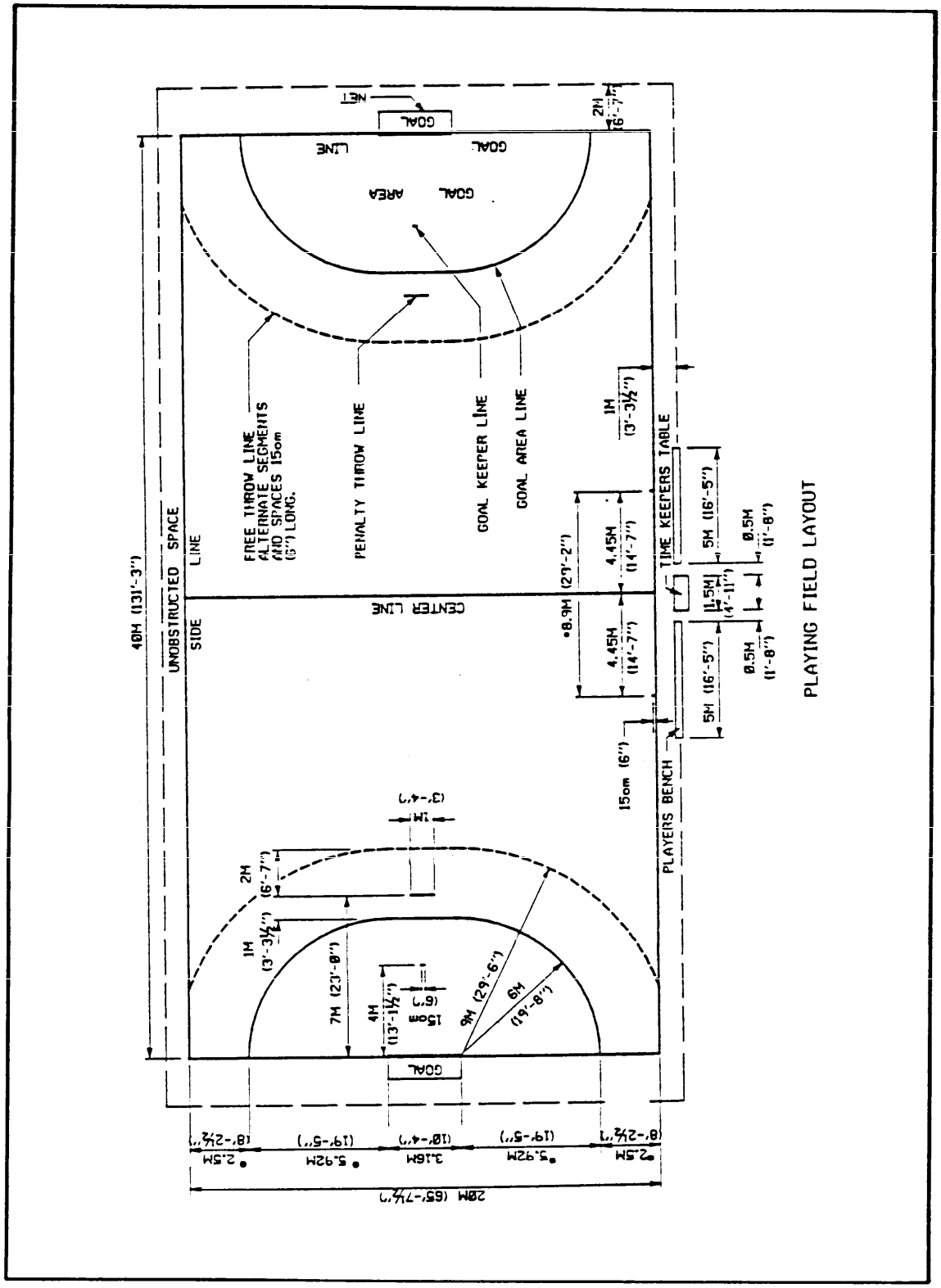


Figure 38a
Team Handball Field -- Layout

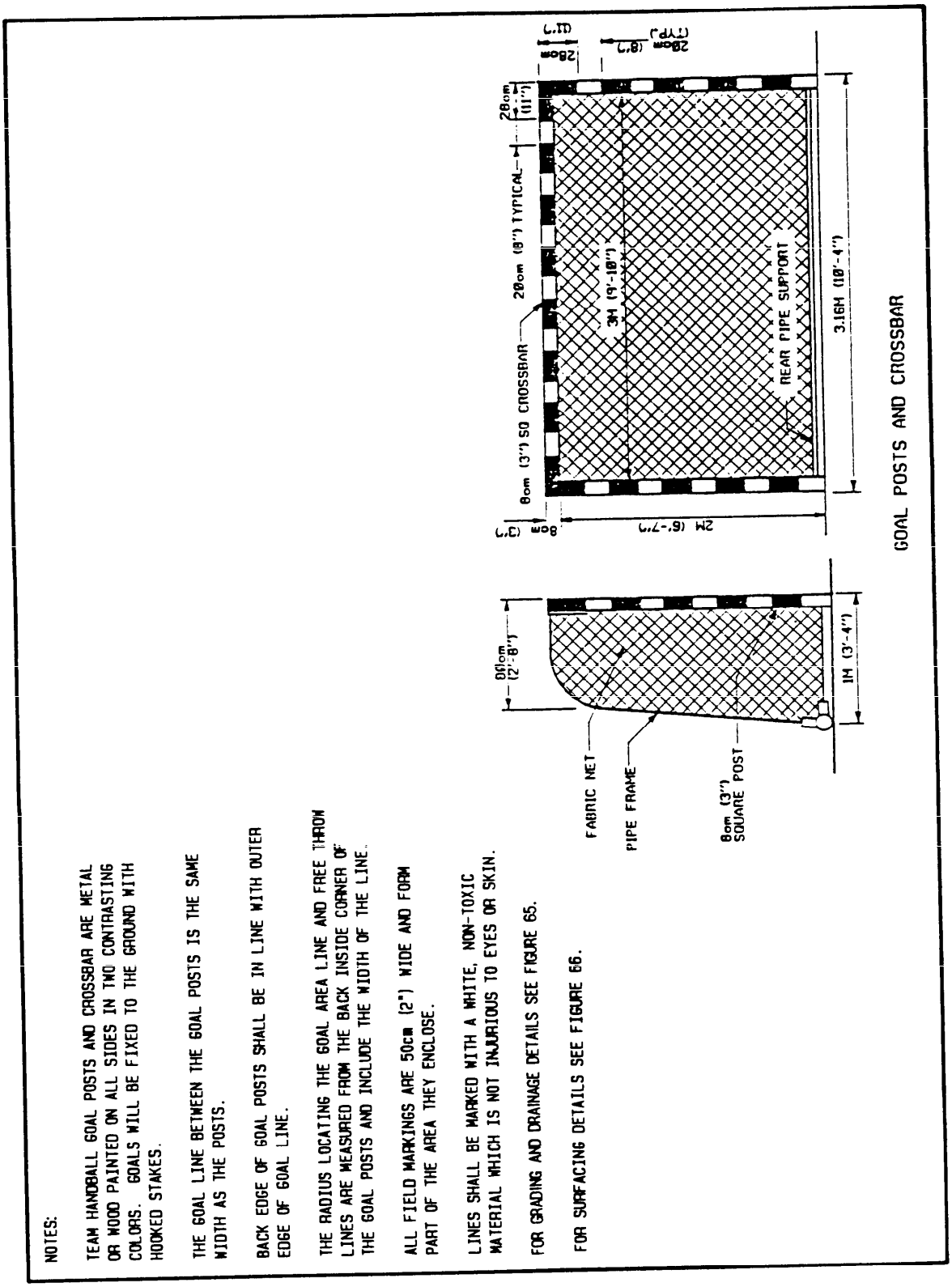


Figure 38b
Team Handball Field -- Goal Detail

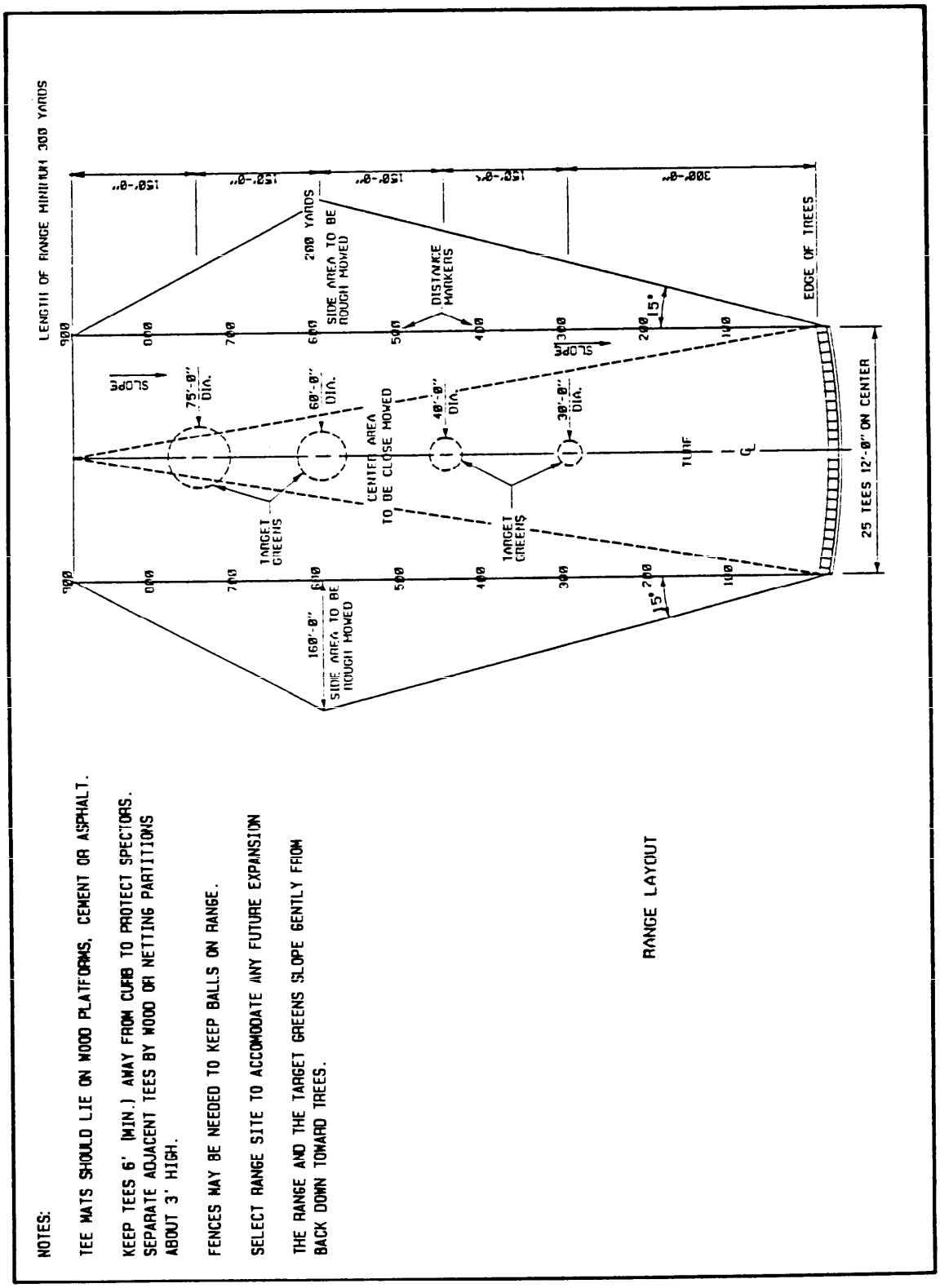


Figure 39a
Golf Driving Range -- Layout

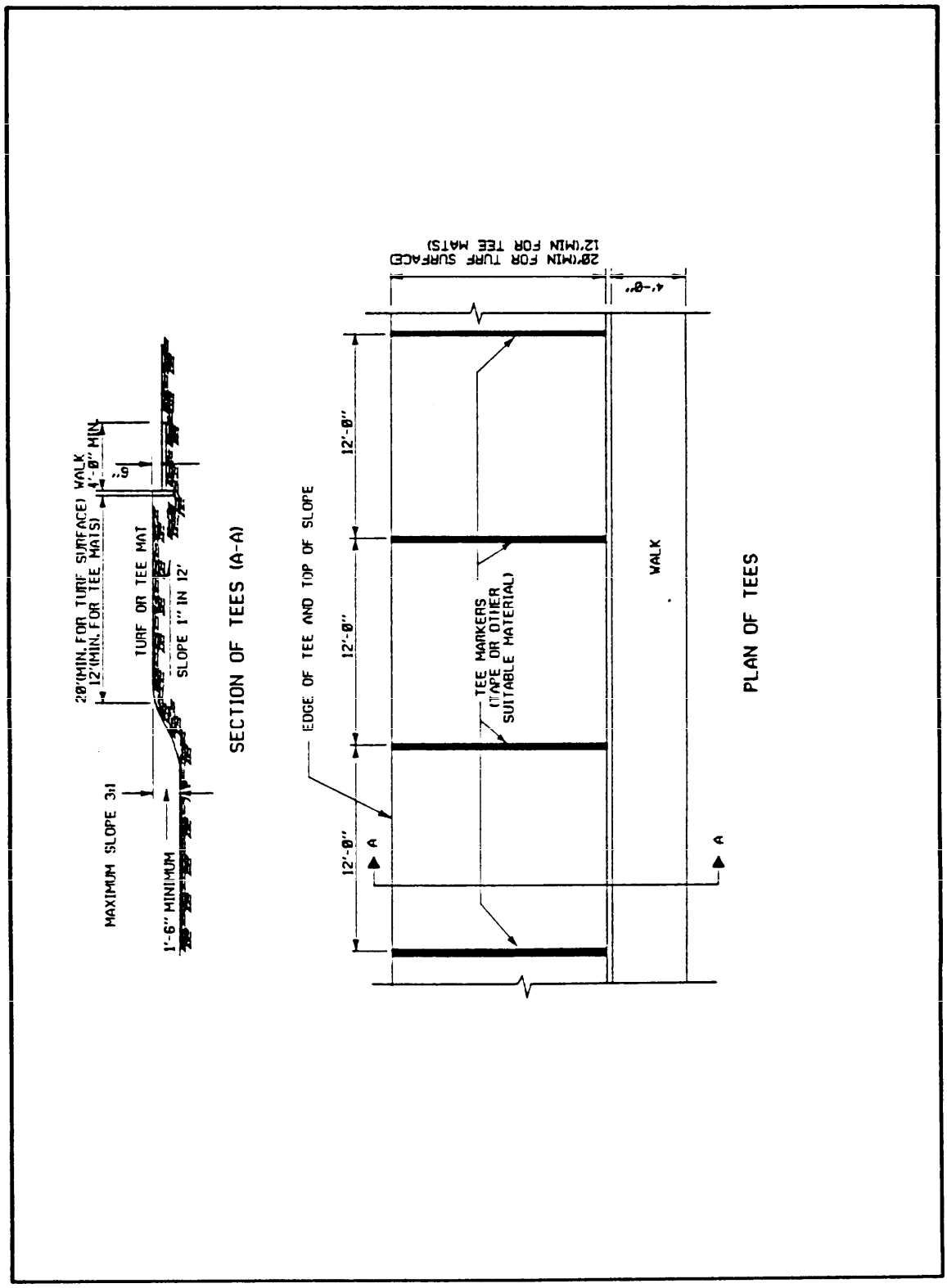


Figure 39b
Golf Driving Range -- Construction Details

Section 4: TRACK AND FIELD

4.1 400-meter Running Track. The 400-meter running track (see Figures 40 and 41) shall meet the following criteria.

a) Source of Information: The Athletic Congress.

b) Recommended Area: The ground space shall be approximately 4.1 acres (1.66 ha).

c) Size and Dimension: The radius to trackside face of curb shall be 103.44 ft (31.53 m). The track width shall be 28 ft (8.53 m) for 8 lanes (each lane 3.50 ft or 1.067 m wide).

d) Orientation: The track shall be oriented with the long axis to be in a sector from north-northwest to south-southeast. The finish line shall be on the north.

e) Surface and Drainage: The track shall meet the following criteria.

(1) The preferred track surface shall be bituminous material with a hot plant cushion course mix. Protective colorcoating shall be optional.

(2) The maximum slopes for the running track are 2 percent (1:50) inward in the center of curves, 1 percent (1:100) inward in the straightaways, and 0.1 percent (1:1000) in the running direction.

f) Special Considerations: Drainage shall be provided for the track surface, but will depend upon site grading.

4.2 Shot Put. The shot put area (see Figure 42) shall be as follows.

a) Source of Information: The Athletic Congress.

b) Recommended Area: The ground space shall be 2,100 ft^2 (195 m^2) minimum.

c) Size and Dimension: The shot put circle shall be 7 ft (2.134 m) in diameter. The throwing sector shall have a 40-degree angle and minimum radius of 70 ft (21.33 m).

d) Orientation: The preferred orientation is for the throwing direction to be toward the northeast quadrant.

e) Surface and Drainage: The surface of the inner circle shall be concrete or similar material. The throwing sector shall be turf at the same level as the top of the metal ring.

f) Special Considerations:

(1) The stopboard shall be firmly fixed so that its inner edge coincides with the inner edge of the shot put circle.

(2) Sector flags are required to mark the end of the landing zone at the distance required by the competition.

4.3 Hammer Throw. The hammer throw area (see Figure 43) shall be as follows.

a) Source of Information: The Athletic Congress.

b) Recommended Area: The ground space shall be 23,000 ft² (2136.7 m²) minimum.

c) Size and Dimension: The hammer throw circle shall be 7 ft (2.13 m) in diameter. The throwing sector shall be a 40-degree angle with a minimum radius of 250 ft (76.2 m).

d) Orientation: The preferred orientation is for the throwing direction to be toward the northeast quadrant.

e) Surface and Drainage: The throwing sector shall be turf at the same level as the top of the metal ring.

f) Special Considerations: Section flags are required to mark end of landing zone at distance required by the competition.

4.4 Discus Throw. The discus throw area (see Figure 44) shall be as follows.

a) Source of Information: Athletic Congress.

b) Recommended Area: The ground space shall be 18,100 ft² (1681.5 m²) minimum.

c) Size and Dimension: The discus throwing circle shall be 8 ft 2-1/2 in. (2.50 m) in diameter. The throwing sector shall be a 40-degree angle and 220 ft (67.06 m) radius (minimum).

d) Orientation: The preferred orientation shall be for the throwing to be toward the northeast quadrant.

e) Surface and Drainage: The throwing sector shall be turf at the same level as the top of the metal ring.

f) Special Considerations: Sector flags are required to mark end of landing zone at distance required by the competition.

4.5 Javelin Throw. The javelin throwing area (see Figure 45) shall be as follows.

a) Source of Information: The Athletic Congress.

b) Recommended Area: The ground space shall be 24,000 ft² (2229.6 m²) minimum.

c) Size and Dimension: The runway length shall be a minimum of 120 ft (36.5 m). The runway width shall be 13 ft 1-1/2 in. (4 m). The throwing sector shall be a 30-degree angle with a minimum radius of 300 ft (91.5 m).

d) Orientation: The preferred orientation is for the throwing direction to be toward the northeast quadrant.

e) Surface and Drainage: Surface and drainage shall meet the following criteria.

(1) The runway may be turf or specialized bituminous surfacing with a maximum slope of 1 percent (1:100) laterally and 0.1 percent (1:1000) in the running direction.

(2) The throwing sector shall be turf at the same level as the runway behind the throwing arc.

f) Special Considerations: Sector flags are required to mark the end of landing zone at distance required by the competition.

4.6 Long Jump and Triple Jump. The long jump and triple jump area (see Figure 46) shall be as follows.

a) Source of Information: The Athletic Congress.

b) Recommended Area: The ground space shall be 1,500 ft² (139.35 m²) minimum.

c) Size and Dimension: The runway shall be 130 ft (36.92 m) long minimum and 4 ft (1.22 m) wide (minimum). The landing pit shall be 9 ft (2.75 m) wide minimum and 32 ft 10 in. (10 m) long minimum.

d) Orientation: The preferred orientation is for the running direction to be toward the north or northeast.

e) Surface and Drainage: The surface and drainage shall be as follows:

(1) Preferred runway surface shall be bituminous material with a hot plant cushion course mix. Protective colorcoating shall be optional.

(2) The maximum slope shall be 1 percent (1:100) laterally and 0.1 percent (1:1000) in the running direction.

(3) The landing pit shall be sand at the same elevation as the takeoff board.

f) Special Considerations: The takeoff board shall be of wood and must be fixed in the runway.

4.7 Pole Vault. The pole vault area (see Figure 47) shall be as follows.

a) Source of Information: The Athletic Congress.

b) Recommended Area: The ground space shall be 1,500 ft² (139.35 m²) minimum.

c) Size and Dimension: The runway shall be 125 ft (38.1 m) long minimum by 4 ft (1.22 m) wide minimum. The vault pit shall be 16 ft (5 m) wide minimum and depth ranges from 12 ft (3.66 m) minimum to 16 ft (5 m) preferred. Height of the material in the jumping pit shall range from 18 in. (0.46 m) to 36 in. (0.92 m) preferred, with a connecting apron of the same material and decreasing height around the vaulting box.

d) Orientation: The preferred orientation is for the running direction to be toward the north to east-northeast.

e) Surface and Drainage: The surface and drainage shall be as follows:

(1) The runway shall be of a bituminous material with a hot plant cushion course mix (protective colorcoating shall be optional).

(2) The maximum slope shall be 1 percent (1:100) laterally and 0.1 percent (1:1000) in the running direction.

f) Special Considerations: The pole vault box shall be fixed in the ground with its entire front edge flush with the front edge of the jumping pit.

4.8 High Jump. The high jump area (see Figure 48) shall be as follows.

a) Source of Information: The Athletic Congress.

b) Recommended Area: The ground space shall be 4,100 ft² (380.9 m²) minimum.

c) Size and Dimension: The high jump runway shall have a minimum semicircle radius of 50 ft (15.24 m) and preferably 70 ft (21.3 m). The high jump pit shall be a minimum of 16 ft (5 m) wide x 8 ft (2.5 m) deep. The material in the jumping pit shall be a minimum of 28 in. (0.7 m) high. The takeoff area shall be a semicircle with a 10 ft (3 m) radius with the centerpoint directly under the center of the cross bar; no point within this area may be higher than the point of measurement.

d) Orientation: The preferred orientation is for the direction of jumping.

e) Surface and Drainage: The surface and drainage shall be as follows:

(1) Runway preferably shall be constructed of bituminous material.

(2) Synthetic surface shall be optional.

(3) Maximum approach apron slope shall be 1 percent laterally (1:100) and 0.1 percent (1:1000) in the running direction.

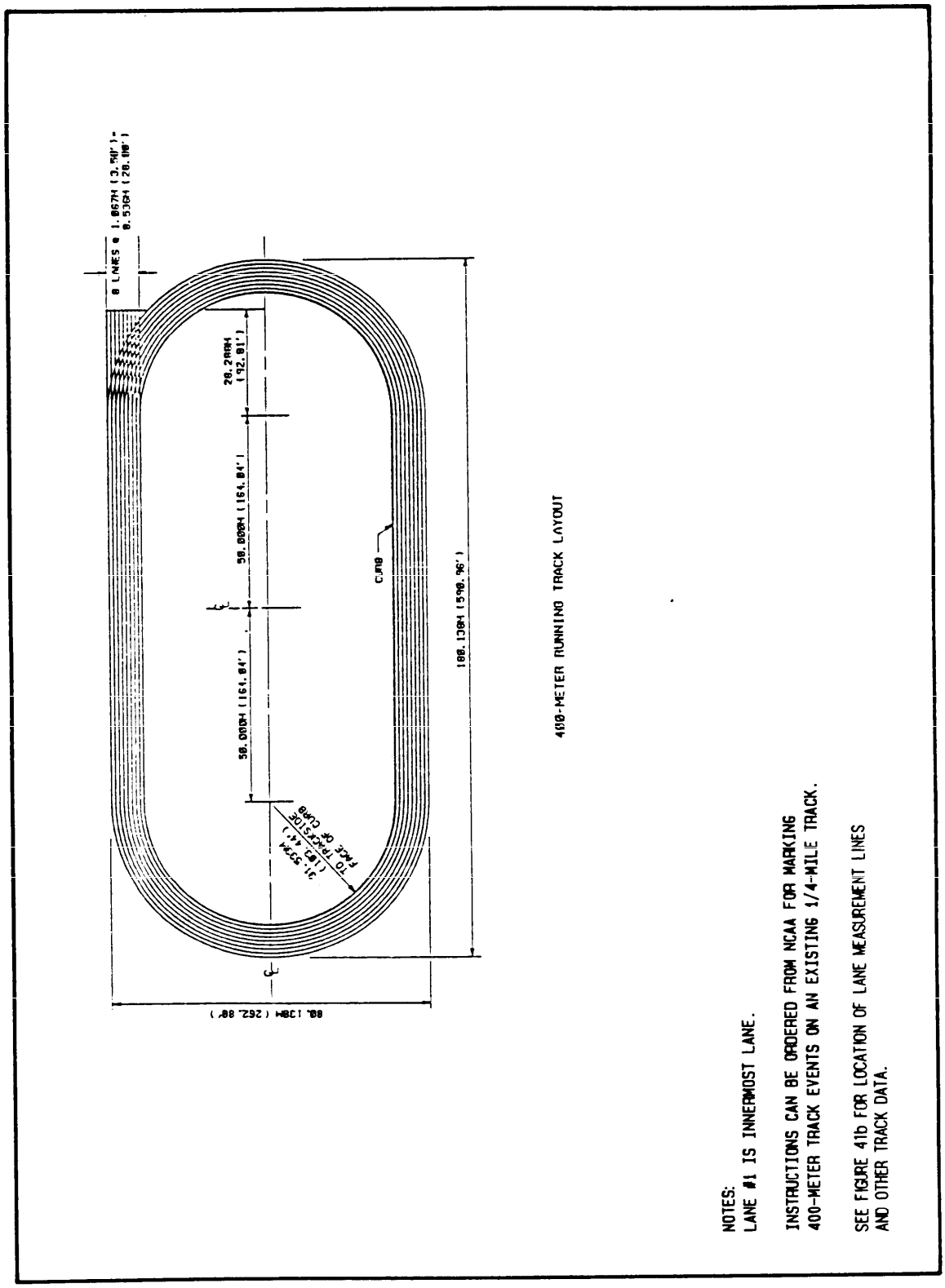


Figure 40
400-Meter Running Track -' Layout

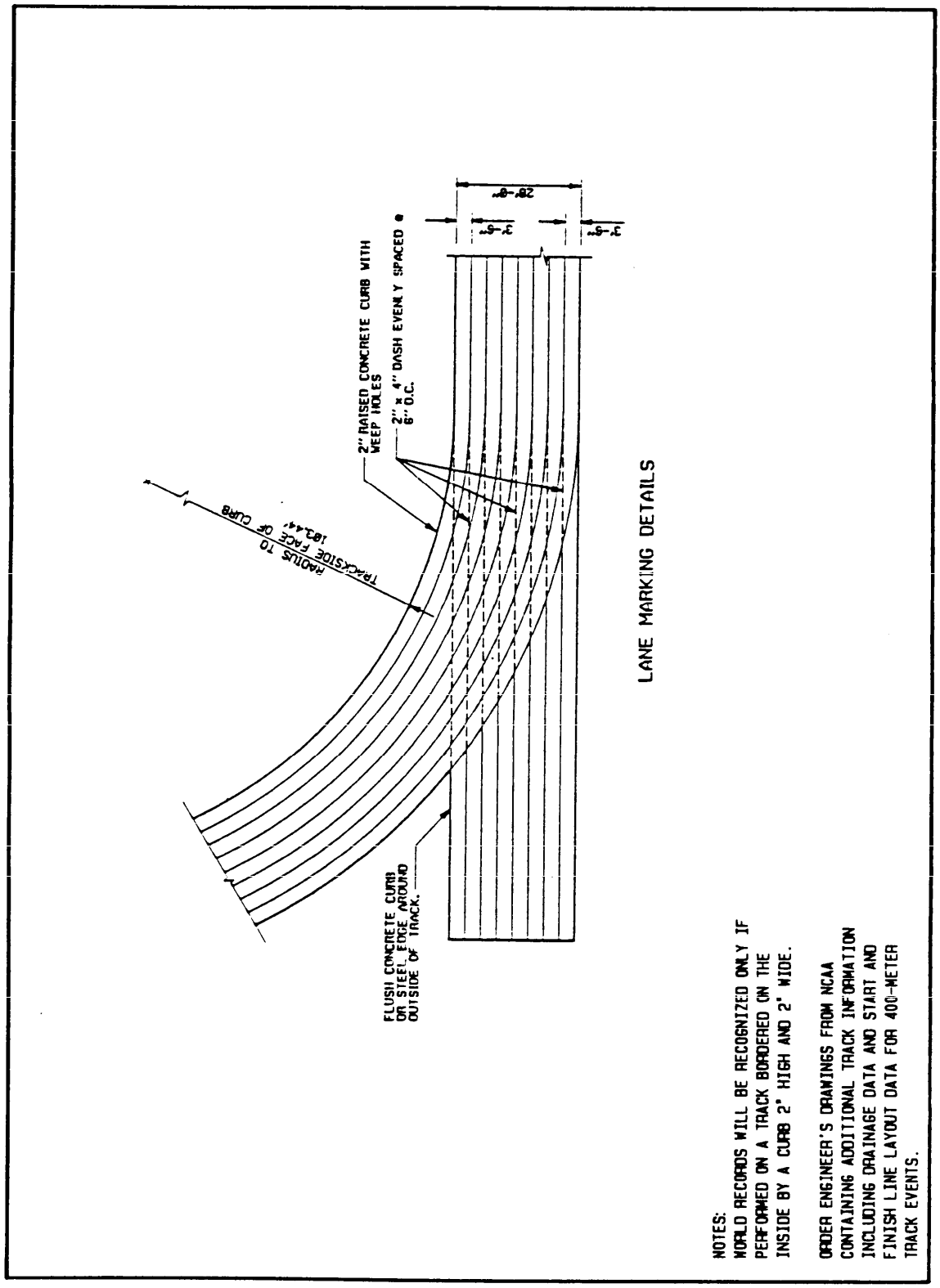


Figure 41a
400-Meter Running Track -- Lane Marking Details

following criteria:

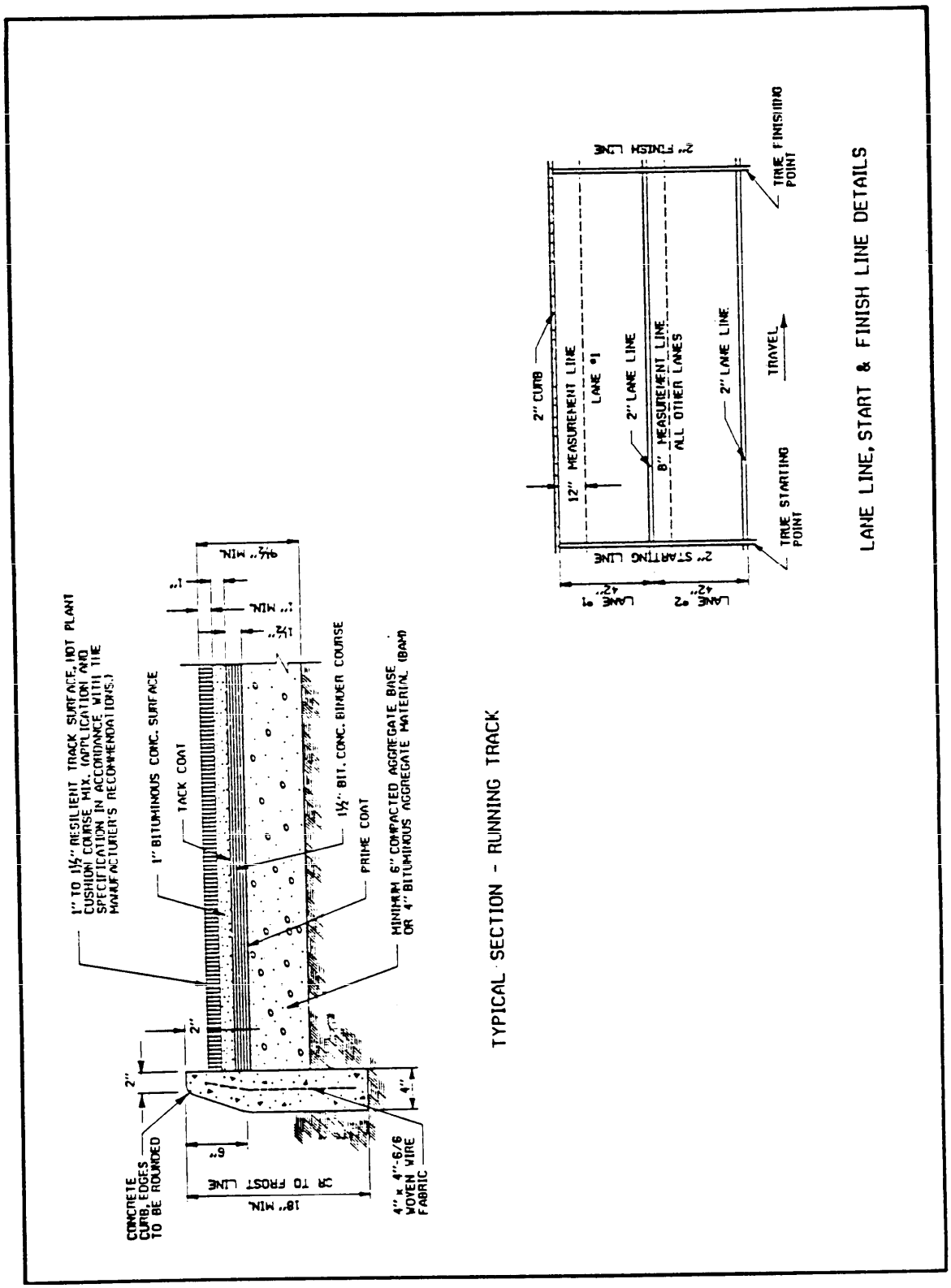


Figure 41b
400-Meter Running Track -- Construction Details

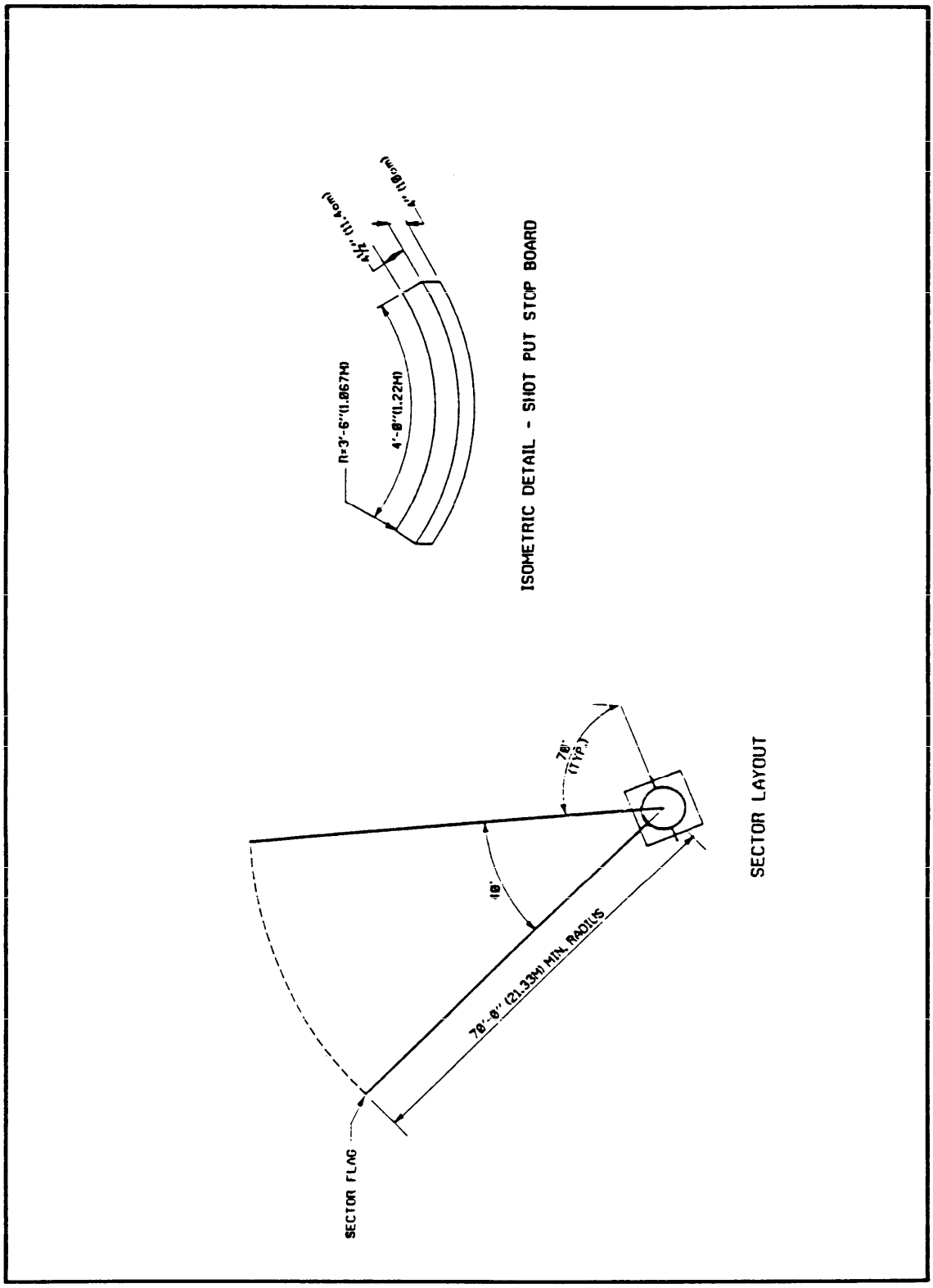


Figure 42a
Shot Put Circle -- Layout

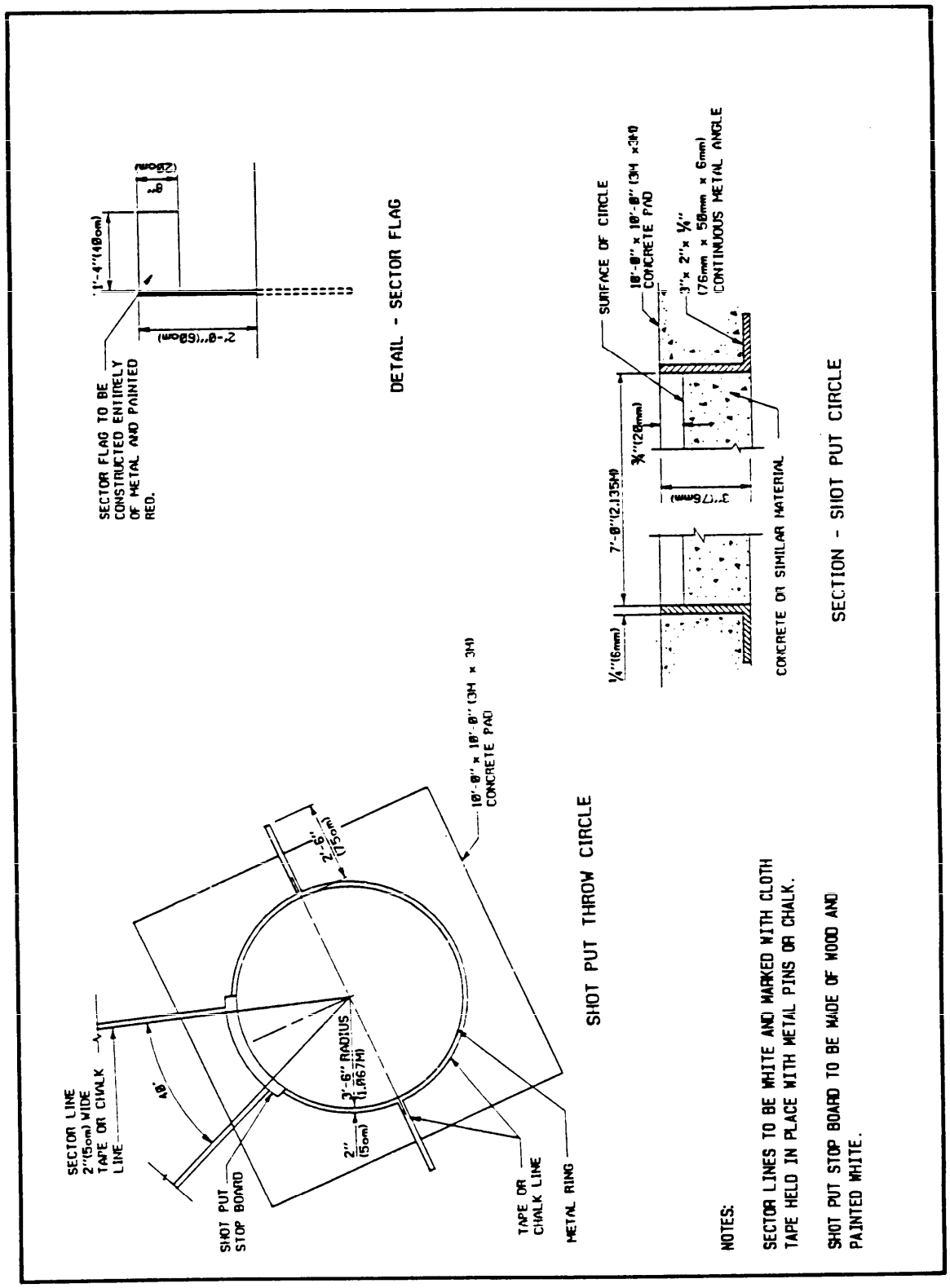


Figure 42b
Shot Put Circle -- Construction Details

Figure 43a
Hammer Throw -- Section Layout

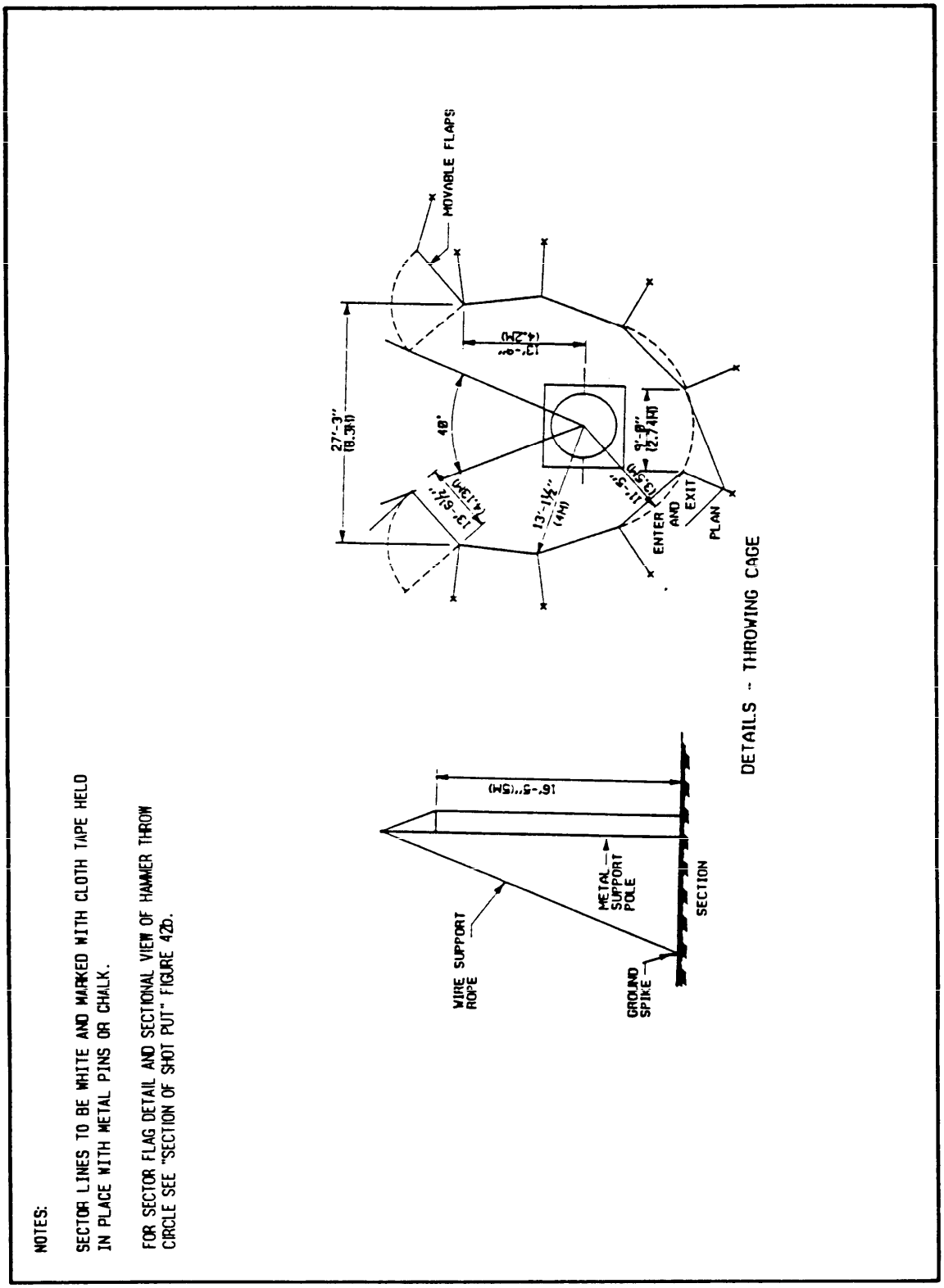


Figure 43b
Hammer Throw -- Throwing Cage Construction Details

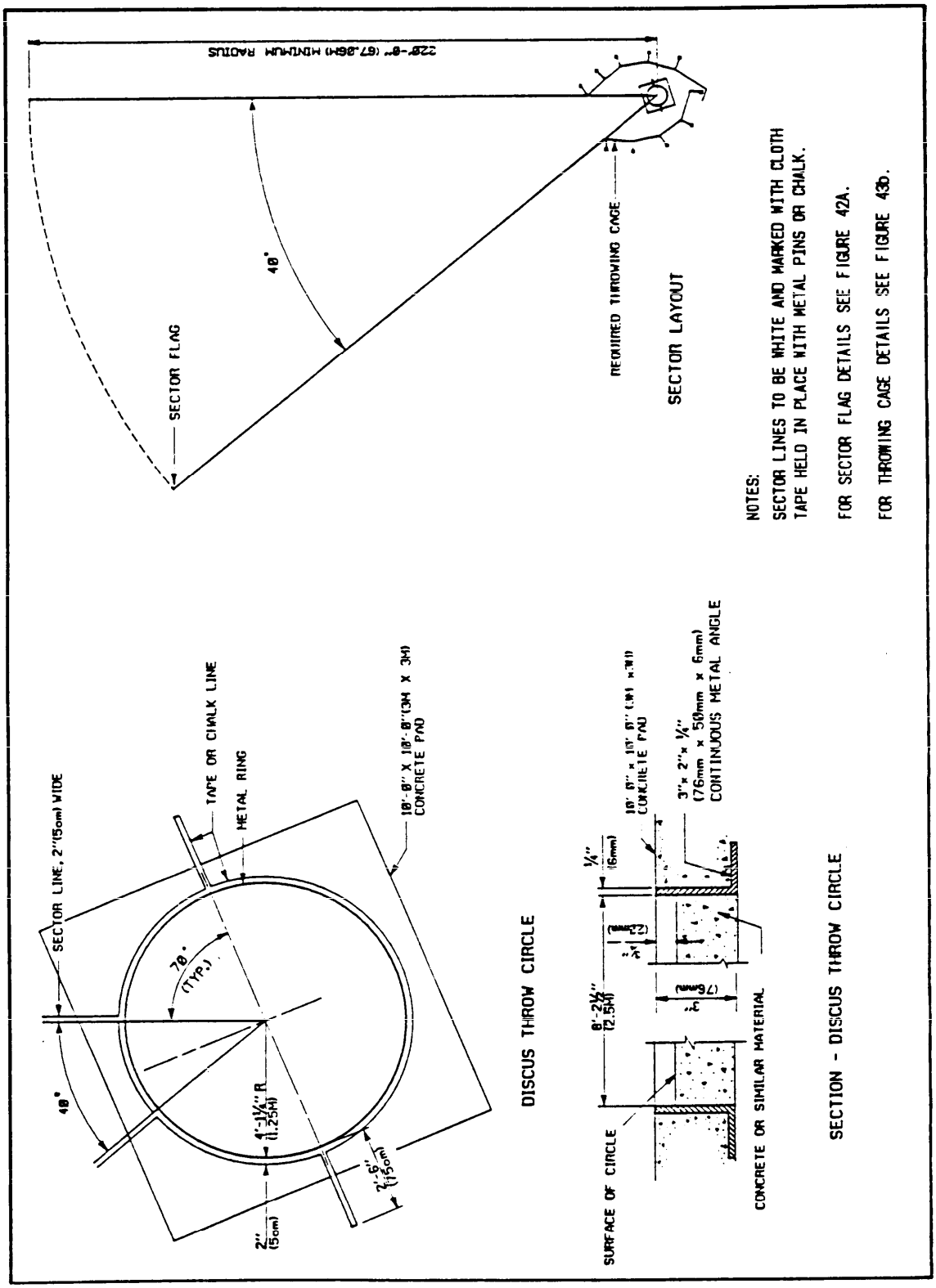


Figure 44
Discus Throw Sector

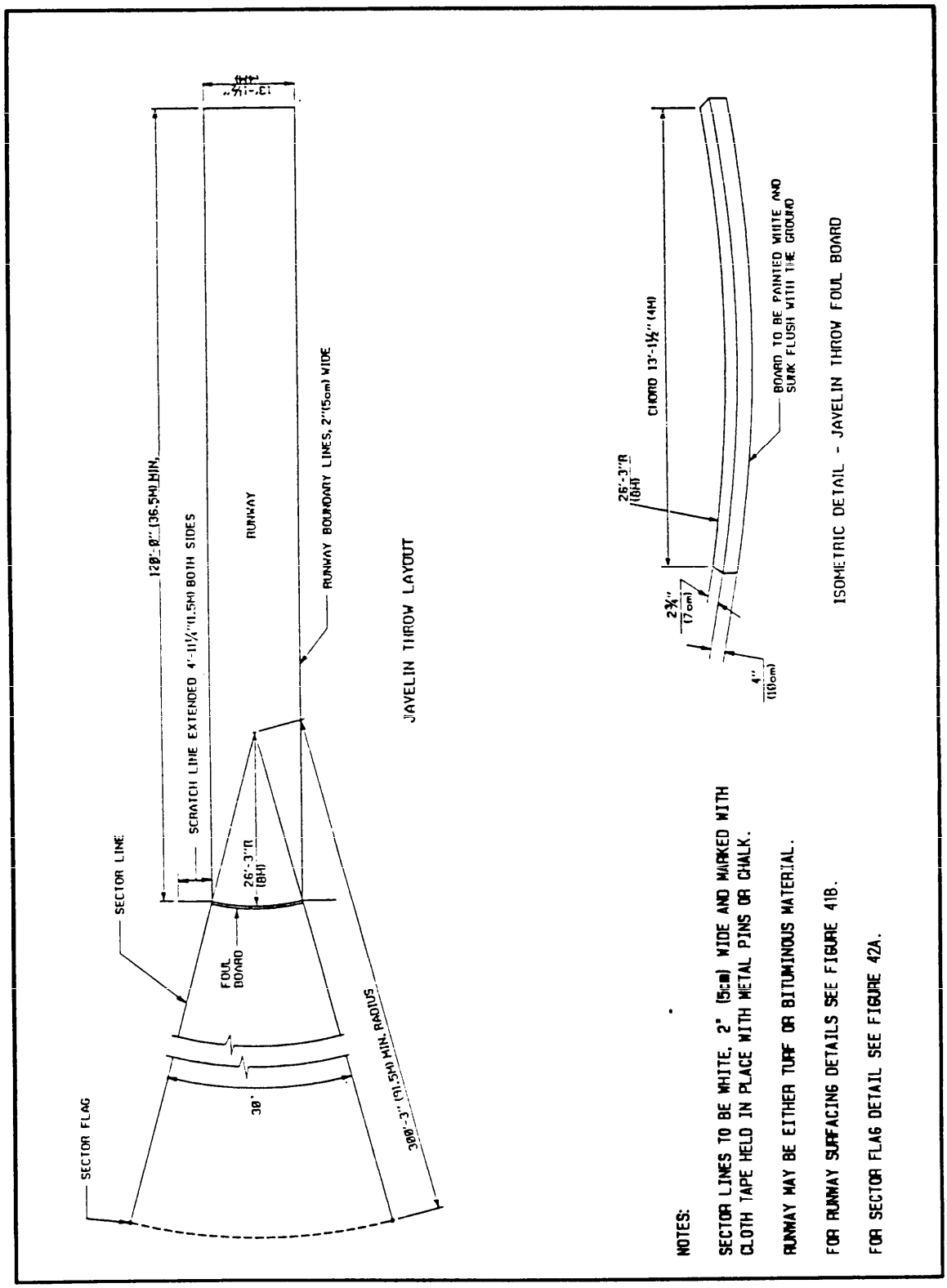


Figure 45
Javelin Throw Area

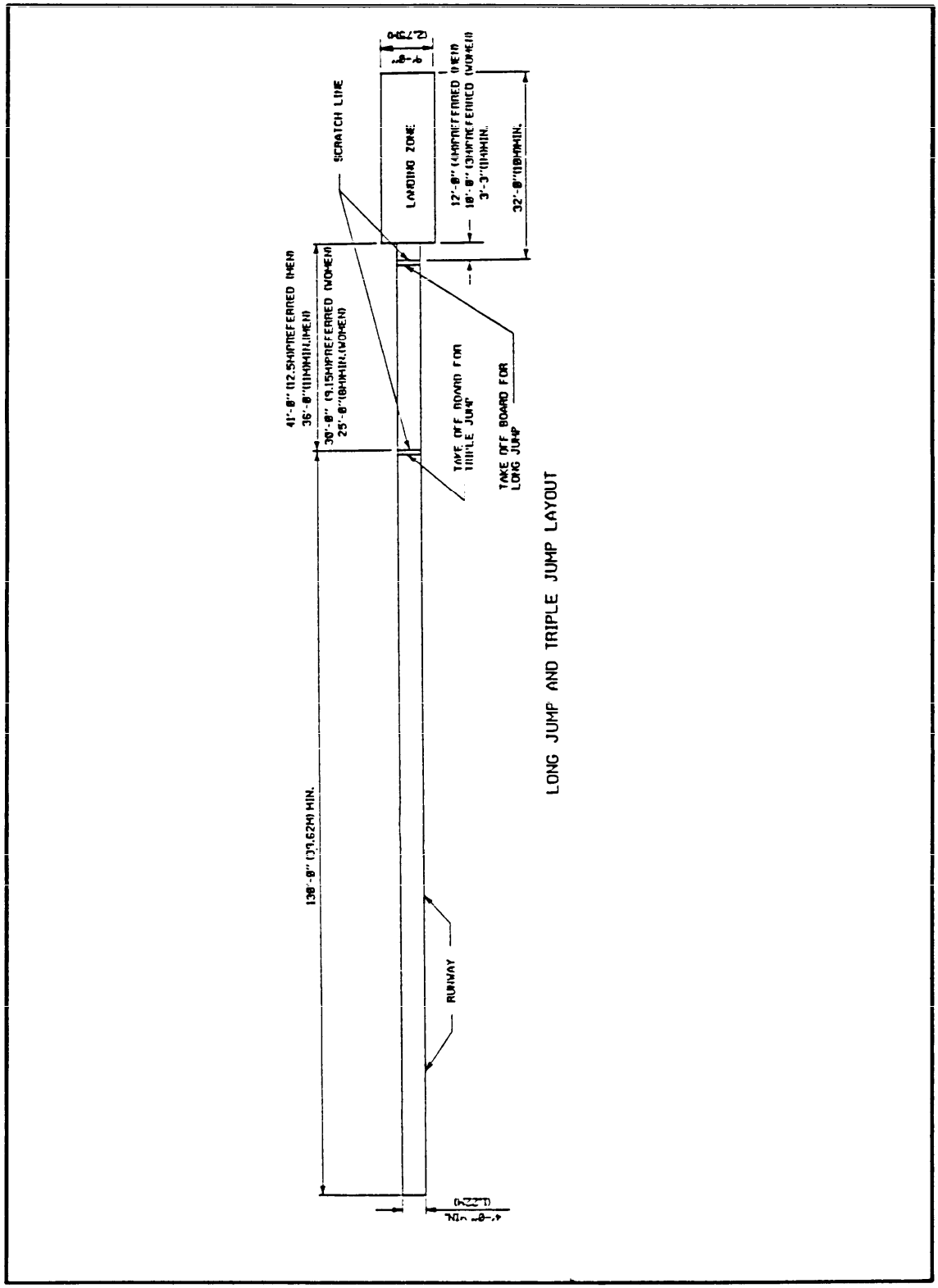


Figure 46a
Long Jump and Triple Jump Area -- Layout

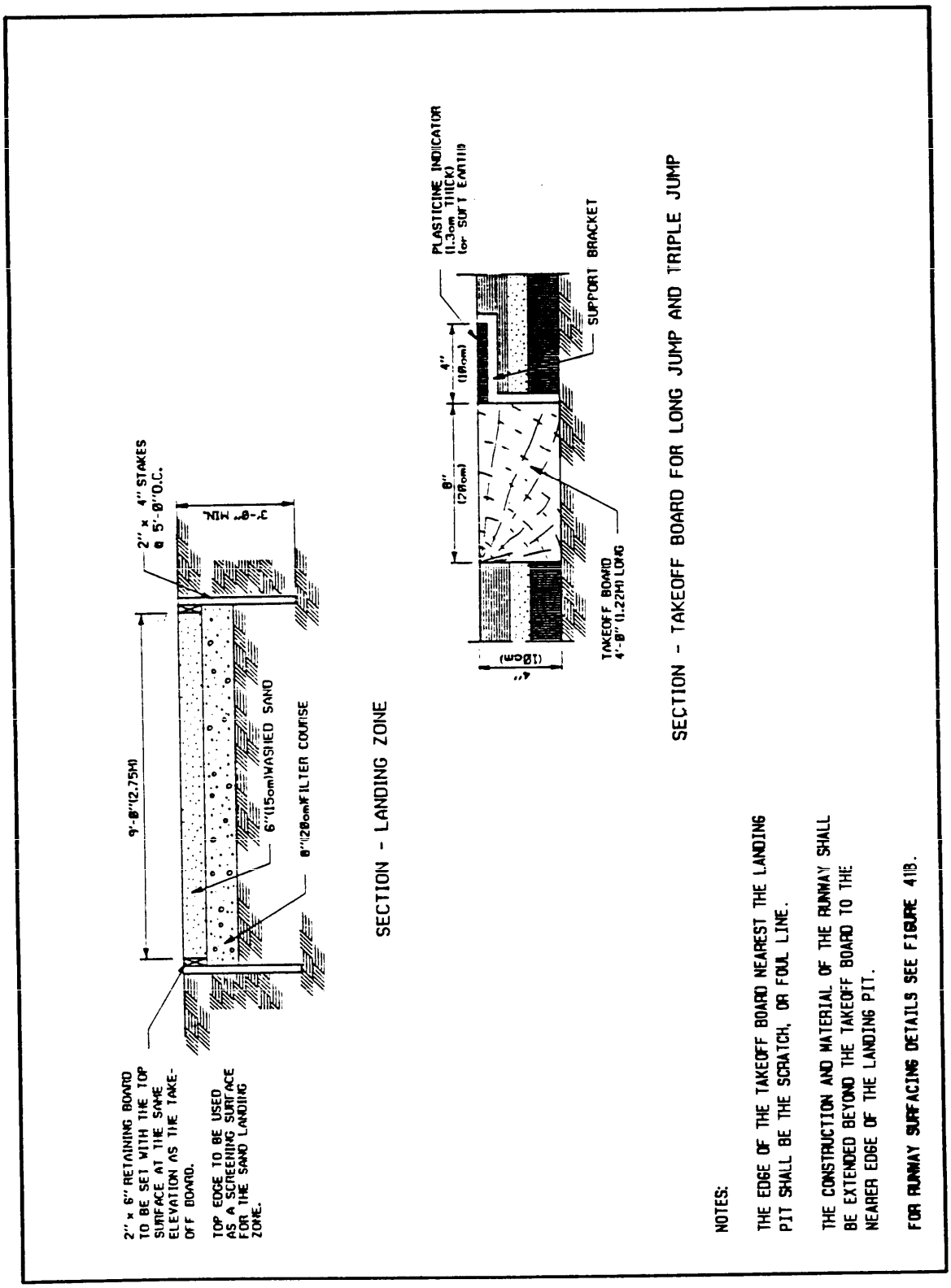


Figure 46b
Long Jump and Triple Jump Area -- Construction Details

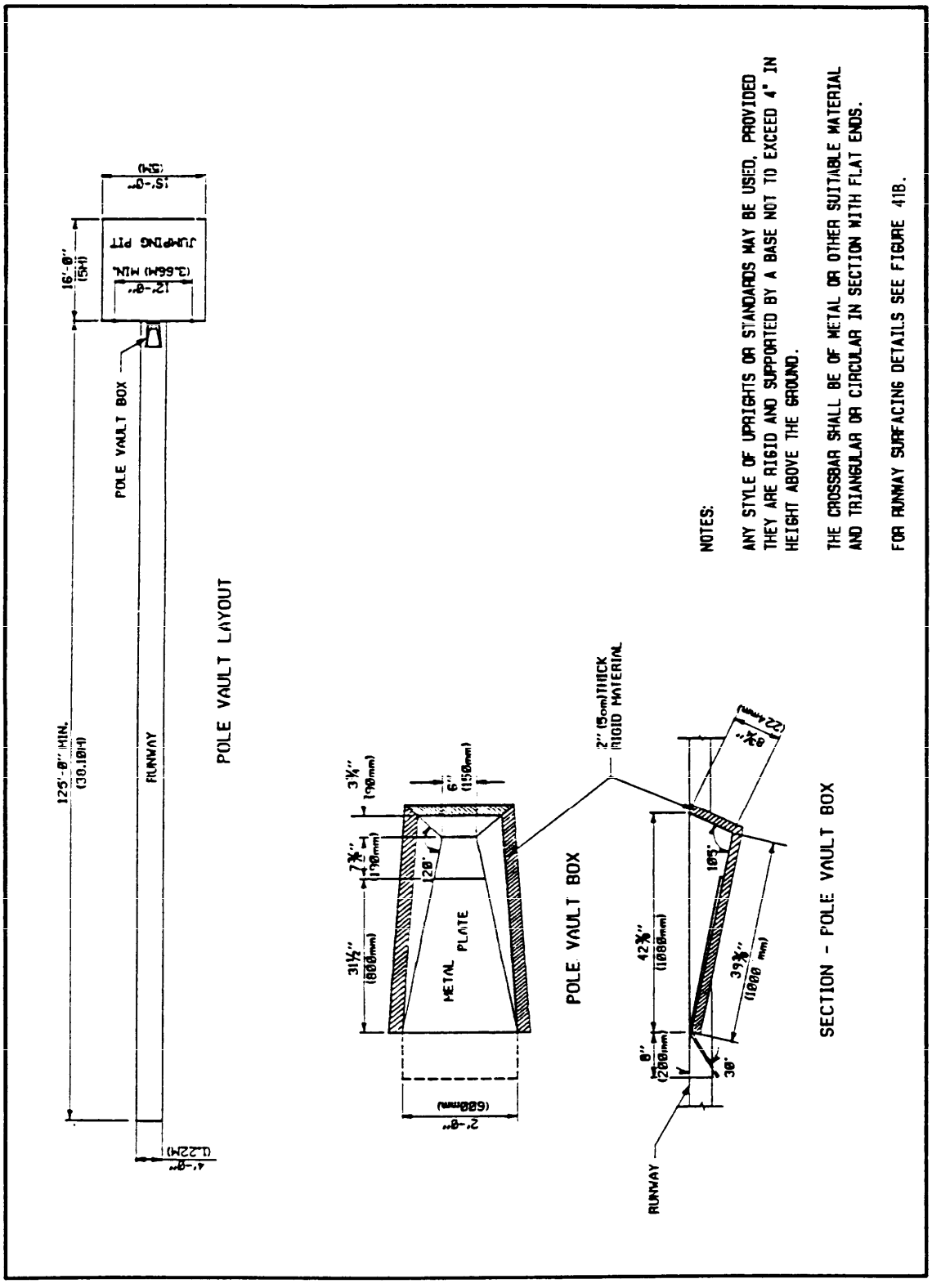


Figure 47a
Pole Vault Area -- Layout

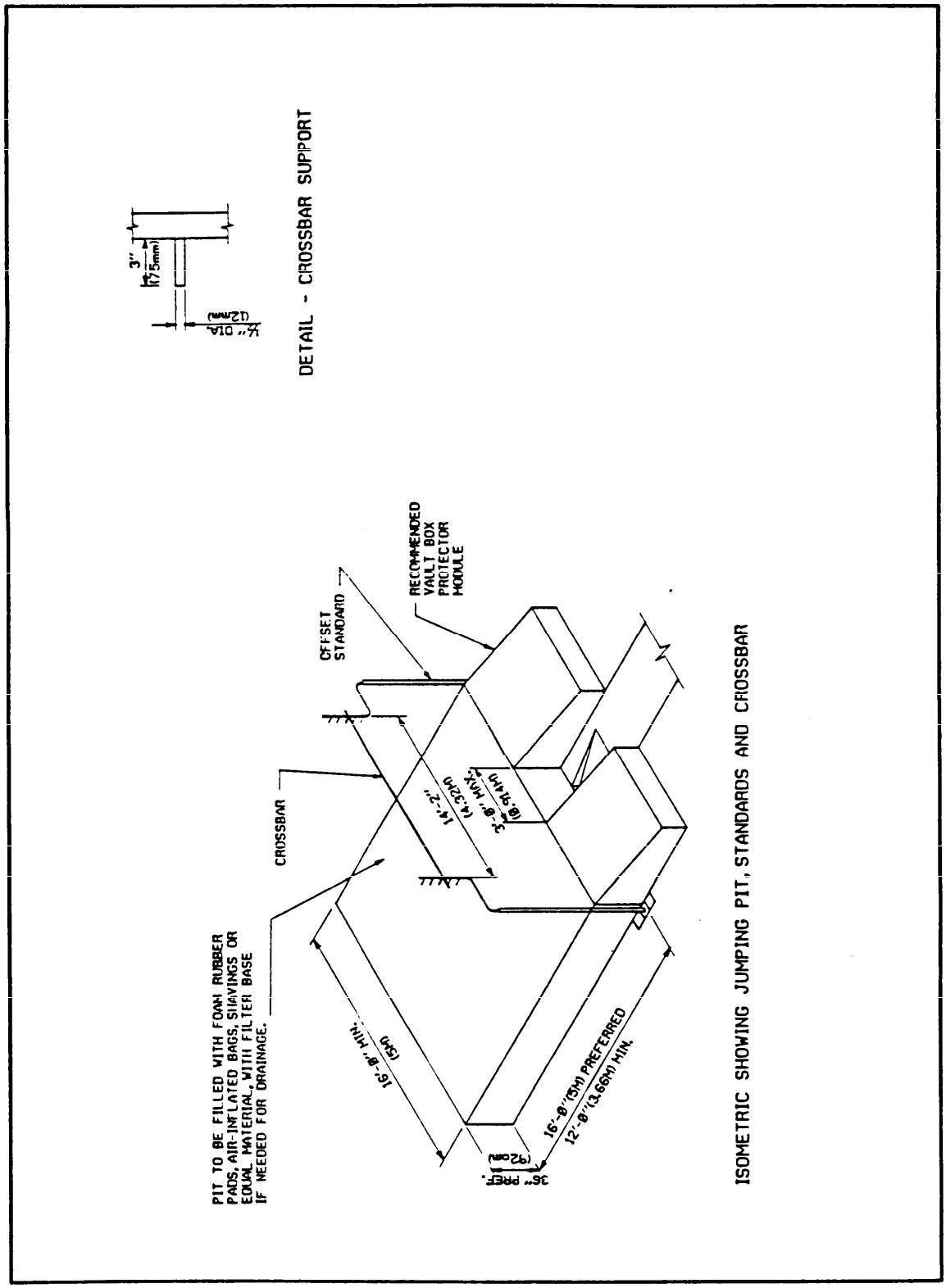


Figure 47b
Pole Vault Area -- Pit and Crossbar Details

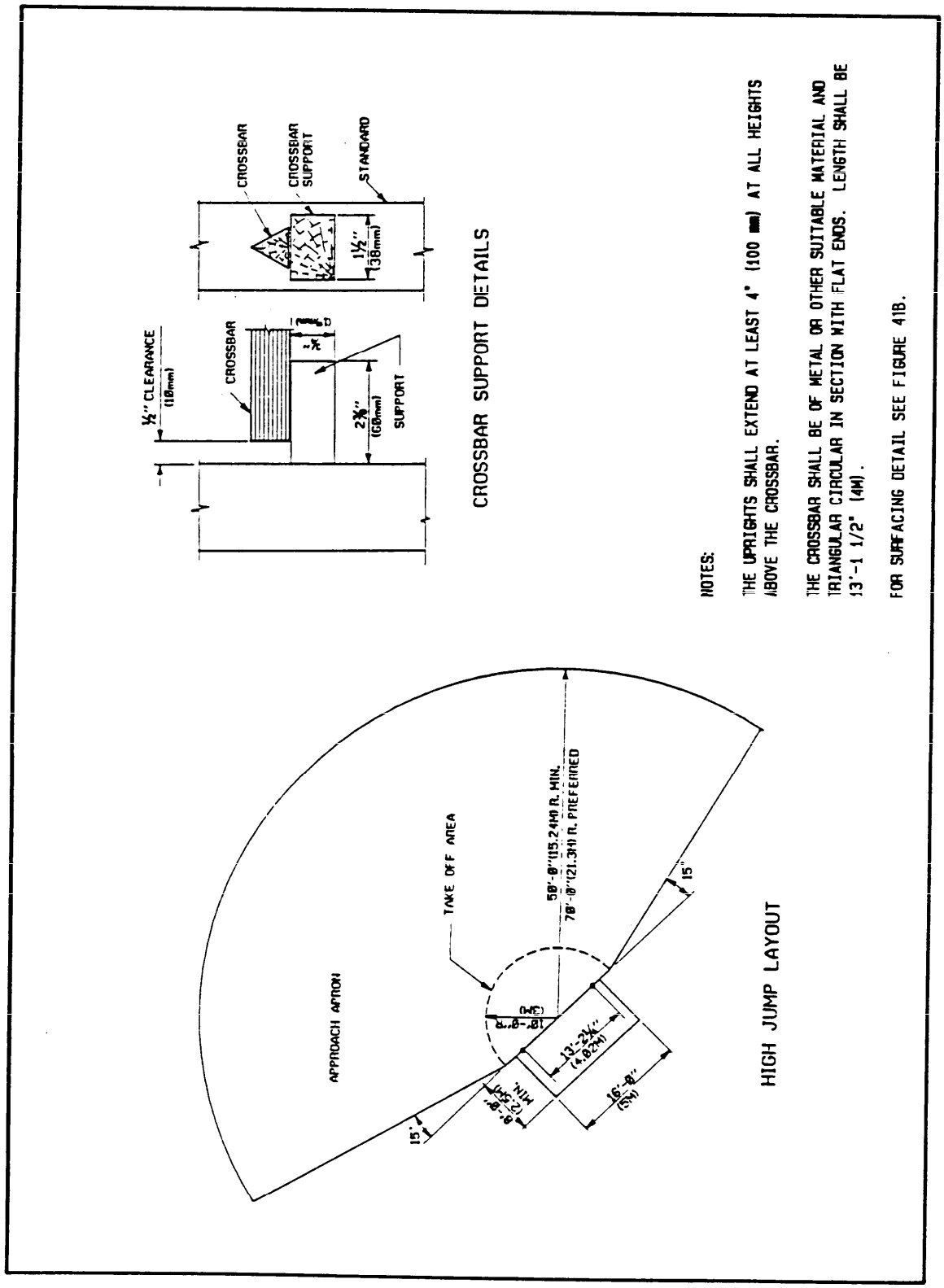
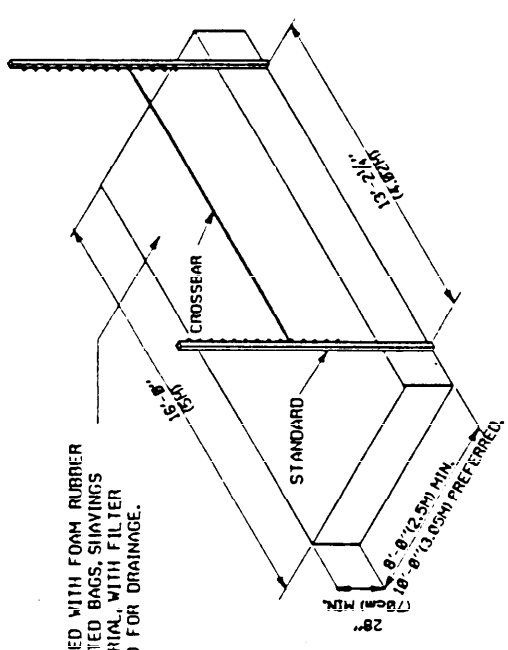


Figure 48a
High Jump Area -- Layout



ISOMETRIC SHOWING JUMPING PIT, STANDARDS AND CROSSBAR

Figure 48b
High Jump Area -- Pit Details

Section 5: MULTIPLE SPORTS COMPLEXES

5.1 Combination Basketball and Volleyball Court Complex. The combination basketball and volleyball court complexes (see Figure 49) shall be as follows.

a) Source of Information: Basketball--NCAA; Volleyball--USVBA.

b) Recommended Area: The ground space shall be 0.2 acres (0.0809 ha) for 1 basketball and 2 volleyball courts.

c) Size and Dimensions: The overall length shall be 114 ft (34.74 m) and the overall width shall be 80 ft (24.38 m).

d) Orientation: The preferred orientation is north-south for the long axis of the court expected to have primary use.

e) Surface and Drainage: The surface and drainage shall meet the following criteria.

(1) Surface shall be of concrete or bituminous material (protective colorcoating shall be optional).

(2) Drainage shall be end-to-end, side-to-side or corner-to-corner diagonally at a minimum slope of 1 inch (25.4 mm) in 10 feet (3.05 m) (0.8 percent).

f) Special Considerations: To allow unobstructed use of the basketball court, volleyball posts must be removable and post-holes equipped with flush-mounted deck plates.

5.2 Combination Tennis, Volleyball, Basketball, Badminton Court Complex. The combination tennis, volleyball, basketball, badminton court complex area (see Figure 50) shall be as follows.

a) Source of Information: Basketball--NCAA; Volleyball--USVBA; Badminton--ABA; Tennis--USTA.

b) Recommended Area: The ground space shall be 24,720 ft^2 (2296.5 m^2) for four tennis courts with one basketball, one volleyball, and one badminton court superimposed thereon.

c) Size and Dimension: The overall length shall be 206 ft (62.78 mm) and the overall width shall be 120 ft (36.57 m).

d) Orientation: The preferred orientation is north-south for the long axis of all courts.

e) Surface and Drainage: The surface and drainage shall meet the following criteria.

(1) The surface shall be of concrete or bituminous material

(protective colorcoating shall be optional).

(2) The drainage shall be end-to-end, side-to-side or corner-to-corner diagonally at a minimum slope of 1 in. (25.4 mm) in 10 ft (3.05 m) (0.8 percent).

f) Special Considerations:

(1) Special provisions shall be made to allow the various net posts to be erected for different court games.

(2) Court shall be enclosed by a 10-ft high fence.

5.3 Multiple Sports Court. Multiple sports courts (see Figure 51) shall be as follows.

a) Source of Information: Basketball--NCAA; Volleyball--USVBA; Tennis--USTA; Shuffleboard--General Sportcraft Company, Ltd.

b) Recommended Area: The ground space shall be 9,840 ft^2 (914.14 m^2).

c) Size and Dimension: 120 ft (36.6 m) long x 82 ft (25 m) wide (overall).

d) Orientation: The preferred orientation is north-south for the long axis of the court expected to have primary use.

e) Surface and Drainage: The surface and drainage shall be as follows:

(1) The surface shall be of concrete or bituminous material; shuffleboard courts must be concrete. Protective colorcoating shall be optional.

(2) The preferred drainage shall be from end-to-end at a slope of 1 in. in 10 ft (0.8 percent). The 12 ft (3.66 m) areas on each end shall be level for the shuffleboard courts.

f) Special Considerations:

(1) Removable posts with flush-mounted deck plates must be used for tennis and volleyball to allow unobstructed use of other courts.

(2) Fencing shall be provided, on all sides of the court, of 10-ft high (3.05 m) chain link fence which shall conform to NFGS-02444.

5.4 Combination Sports Fields. The combination sports fields (see Figure 52) shall be as follows.

a) Source of Information: Baseball--The Official Playing Rules Committee, Official Baseball Rules; Softball--Amateur Softball Association of America (ASA); Touch and Flag Football--The Athletic Institute. Football, 11-man--NCAA.

b) Recommended Area: Varies with the number of fields and the configuration.

c) Size and Dimension: Varies with the number of fields and the configuration.

d) Orientation: The preferred orientation varies when combinations are used. Selection for priority shall be based on anticipated use, time of play, and local site conditions.

e) Surface and Drainage: Surface and drainage shall be as follows:

(1) Surface shall be turf.

(2) Drainage shall be provided following guidelines for individual sports.

f) Special Considerations: Safety aspects of each sport shall not be compromised when multi-use concepts are employed.

5.5 Sports Fields within Running Tracks. Sports fields within running tracks (see Figure 53) shall be as follows.

a) Source of Information: Football--NCAA; Soccer--United States Soccer Federation (USSF).

b) Recommended Area: The ground space shall be approximately 4.1 acres (1.66 ha).

c) Size and Dimensions: See Figures 40 and 41 for track details. See Figures 29 and 30 for football field details, and Figures 33 and 34 for soccer field details. The overall length shall be 600 ft (182.8 m) and the overall width shall be 276 ft (84.12 m).

d) Orientation: Refer to para 4.1d.

e) Surface and Drainage: Surface and drainage shall be as follows:

(1) Surfaces shall be in accordance with the provisions as stated in Section 5 for the particular sports field.

(2) Details for drainage shall be obtained from the NCAA (see Figures 40 and 41 for 400 m track grading and drainage).

f) Special Considerations: Special Considerations will be those noted for the particular sport or event as stated in Section 4.

5.6 Multiple Field Events within Running Tracks. Multiple field event areas within running tracks (see Figure 54) shall be as follows.

a) Source of Information: NCAA.

b) Recommended Area: The ground space shall be approximately 4.1 acres (1.66 ha).

c) Size and Dimensions: See figures 40 and 41 for track details. See Figure 42 for shot put, Figure 46 for long jump and triple jump, Figure 47 for pole vault, and Figure 48 for high jump.

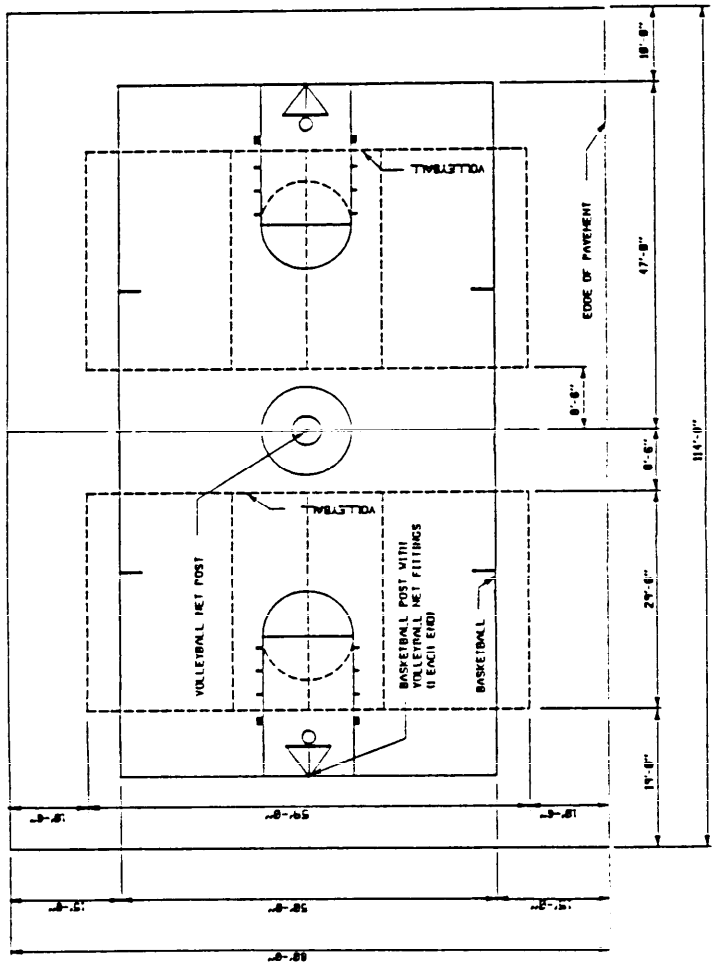
d) Orientation: Refer to para 4.1d for orientation details.

e) Surface and Drainage: Surface and drainage shall be as follows.

(1) Surface shall be in accordance with the provisions as stated in Section 5 for the particular event.

(2) Details for drainage shall be obtained from the NCAA.

f) Special Considerations: Special Considerations will be those noted for the particular sport or event as stated in Section 4.



NOTES:

FOR INDIVIDUAL COURT DIMENSIONS AND DETAILS, SEE FIGURE 3 (BASKETBALL) AND FIGURE 21 (VOLLEYBALL).

FOR REMOVABLE VOLLEYBALL NET POST DETAILS SEE FIGURE 63.

FOR SURFACING DETAILS SEE FIGURE 66.

Figure 49
Combination Basketball-Volleyball Court Complex

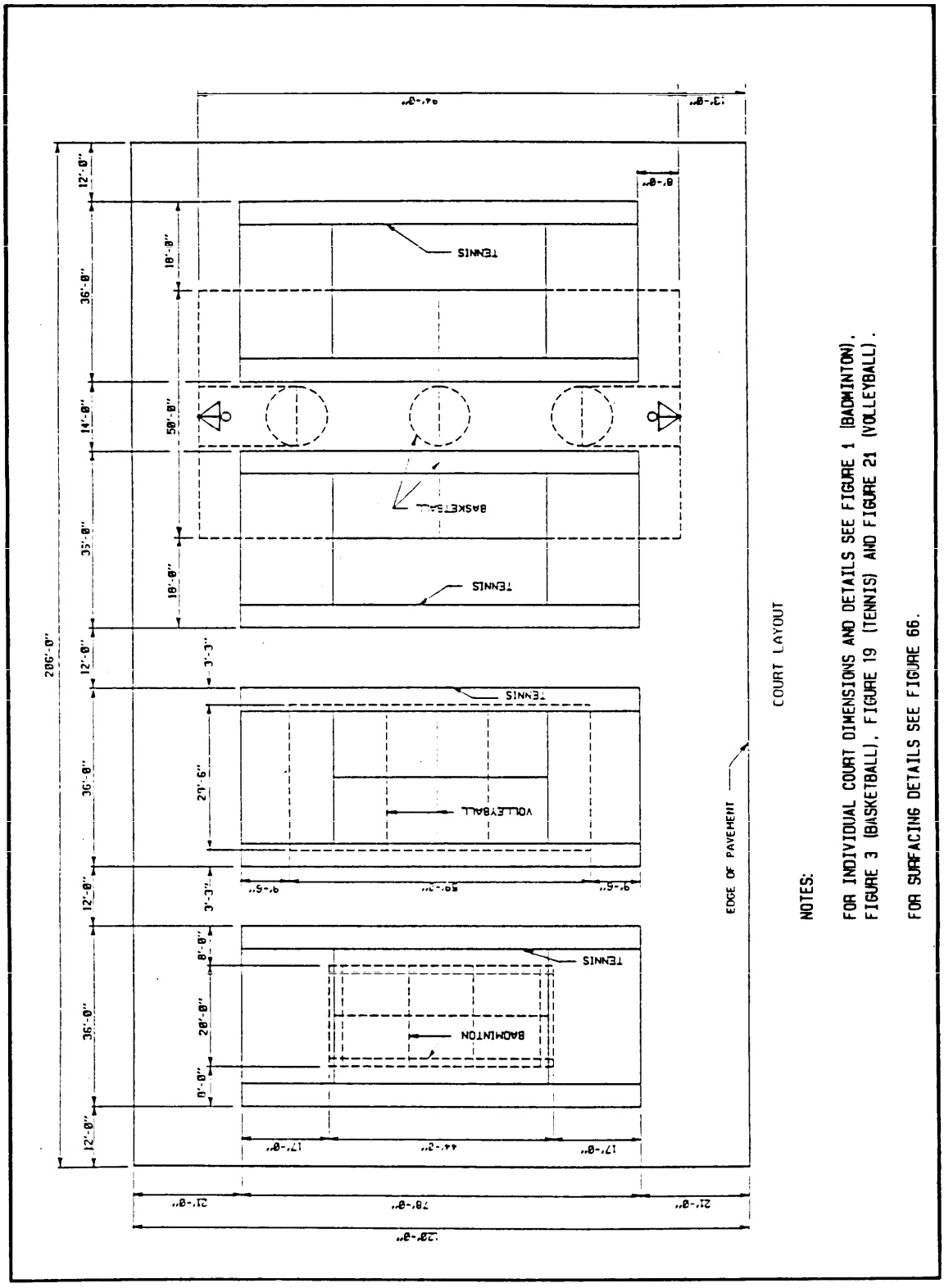


Figure 50
Combination Tennis, Volleyball, Basketball, Badminton Court Complex

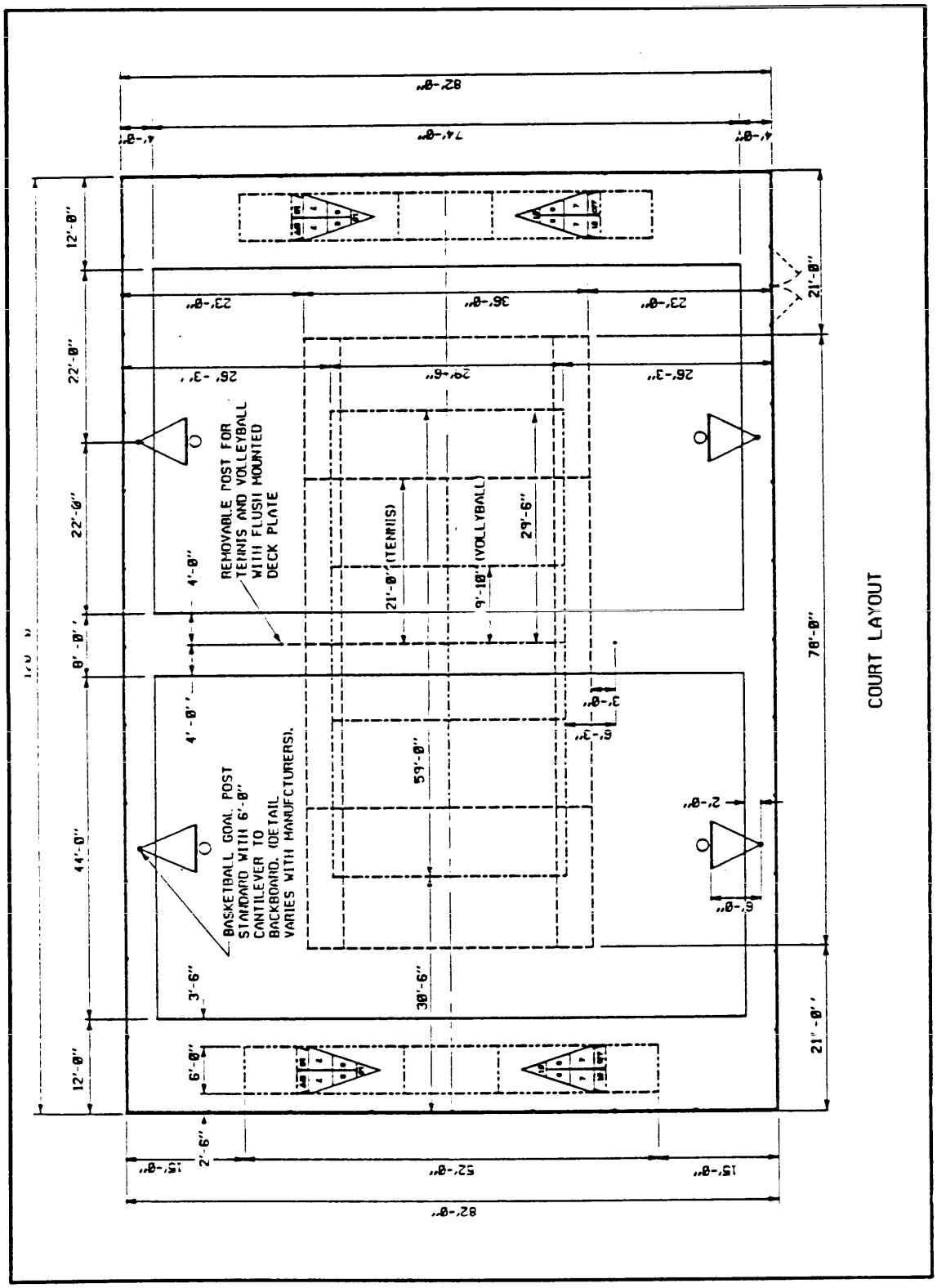


Figure 51a
Multiple Sports Court -- Layout

NOTES:

FOR INDIVIDUAL COURT DIMENSIONS AND DETAILS SEE FIGURE 3 (BASKETBALL), FIGURE 15 (SHUFFLEBOARD), FIGURE 19 (TENNIS) AND FIGURE 21 (VOLLEYBALL).

THE AREA IN WHICH SHUFFLEBOARD COURTS ARE LOCATED MUST BE PAVED AS AN OVERRUN FOR THE TENNIS COURT WHETHER OR NOT THE SHUFFLEBOARD COURTS ARE INSTALLED; END TO END MODIFIED DRAINAGE SCHEME MUST BE USED IF THEY ARE INSTALLED.

TO ACCOMODATE REGULATION-SIZED BASKETBALL COURTS, PAVED AREA MUST BE INCREASED TO AT LEAST 102' X 132'.

FOR REMOVABLE NET POST DETAILS SEE FIGURE 63.

FOR DRAINAGE DETAILS SEE FIGURE 65.

FOR SURFACING DETAILS SEE FIGURE 66.

COURT IDENTIFICATION LEGEND:

•BASKETBALL _____
SHUFFLEBOARD .....
TENNIS - - - - -
VOLLEYBALL -.-.-.-

Color key for painted court lines

Basketball.....Light Green
Tennis.....White
Volleyball.....Yellow
Shuffleboard.....Black

Figure 51b
Multiple Sports Court -- Color Key and Notes

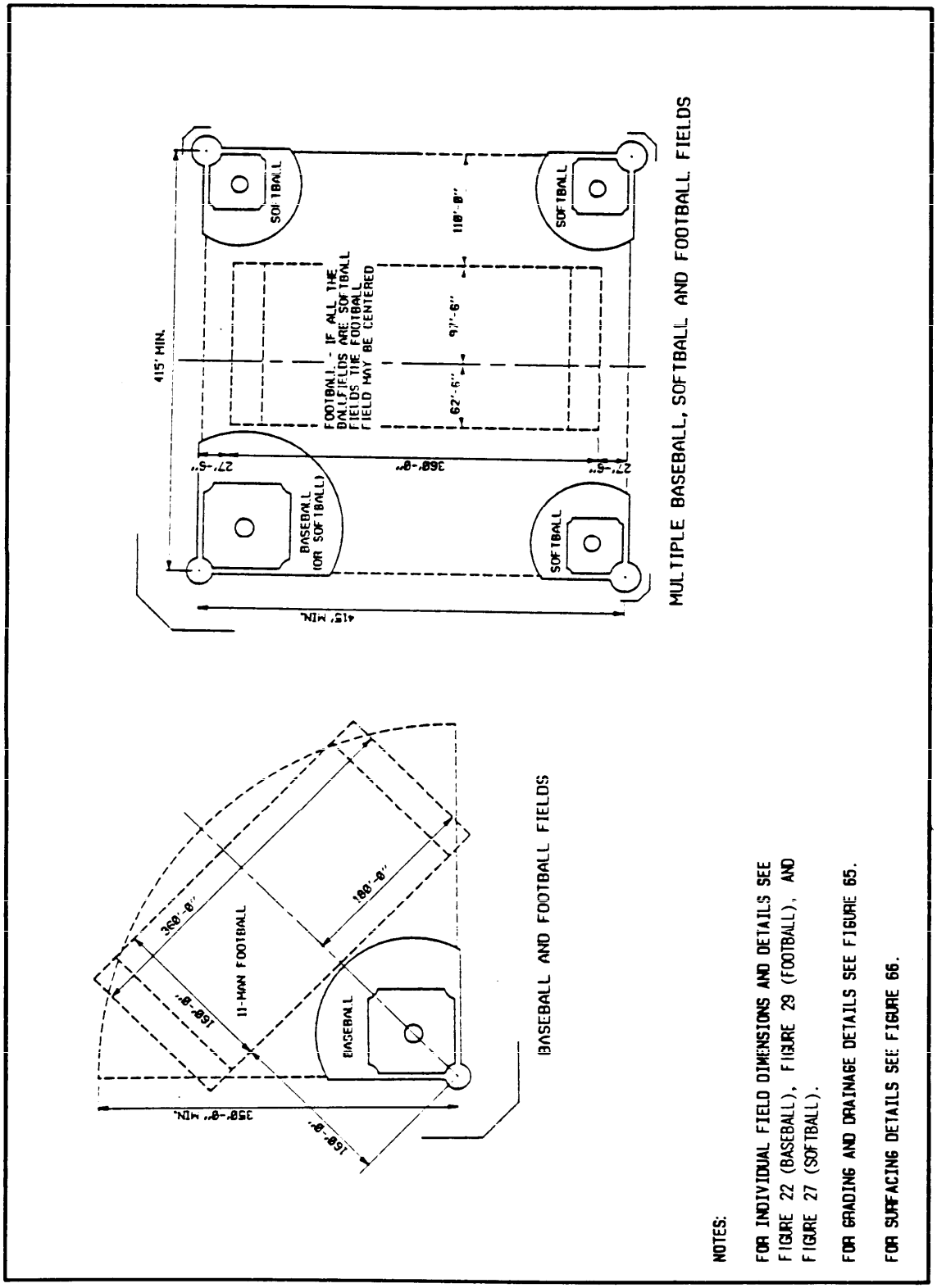


Figure 52a
Combination Sports Fields -- Baseball, Softball, and Football

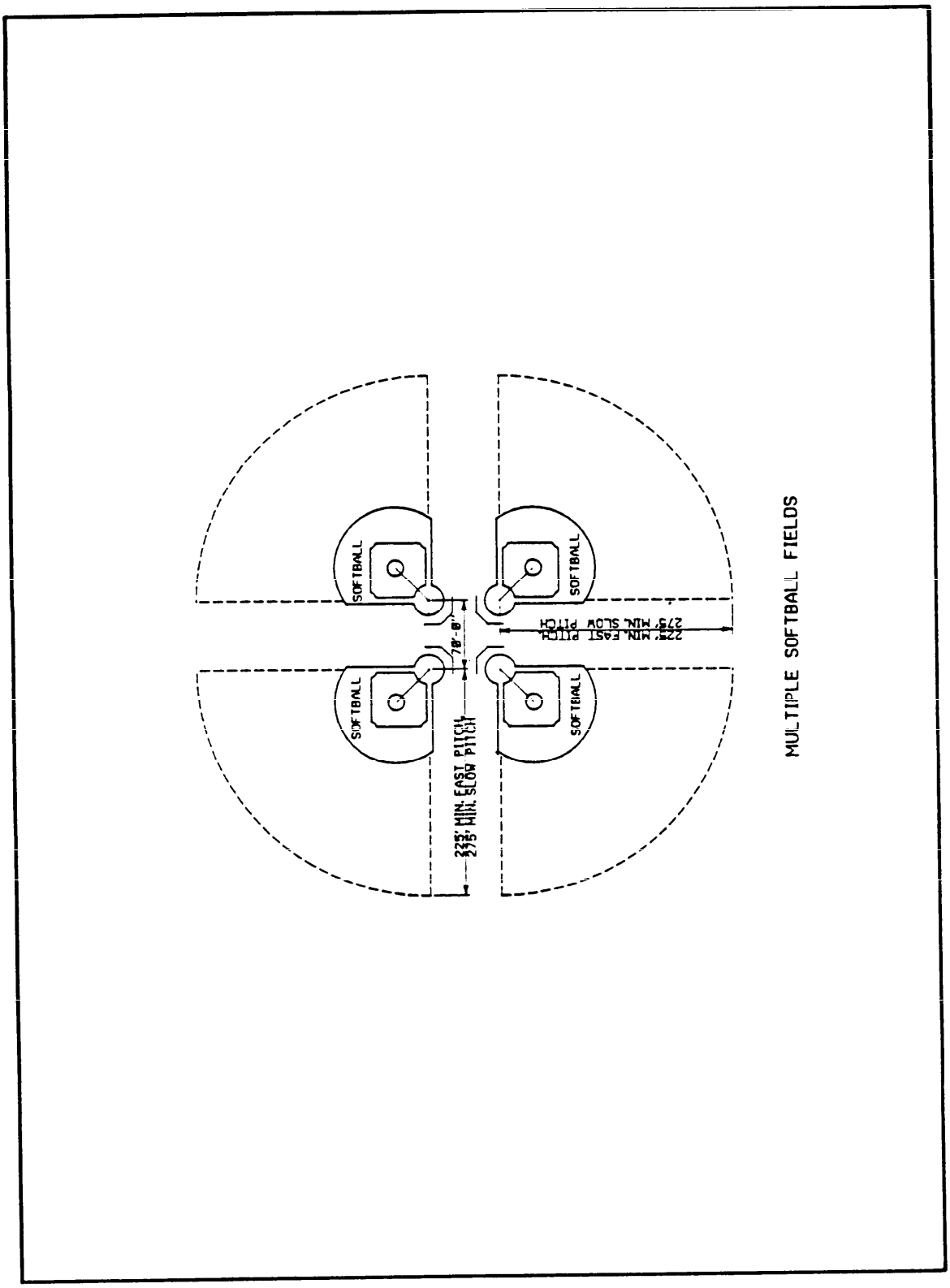


Figure 52b
Combination Sports Fields -- Multiple Softball Fields

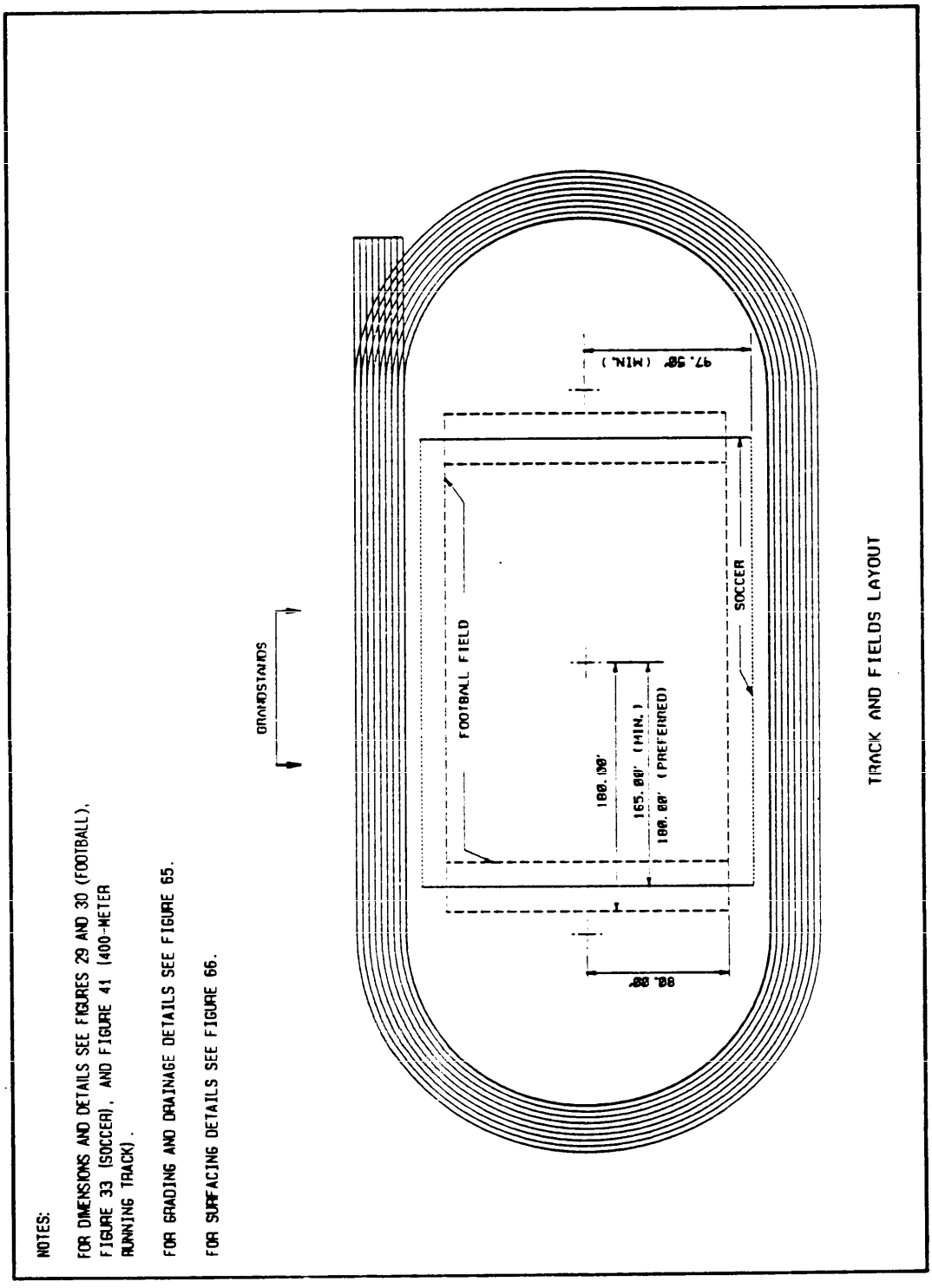


Figure 53
Sports Fields Within Running Tracks

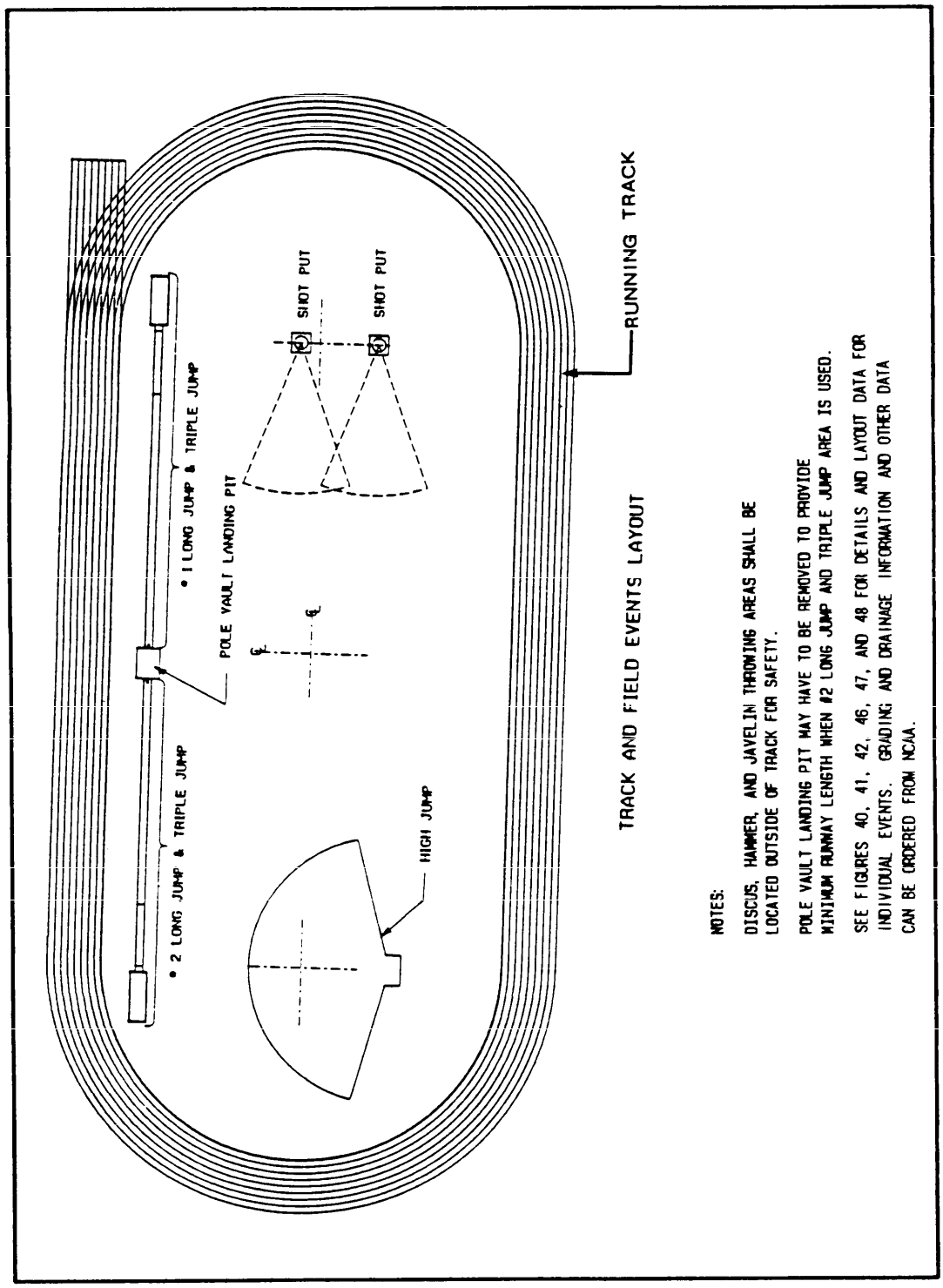


Figure 54
Multiple Field Events Within Running Tracks

Section 6: RECREATIONAL SHOOTING RANGES

6.1 Archery, Target Range. The archery target range (see Figure 55) shall be as follows.

a) Source of Information: National Archery Association (NAA).

b) Recommended Area: The ground space shall be 1.1 acres (0.445 ha) minimum.

c) Size and Dimension: The shooting range shall be 426.51 ft (130 m) long with 16.40 ft (5 m) minimum between targets. Roped clear space on each side of range shall be 32.81 ft (10 m) minimum. Roped clear space behind targets shall be at least 82 ft (25 m) or 41 ft (12.5 m) with bunker.

d) Orientation: The range shall be located so that the archer shall be facing north, plus or minus 45 degrees.

e) Surface and Drainage: Surface and drainage shall be as follows:

(1) Surface shall be turf and free from obstructions or hard objects.

(2) Drainage shall be preferably from side-to-side to maintain a constant, relatively level elevation between the target and the archer at the various shooting distances.

f) Special Considerations: Range warning signs shall be provided on the range's sides and rear to warn people of the range.

6.2 International Shooting Union Automatic Trap. The international shooting union automatic trap (see Figure 56) shall be as follows.

a) Source of Information: National Rifle Association (NRA).

b) Recommended Area: Allowance shall be 15 acres (6.07 ha) for a single field. The entire field shall be located in a relatively flat area with an open background.

c) Size and Dimension: Size and dimension shall be as follows:

(1) Walks and structure shall occupy an overall area approximately 60 ft (18.29 m) deep x 45 ft (13.72 m) wide.

(2) Shooting stations shall be 3 to 3.3 ft (0.9 to 1 m) square.

d) Orientation: The preferred orientation shall be for the centerline through station No. 3 to run northeast-southwest with the shooter facing northeast.

e) Surface and Drainage: The shooting stations shall be portland

cement concrete. Walkways may be paved or unpaved. The shooting area and a surrounding minimum radius of 75 to 82 yards (68.6 to 75 m) shall be turf. The 300-yard (274.3 m) radius shotfall danger zone outside of the cleared area may be turf, water, or left in natural condition.

f) Special Considerations:

(1) If shooting is entirely over land there shall be safety provisions for fencing, posting of warning signs, and clearing away of concealing brush.

(2) If shooting is over water, warnings posted on buoys or other signs are required and the trap house should be far enough inland to permit recovery of unbroken targets.

(3) Range safety shall be in accordance with installation safety requirements and outdoor range safety manuals.

(4) Contact the NRA for information on trap house construction and trap machines.

6.3 Skeet Field. The skeet field (see Figure 57) shall be as follows.

a) Source of Information: National Skeet Shooting Association (NSSA), 1974.

b) Recommended Area: Allow 29 acres (11.74 ha) for a single field. Shotfall danger zones of adjacent fields partially overlap and require only 2 acres (0.81 ha) additional land.

c) Size and Dimension: Walks and structures shall occupy an area approximately 130 ft (39.6 m) x 80 ft (24.38 m) deep. The minimum cleared area shall be a semicircle with a radius of 100 yards (91.44 m) (3.25 acres or 1.32 ha). The shotfall danger zone shall be a semicircle with a radius of 300 yards (274.3 m) (29 acres or 11.74 ha).

d) Orientation: The preferred orientation shall be for the centerline from station No. 4 through station No. 8 to run northeast-southwest with the shooter facing northeast.

e) Surface and Drainage: Shooting stations shall be portland cement concrete. Walkways may or may not be paved. Shooting area and 100-yard radius minimum cleared area are to be turf. The 300-yard radius shotfall danger zone may be turf, water, or left in natural condition, and the entire field shall be located in a relatively flat area with an open background.

f) Special Considerations:

(1) If shooting is entirely over land, there shall be safety provisions for fencing, posting of warning signs and clearing away of concealing brush.

(2) If shooting is over water, warnings posted on buoys or other signs are required, and skeet houses shall be far enough inland to permit recovery of unbroken targets.

(3) Range safety shall be in accordance with installation safety requirements and outdoor range safety manuals.

(4) Contact the NRA for information on skeet house construction and trap machines.

6.4 Trap Field. The trap field (see Figure 58) shall be as follows.

a) Source of Information: Amateur Trapshooting Association (ATA).

b) Recommended Area: Allow 18 acres (7.3 ha) for a single field. Shotfall danger zones of adjacent trap fields may overlap.

c) Size and Dimension: Walks and structures shall occupy an overall area approximately 100 ft (30.48 m) deep x 65 ft (19.81 m) wide. The minimum cleared area shall be a section with a radius of 100 yards (91.44 m) (3.25 acres or 1.32 ha). The shotfall danger zone shall be a section with a radius of 300 yards (29 acres) (274.3 m or 11.74 ha).

d) Orientation: The preferred orientation shall be for the centerline through shooting station No. 3 to run northeast-southwest with the shooter facing northeast.

e) Surface and Drainage: Shooting stations shall be portland cement concrete. Walkways may be paved or unpaved. The shooting area and 100-yard radius minimum cleared areas shall be turf. The 300-yard radius shotfall danger zone may be turf, water, or left in natural condition, and the entire field shall be located in a relatively flat area with an open background.

f) Special Considerations:

(1) If shooting is to be entirely over land there shall be safety provisions for fencing, posting of warning signs, and clearing away of concealing brush.

(2) If shooting is to be over water, warnings posted on buoys, or other signs are required, and the trap house shall be far enough inland to permit recovery of unbroken targets.

(3) Range safety shall be in accordance with installation safety requirements and outdoor range safety manuals.

(4) Contact the NRA for information on trap house construction and trap machines.

6.5 Combination Skeet and Trap Field. Combination skeet and trap fields (see Figure 59) shall be as follows.

a) Source of Information: Skeet--NSSA; Trap--ATA.

b) Recommended Area: Allow 30 acres (12.14 ha) for a combination field.

c) Size and Dimension: All walks and structures shall occur within an area approximately 130 ft (39.6 m) wide x 115 ft (35.05 m) deep. Minimum cleared area shall be contained within two superimposed segments with a 100-yard radii (3.25 acres). The shotfall danger zone shall be contained within two superimposed segments with 300-yard (274.3 m) radii (29 acres or 11.74 ha).

d) Orientation: The preferred orientation shall be for the centerline from skeet station No. 4 through station No. 8 to run northeast-southwest with the shooter facing northeast.

e) Surface and Drainage: Shooting stations shall be portland cement concrete. Walkways may or may not be paved. The shooting area and minimum cleared area shall be turf. The shotfall danger zone may be turf, water, or left in natural condition, and the entire field shall be located in a relatively flat area with an open background.

f) Special Considerations:

(1) If shooting is entirely over land there shall be safety provisions for fencing, posting of warning signs and clearing away of concealing brush.

(2) If shooting shall be over water, warnings posted on buoys or other signs are required and the trap house shall be far enough inland to permit recovery of unbroken targets.

(3) Range safety shall be in accordance with installation safety requirements and outdoor range safety manuals.

(4) Contact the NRA for information on skeet and trap house construction and trap machines.

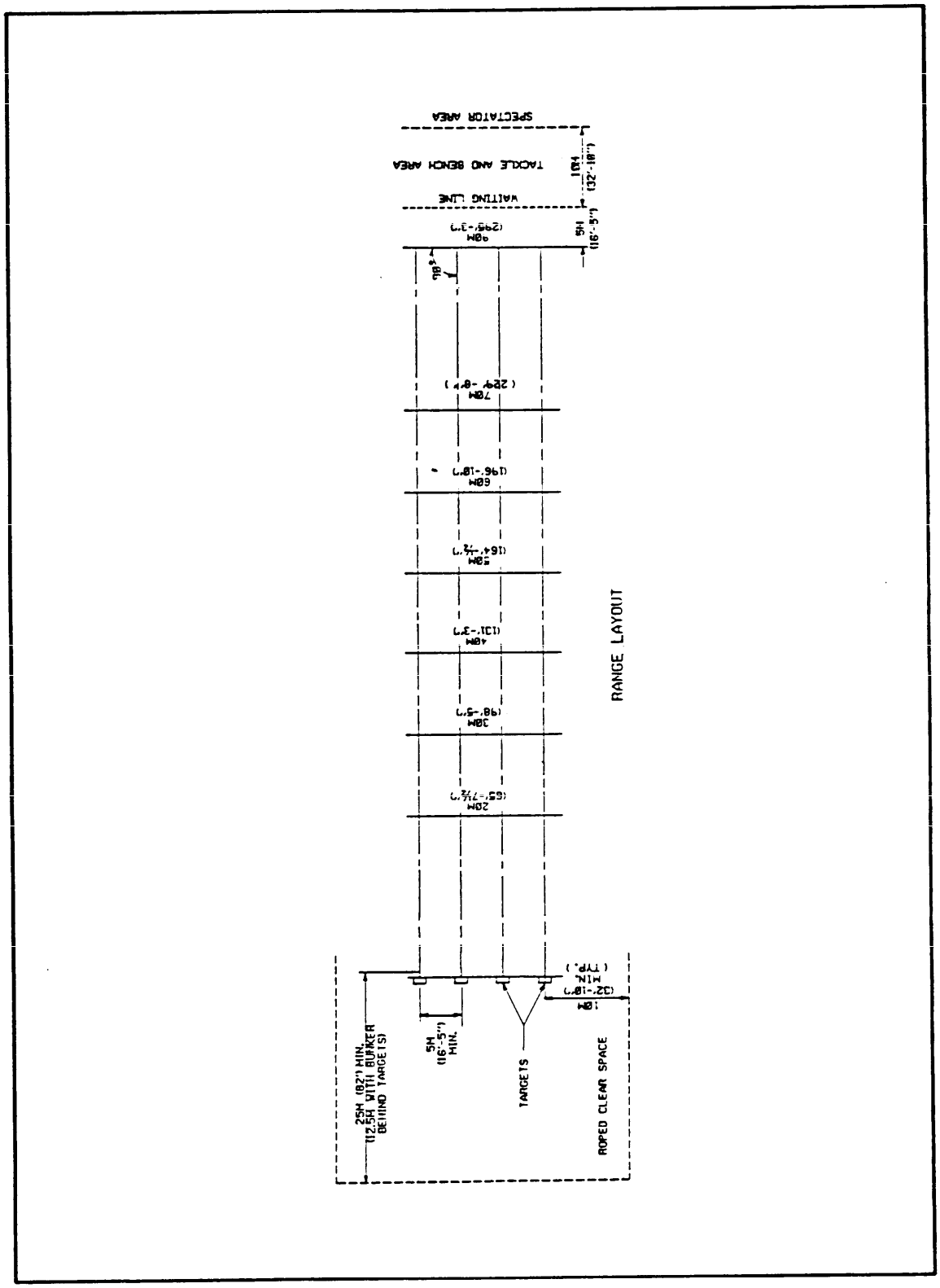


Figure 55a
Archery Range -- Layout

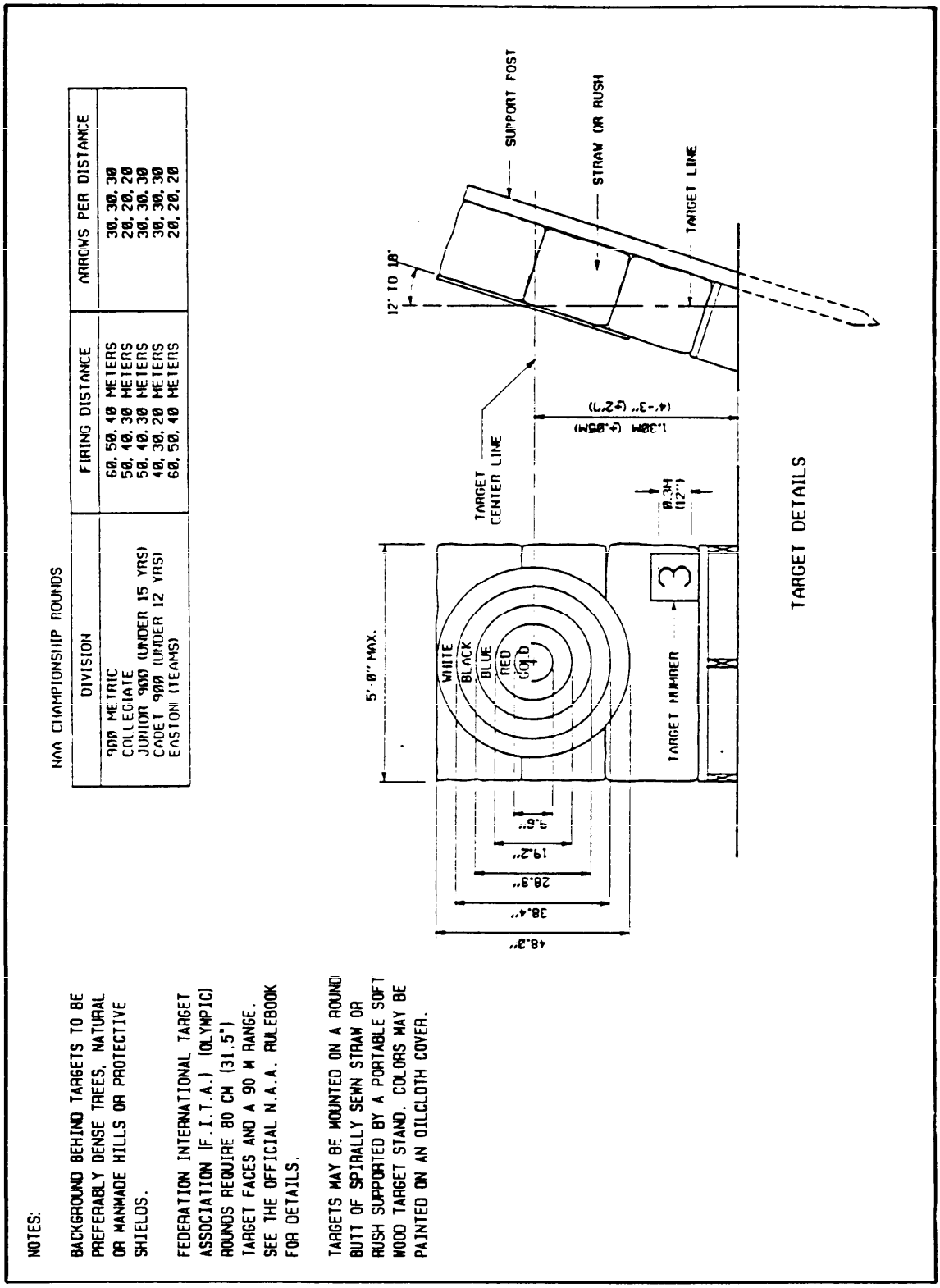


Figure 55b
Archery Range -- Target Details

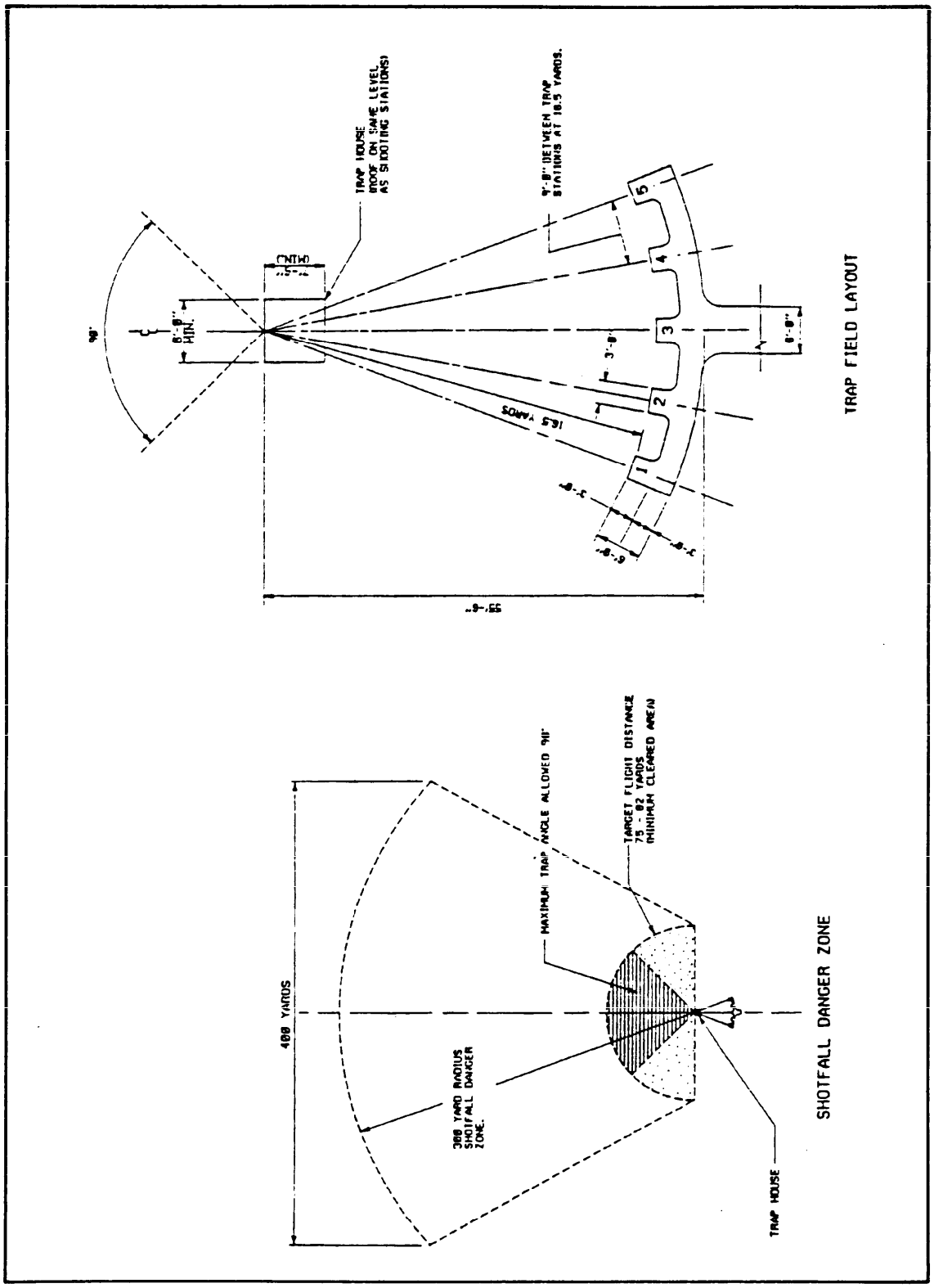


Figure 56
International Shooting Union Automatic Trap

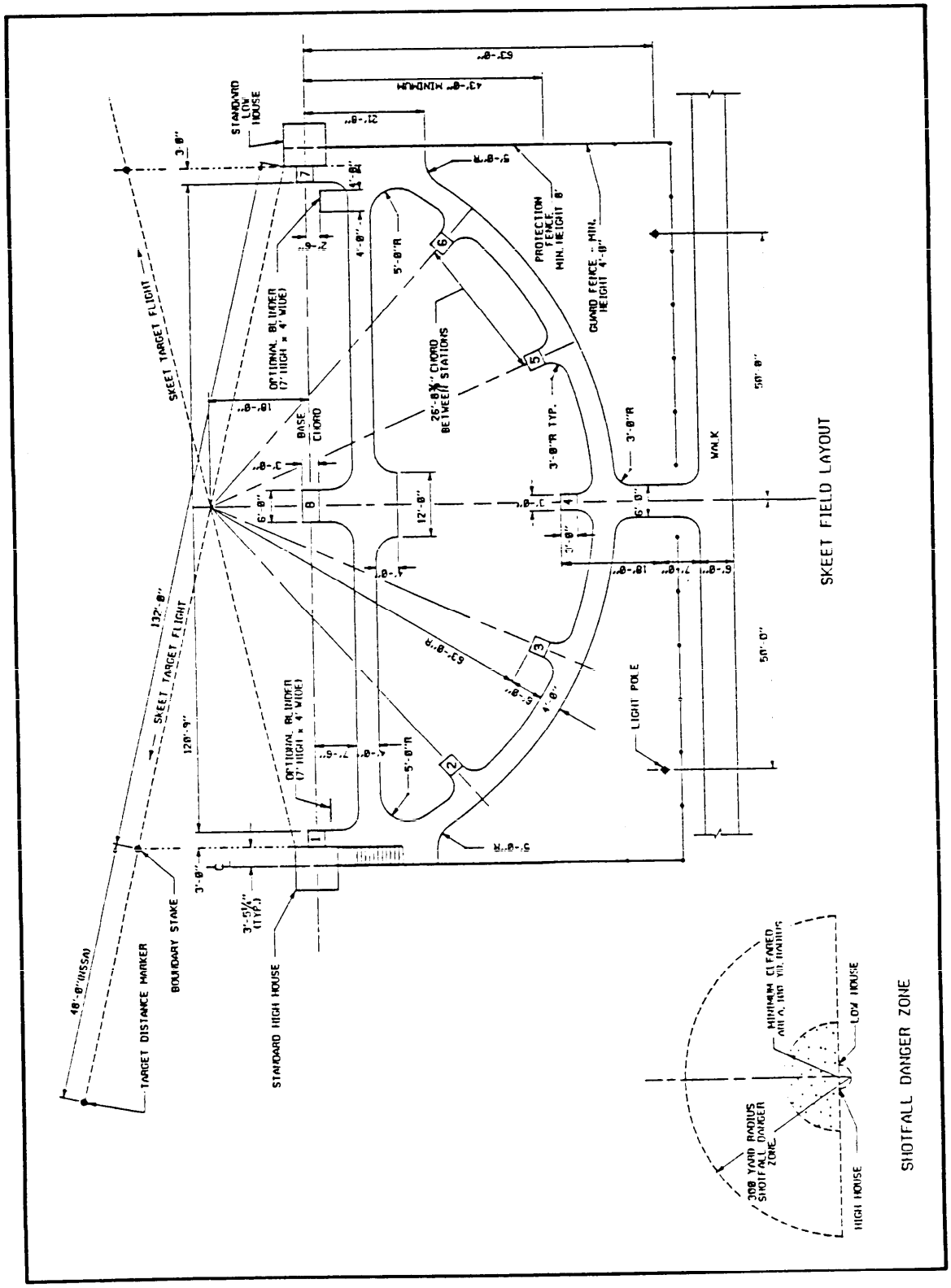


Figure 57
Skeet Field

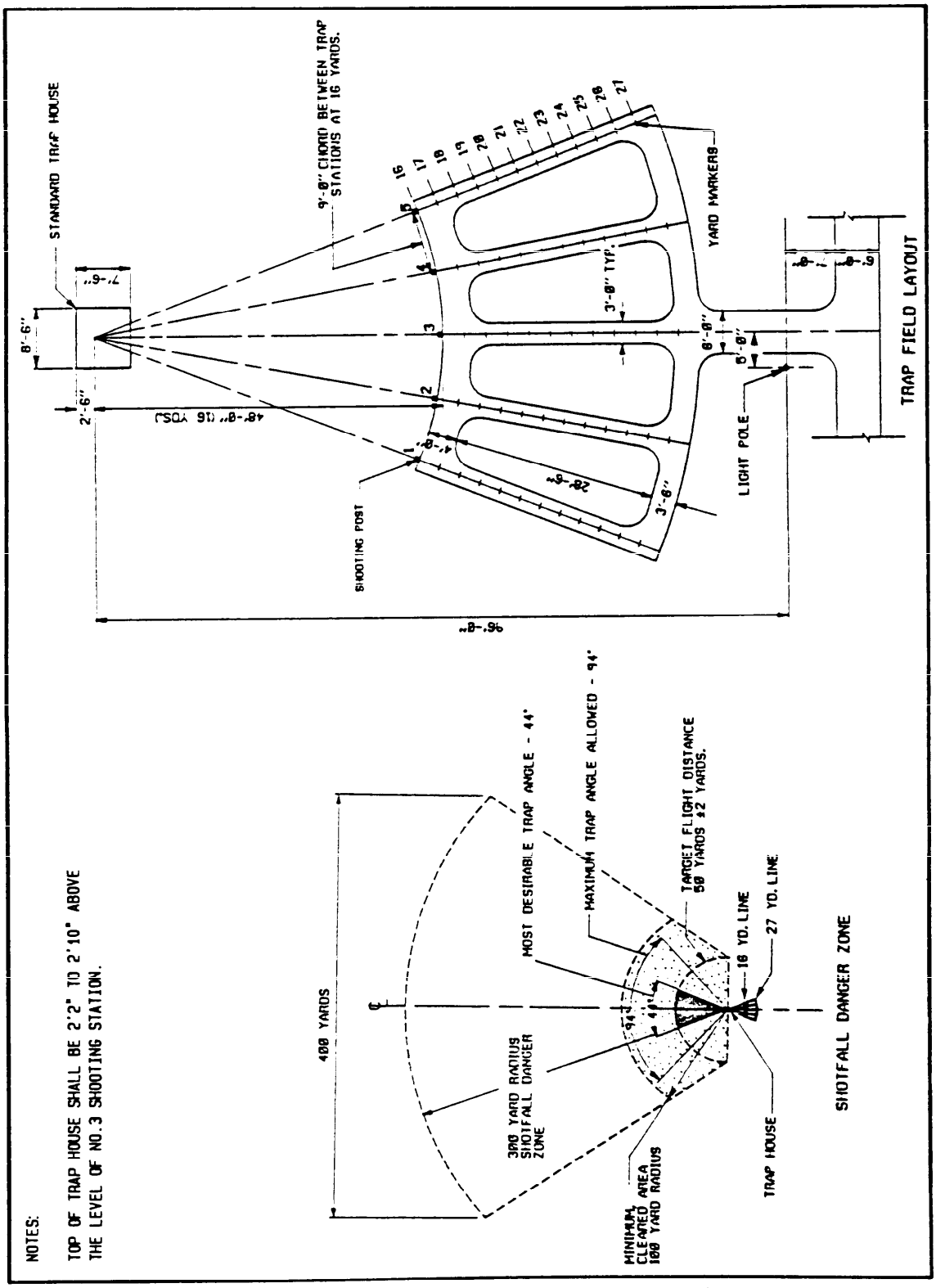


Figure 58
Trap Field

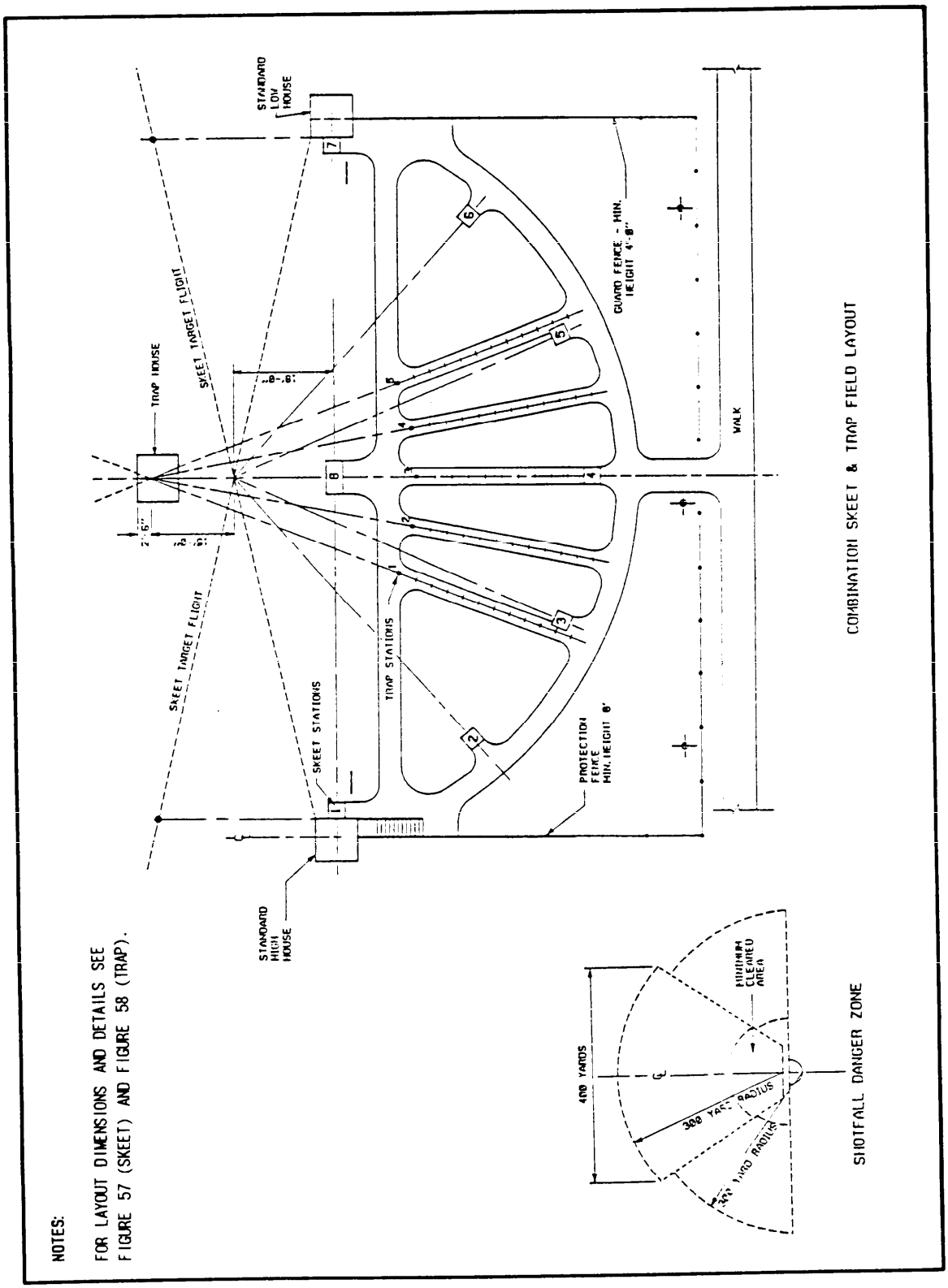


Figure 59
Combination Skeet and Trap Field

Section 7: MOTOR SPORTS

7.1 Go-Kart (Oval Track). The oval go-kart track (see Figure 60) shall be as follows.

a) Source of Information: International Kart Federation, Inc. (IKF).

b) Recommended Area: The ground area varies from 2 to 2.7 acres (0.81 to 1.1 ha).

c) Size and Dimension: Specific track layout data are given in Figure 60. The track surface width in a turn shall be a minimum of 5 ft (1.5 m) wider than straightaway width.

d) Orientation: The track shall be located so that the long axis points roughly north-south. The start-finish line shall be located so that karts cross the line traveling north.

e) Surface and Drainage: Surface and drainage shall be as follows:

(1) Track surfaces can be asphalt, concrete or dirt graded to a smooth surface, free of holes and rough spots. Gravel surfaces are not permitted. Banked turns are permitted, but flat tracks with no banked turns are strongly recommended.

(2) Inlets and underground pipes are normally needed to drain the inside of the oval.

f) Special Considerations:

(1) A 35-ft (10.67 m) width (minimum) safety apron shall be maintained around entire track on all sides. This area must be free of ditches, holes, trees and all other obstacles. Safety apron shall be loose dirt graded flat or with a 2 percent slope (maximum) for drainage.

(2) If a paved track is used, the pit area shall also be paved.

7.2 Go-Kart (Road Track). The go-kart road track (see Figure 61) shall be as follows:

a) Source of Information: International Kart Federation, Inc. (IKF).

b) Recommended Area: The ground space shall be approximately 5.5 acres (2.23 ha).

c) Size and Dimension: The track surface width (in an oval turn) shall be a minimum of 5 ft wider than straightaway track width.

d) Orientation: The track long axis shall point north-south. The kart shall cross the start-finish line traveling north.

e) Surface and Drainage: Track surfaces may be asphalt, concrete or dirt graded to a smooth surface, free of holes and rough spots. Gravel surfaces are not permitted. Banked turns are permitted, but flat tracks with no banked turns are strongly recommended. Inlets and underground pipes are required for draining the inside of track.

f) Special Considerations:

(1) A 35-ft (10.67 m) wide (minimum) safety apron will be maintained around entire track on all sides. This area must be free of ditches, holes, trees and all other obstacles. The safety apron will be loose dirt graded flat or with a maximum of 2 percent slope for drainage.

(2) When a paved track is used, the pit area will be paved also.

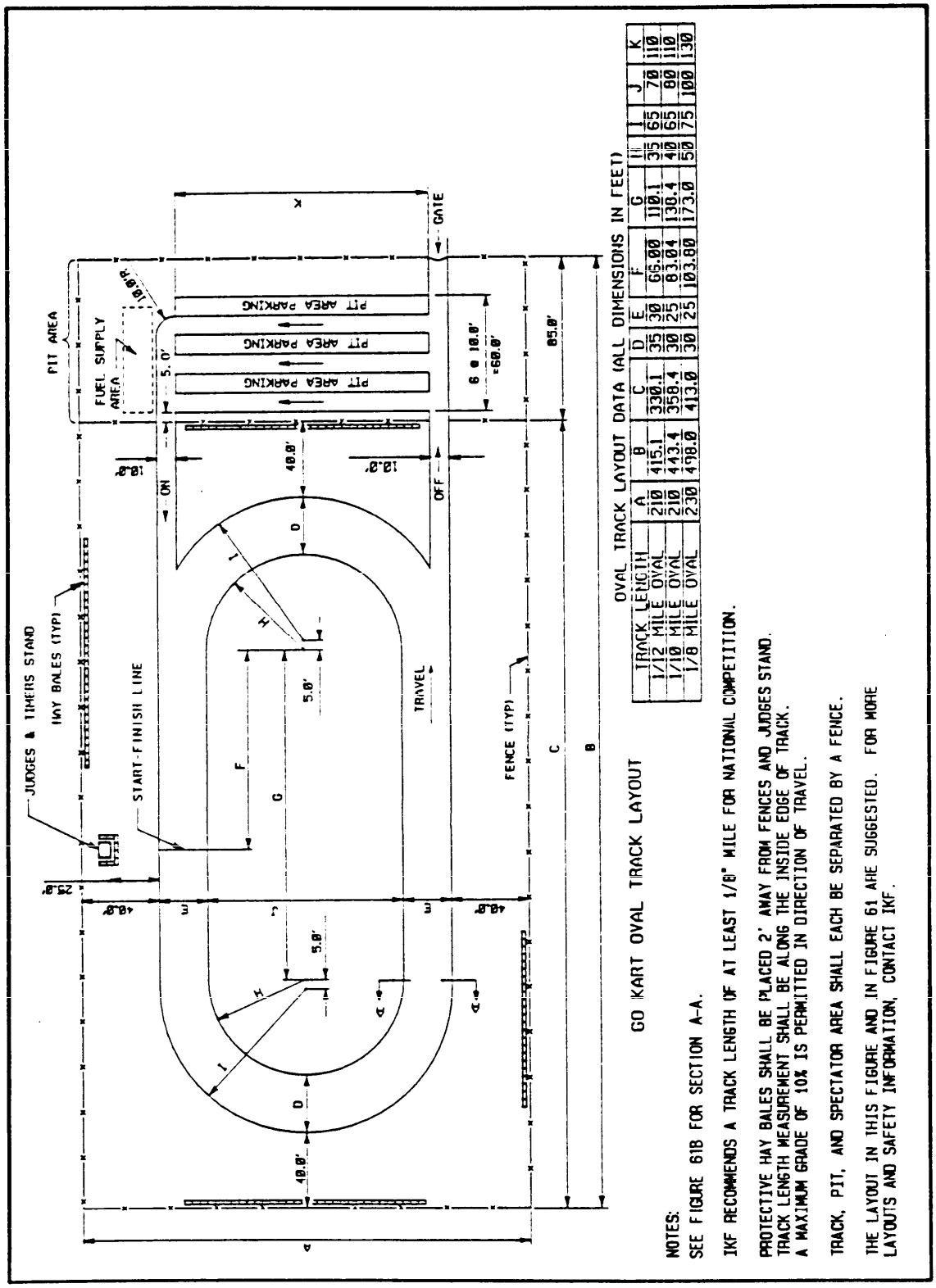


Figure 60
Go Kart Oval Track -- Layout

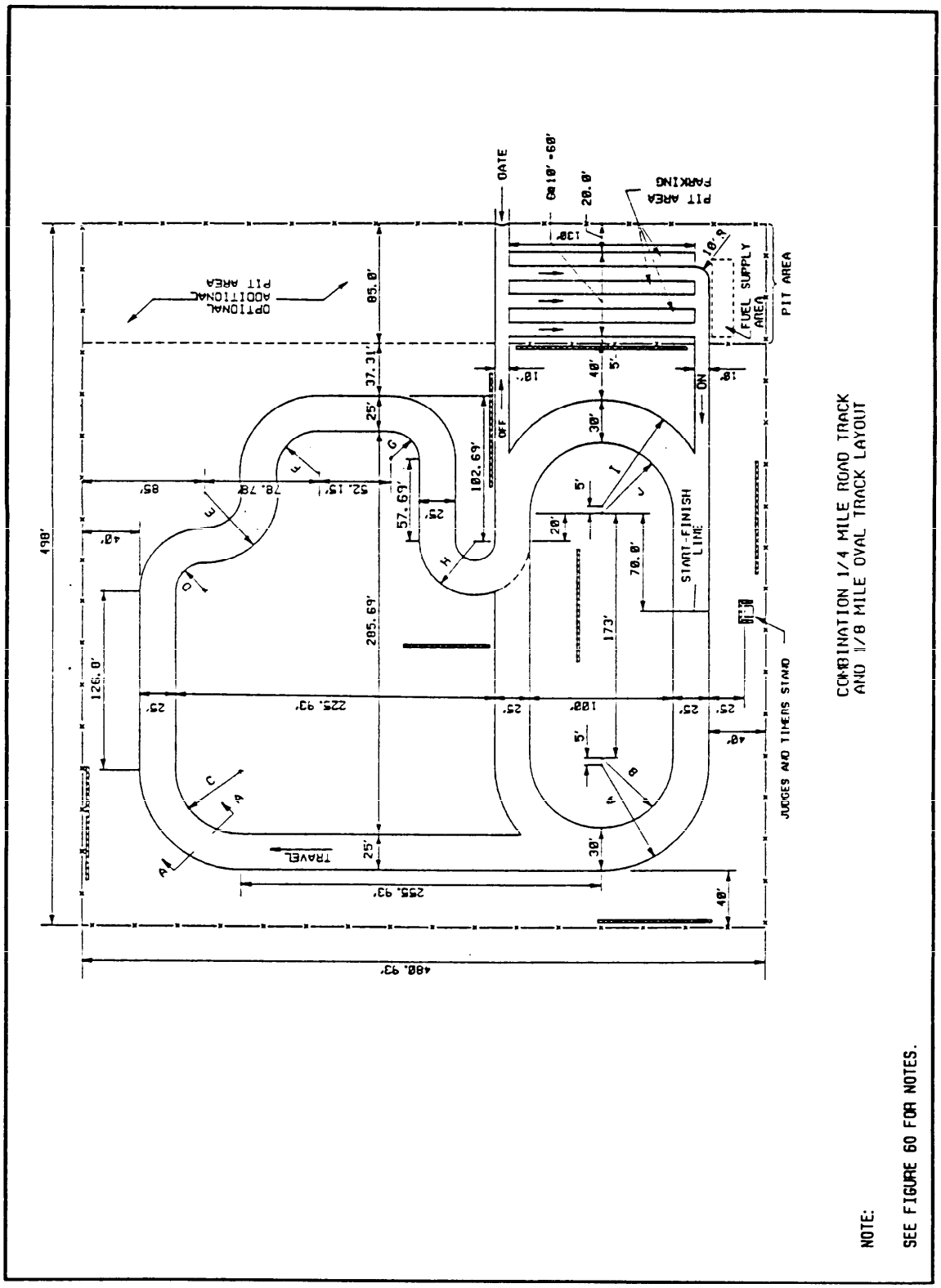


Figure 61a
Go Kart Road Track -- Layout

Figure 61b
Go Kart Road Track -- Construction Details

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Section 8: CONSTRUCTION DETAILS

8.1 Posts, Grading, Drainage, and Surfacing. This section contains details for net post and goal post construction, grading, drainage, and playing surfaces for a variety of sports.

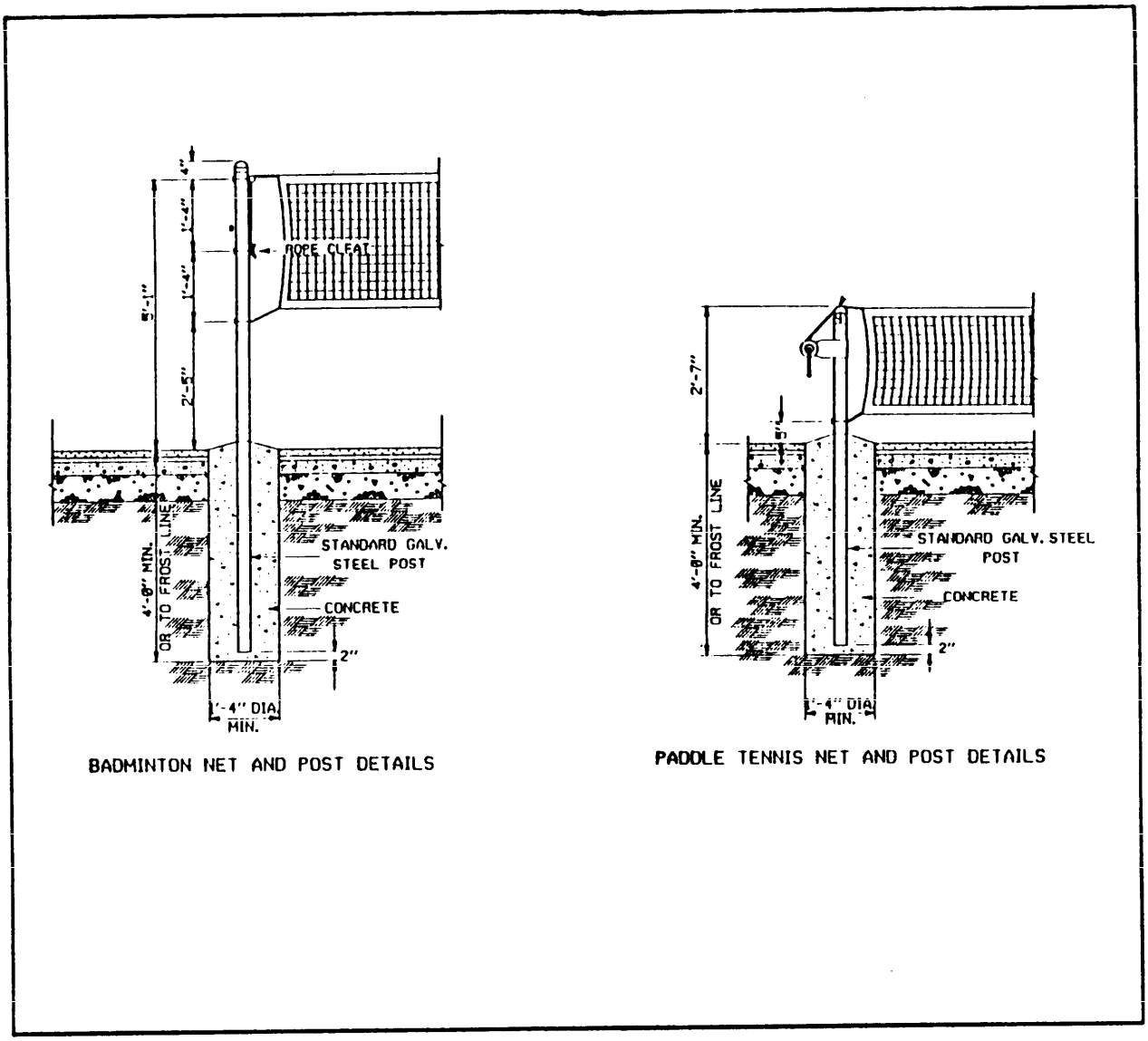


Figure 62a
Fixed Net Posts -- Badminton and Paddle Tennis

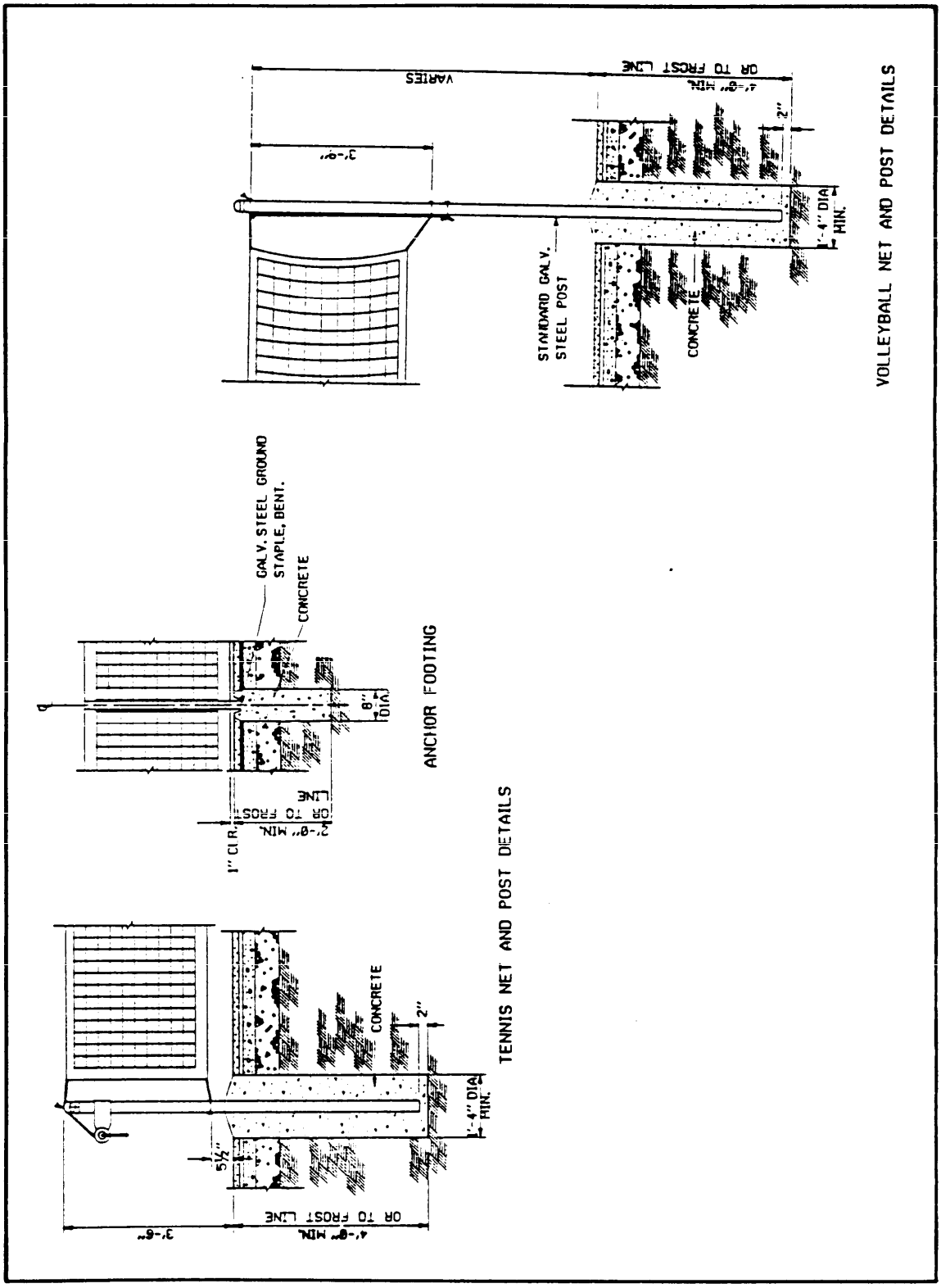


Figure 62b
Fixed Net Posts -- Tennis and Volleyball

e/ Surface and drainage. The surface and drainage shall meet the

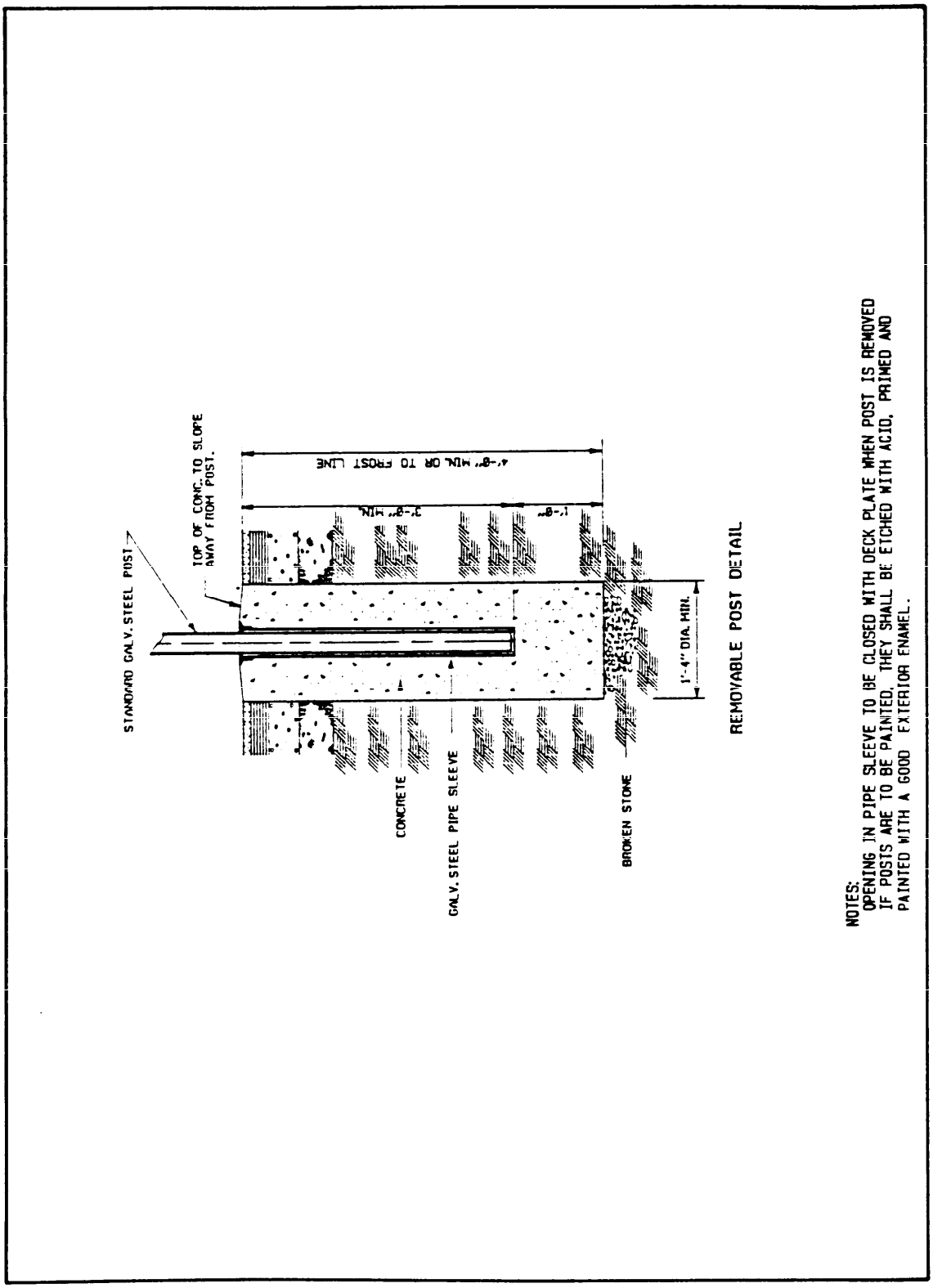


Figure 63
Removable Net Posts

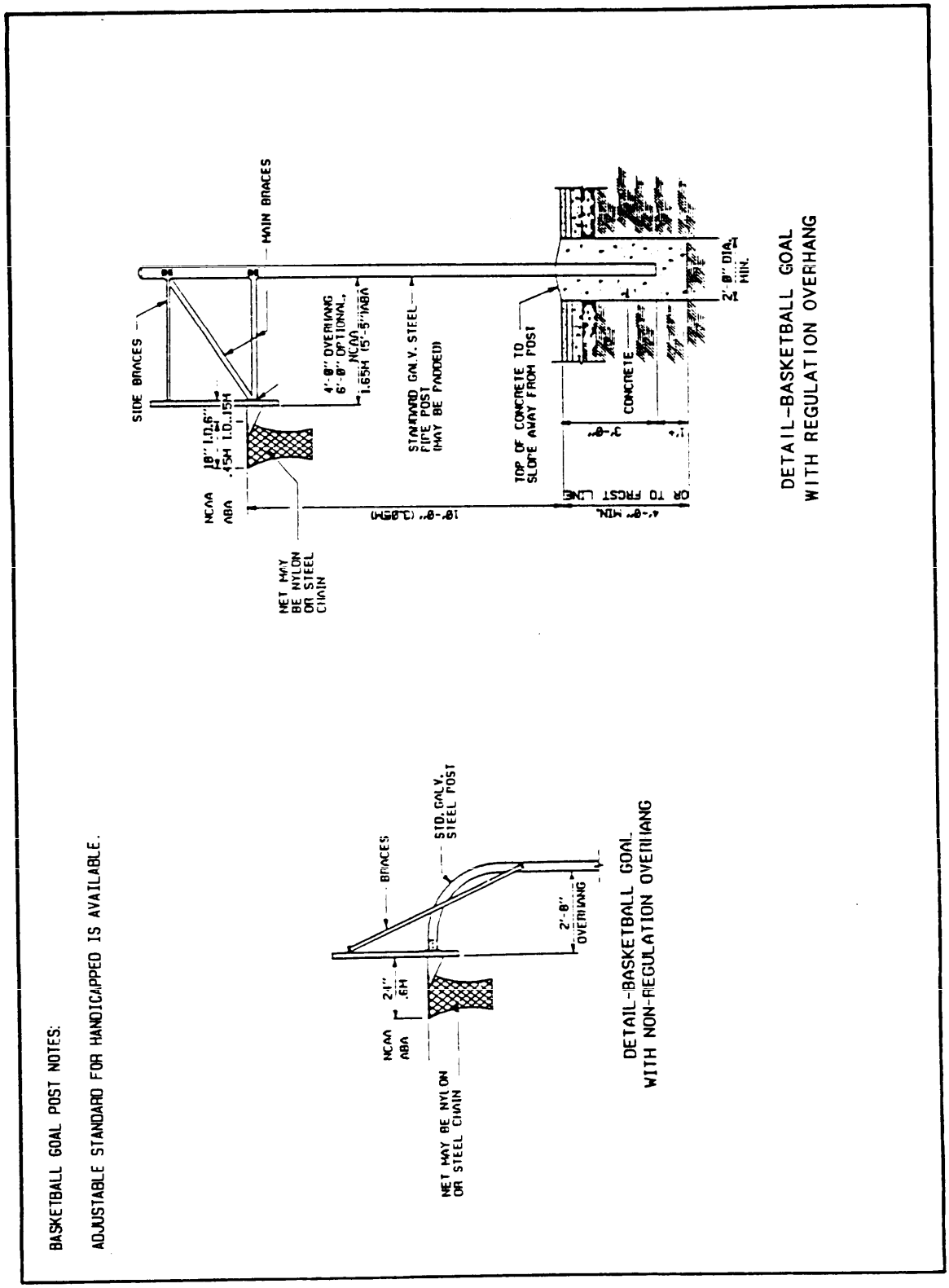


Figure 64a
Goal Post Details -- Basketball

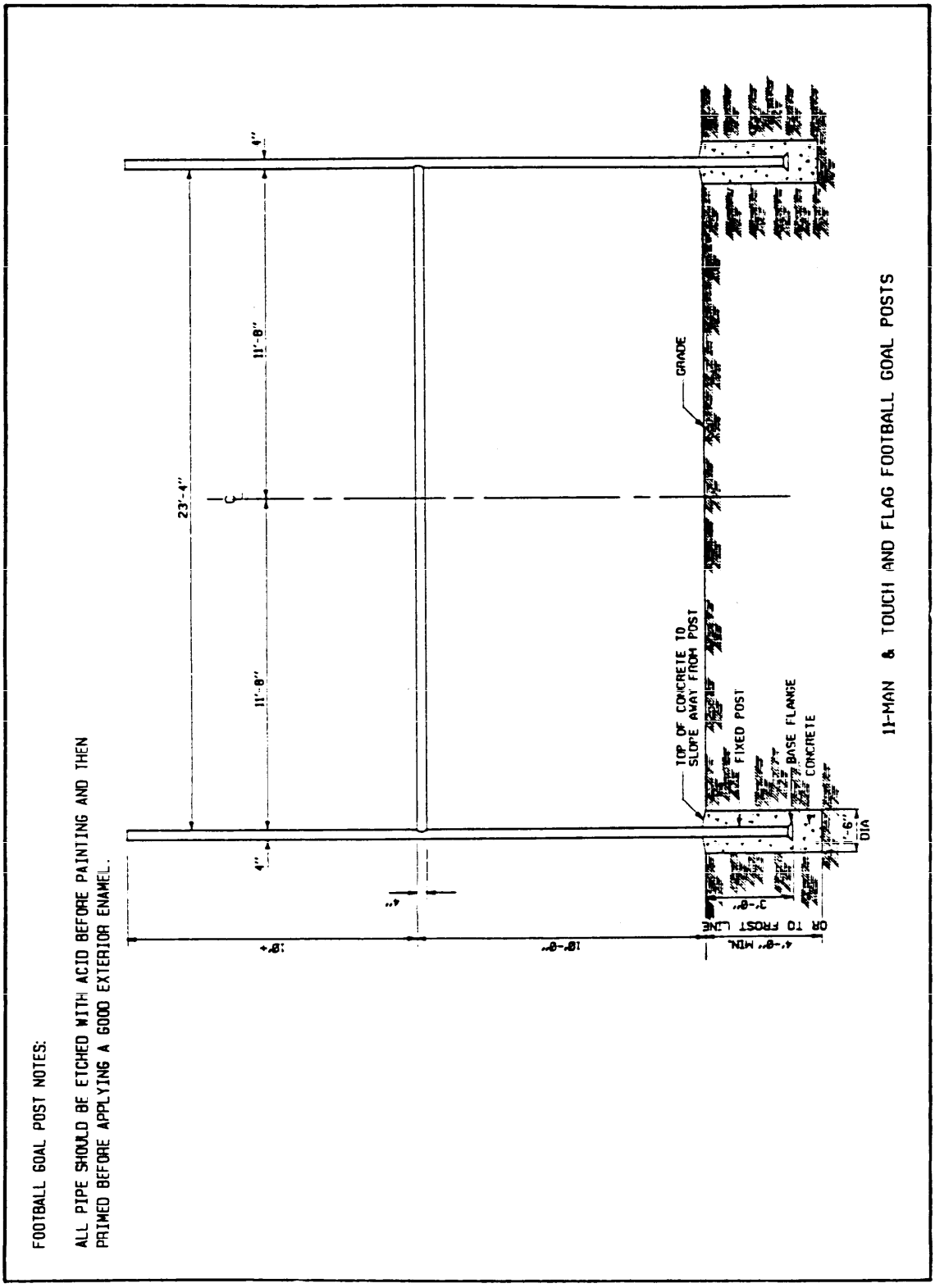


Figure 64b
Goal Post Details -- Football

(1) Alternative four-wall court. The layout shall be

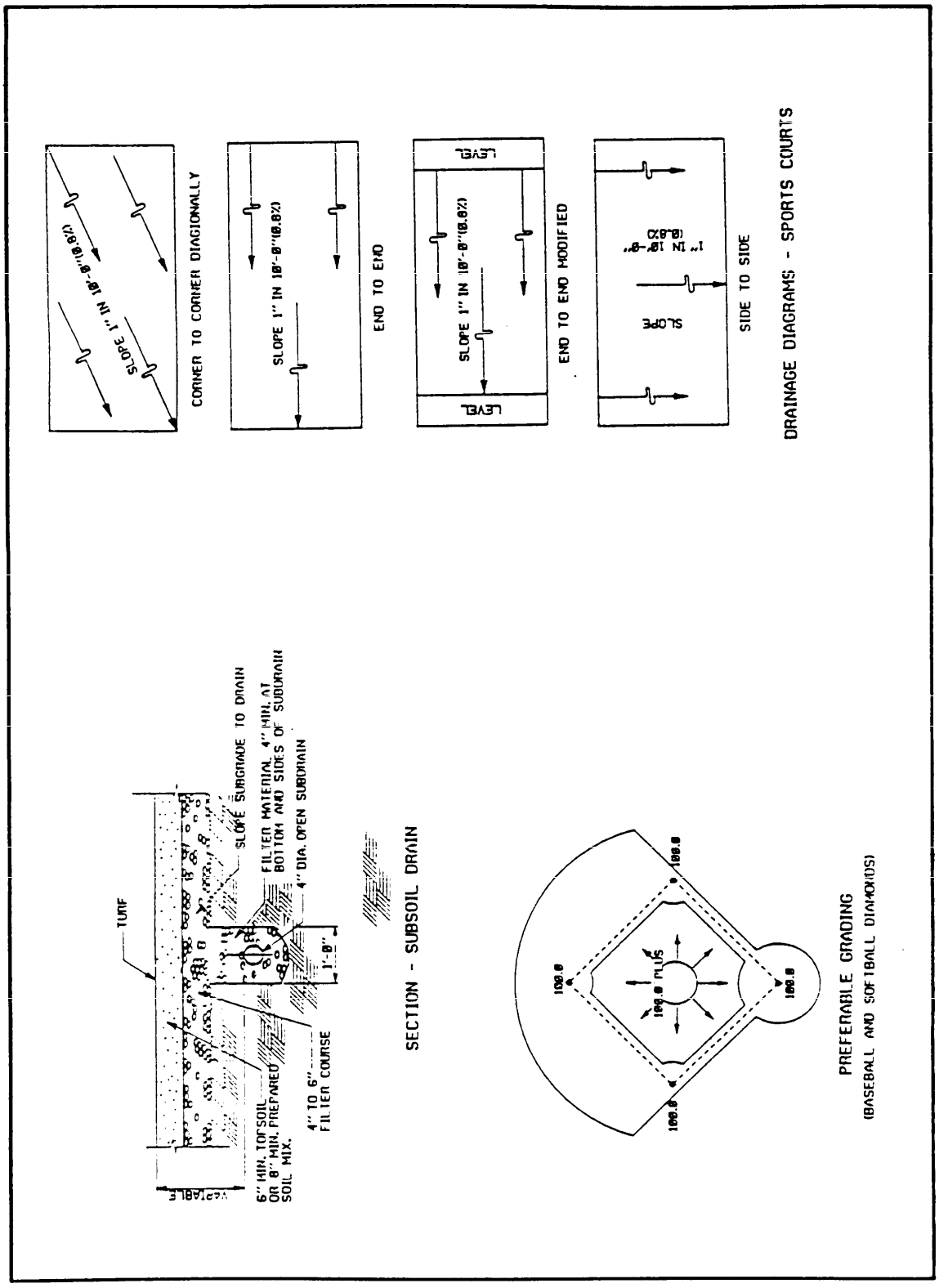


Figure 65a
Typical Grading and Drainage Details -- Courts and Diamonds

NOTES:

SEE FIGURE ON INDIVIDUAL SPORTS FOR HEIGHT OF PITCHER'S PLATE ABOVE HOME PLATE.

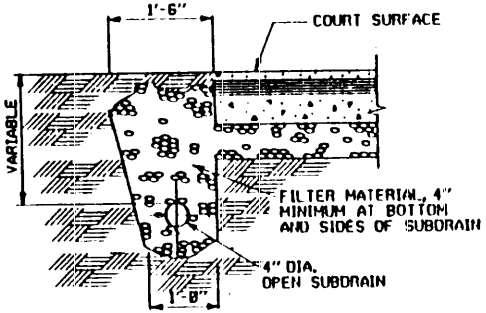
IT IS PREFERABLE THAT THE BASE LINES BE LEVEL. IF THE DIAMOND MUST PITCH, THE AVERAGE SLOPE SHALL BE 2.0% FROM FIRST BASE TO THIRD BASE OR VICE VERSE.

THE MINIMUM SLOPE FOR DRAINAGE ON TURF AREAS OUTSIDE THE SKINNED AREA IS 1.0% WHEN ADEQUATE SUBSOIL DRAINAGE IS PROVIDED. THE MAXIMUM IS 2.5%.

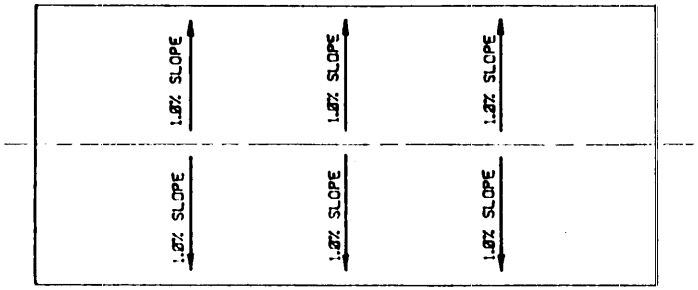
PERIMETER DRAINS MAY BE PROVIDED FOR PAVED AREAS. UNDERDRAINS ARE NOT RECOMMENDED BENEATH PAVED AREAS.

SUBDRAINS AND FILTER COURSE ARE TO BE USED ONLY WHEN SUBSOIL CONDITIONS REQUIRE. WHERE SUBSOIL DRAINAGE IS NECESSARY, THE SPACING OF SUBDRAINS IS DEPENDENT ON LOCAL SOIL CONDITIONS AND RAINFALL.

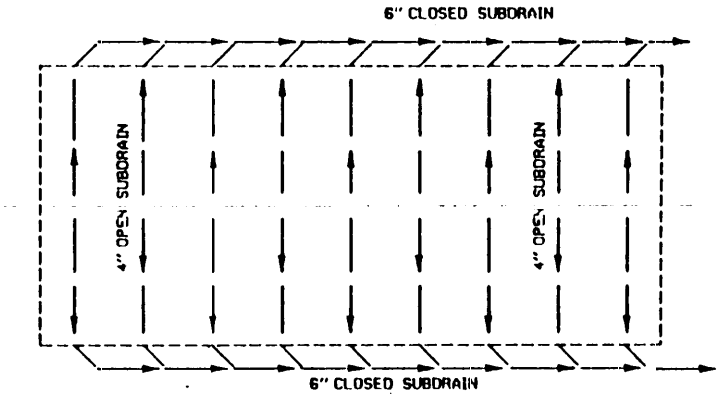
SUBDRAINS ARE TO HAVE A MINIMUM GRADIENT OF 0.15%.



SECTION - PERIMETER DRAIN
(SPORTS COURTS)



PREFERRED GRADING
(RECTANGULAR SPORTS FIELDS)



SUBSOIL DRAINAGE
(RECTANGULAR SPORTS FIELDS)

Figure 65b
Typical Grading and Drainage Details -- Rectangular Sports Fields

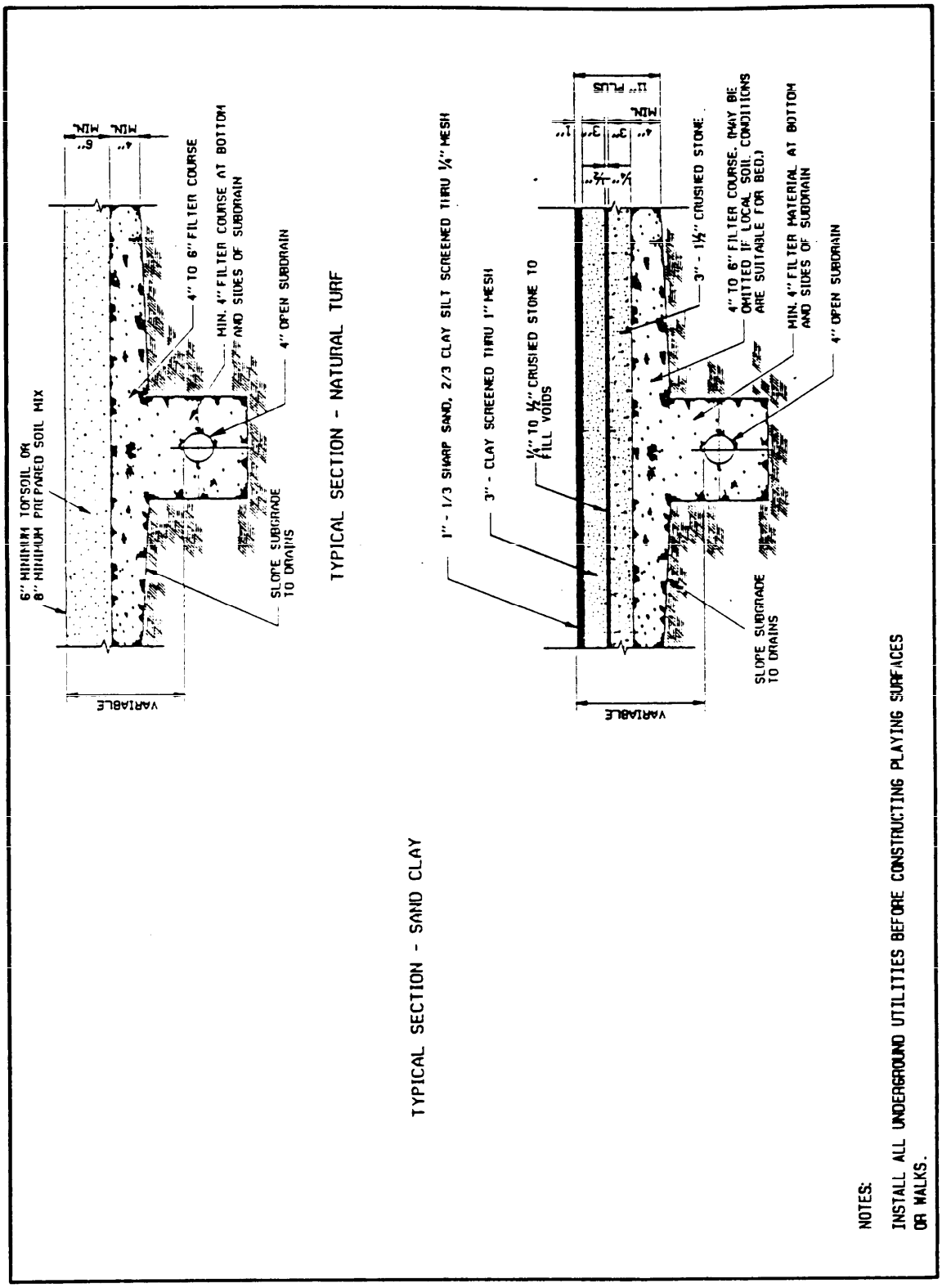


Figure 65
Typical Playing Surface Details

REFERENCES

NOTE: Unless otherwise specified in the text, users of this handbook should utilize the latest revisions of the documents cited herein.

FEDERAL/MILITARY SPECIFICATIONS, STANDARDS, BULLETINS, HANDBOOKS, AND NAVFAC GUIDE SPECIFICATIONS:

The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise indicated, copies are available from Commanding Officer, Naval Publications and Forms Center, ATTENTION: NPODS, 5801 Tabor Avenue, Philadelphia, PA 19120-5099.

SPECIFICATIONS

NAVFAC GUIDE SPECIFICATION

NFGS-02444 Fence, Chain Link

STANDARDS

MILITARY

FED-STD-795 Uniform Federal Accessibility Standards

NON-GOVERNMENT PUBLICATIONS

The following publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the Department of Defense Index of Specifications & Standards (DODISS).

ILLUMINATING ENGINEERING SOCIETY (IES)

Recommended Practice for Sports Lighting

(Unless otherwise indicated, copies are available from the Illuminating Engineering Society, 345 East 47th Street, New York, NY 10017, (212) 705-7641.

GAME RULES AND REGULATIONS

The rules and regulations specified in the text form a part of this document to the extent specified herein and are available through the organizations listed below.

Amateur Athletic Union (AAU), 3400 West 86th Street, Indianapolis, IN 46268

Amateur Basketball Association-USA (ABAUSA), 1750 East Boulder Street, Colorado Springs, CO 80909

Amateur Hockey Association of the United States (AHAUS), 2997 Broadmoor Valley Road, Colorado Springs, CO 80906

American Lawn Bowls Association (ALBA), 11660 S.W. King George, King City, OR 97224

Amateur Softball Association America (ASA), 2801 NE 50th Street, Oklahoma City, OK 73111

Amateur Trapshooting Association (ATA), 601 West National Road, Vandalia, OH 45377

American Platform Tennis Association (APTA), PO Box 901, Upper Montclair, NJ 07043

American Roque League, Inc. (ARL), 4205 Briar Creek Lane, Dallas, TX 75214

AMF Voit, Inc., 3801 South Harbor Boulevard, Santa Anna, CA 92704

The Athletic Congress, 200 Castlewood Drive, North Palm Beach, FL 33408

Babe Ruth Baseball, 1770 Brunswick Ave, PO Box 5000, Trenton, NJ 08638

Field Hockey Association of America (FHAA), 1750 East Boulder Street, Colorado Springs, CO 80909

General Sportcraft Co., Ltd., 140 Woodbine Street, Bergenfield, NJ 07621

International Kart Federation (IKF), 416 South Grand, Covina, CA 91724

International Shooting Union (ISU), Wiesbaden-Klarenthal, West Germany. Rules may also be obtained from the National Rifle Association.

Little League Baseball, Inc., PO Box 3485, Williamsport, PA 17701

National Archery Association of the United States (NAAUS), 1750 East Boulder Street, Colorado Springs, CO 80909

National Association for Girls and Women in Sports (NAGWS), 1900 Association Drive, Reston, VA 22091

National Collegiate Athletic Association, PO Box 1906, Mission, KS 66201

National Golf Foundation, 200 Castlewood Drive, North Palm Beach, FL 33408

National Horseshoe Pitchers Association of America (NHPA), 2648 Basswood Street, Newport Beach, CA 92660

National Rifle Association (NRA), 1600 Rhode Island Avenue, Washington, DC 20036

National Skeet Shooting Association (NSSA), PO Box 28188, San Antonio, TX 78228
National Spa and Pool Institute, 2000 K Street, NW, Washington, DC 20006

The Official Playing Rules Committee, Official Baseball Rules, c/o The Sporting News, 1212 North Lindberg Blvd., St. Louis, MO 63132

Pony Baseball, Inc., PO Box 225, Washington, PA 15301

Pop Warner Junior League Football, 1315 Walnut Street, Suite 606, Philadelphia, PA 19107

U.S.A. Field Hockey Association (USAFHA), 1750 East Boulder Street, Colorado Springs, CO 80909

U.S. Air Force, c/o Director of Student Operations, Squadron Officer School, Maxwell Air Force Base, AL 36112

U.S. Badminton Association (USBA), 501 West 6th Street, Papillion, NB 68046

U.S. Diving, 901 West New York Street, Indianapolis, IN 46202

U.S. Handball Association (USHA), 4101 Dempster Street, Skokie, IL 60076

U.S. Soccer Federation (USSF), 1750 E. Boulder Street, Colorado Springs, CO 80909

U.S. Paddle Tennis Association (USPTA), 189 Seeley Street, Brooklyn, NY 11218

U.S. Swimming (USS), 1750 East Boulder Street, Colorado Springs, CO 80909

U.S. Team Handball Federation (USTHF), 1750 East Boulder Street, Colorado Springs, CO 80909

U.S. Tennis Association (USTA), 729 Alexander Road, Princeton, NJ 08540

U.S. Volleyball Association (USVBA), 1750 East Boulder Street, Colorado Springs, CO 80909

CUSTODIAN
NAVY - YD

PREPARING ACTIVITY
NAVY - YD

PROJECT NO.
FACR-0220

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APPENDIX BB

PT ROUTES

COPY ____ OF ____ COPIES
HQS, 101ST ABN DIV (AASLT) & FT CAMPBELL
FORT CAMPBELL, KY 42223
23 1600 JAN 07

OPORD 65-07 (Physical Training Run and Foot March Routes)

TIME ZONE USED THROUGHOUT THE ORDER: Sierra (Local).

1. SITUATION. Establish changes in support of a revision to CAM Reg 350-1, Training Directorate, regarding a change to the roadways authorized for conducting Physical Training (PT). Units and Directorates are to assure the dissemination of this information to their subordinates and any necessary adjustment to daily reporting times and activities. Effective 05 FEB 07, the roadways authorized for PT will change from Wickham Ave only to an expanded system (See Enclosure 1).

2. MISSION. 101st ABN DIV (AASLT) and Fort Campbell implements changes to the published PT run and foot march routes, effective 05 FEB 07, IOT provide units with safe access to a road/trail network and permit leaders to plan flexibility and variety into their PT schedule as well as facilitate vehicular traffic on the installation.

3. EXECUTION.

3.A INTENT. Provide units safe access to a variety of run routes and fitness centers, near their respective unit areas, in order to facilitate unit PT. This plan must also take into account the requirements for vehicular traffic during PT hours.

3.A.1 Concept of the Operation. Effective 05 FEB 2007 from 0630-0800 hrs, daily, all elements on FTCKY will conduct unit, group and individual runs on specified PT routes as shown map in Encl 1

3.B. Tasks to Maneuver Units. All BCTs and CABs

3.B.1. Effective 05 Feb 07, begin conducting PT on routes as outlined in Encl 1 and revised CAM Reg 350-1, dated TBD.

3.B.2. Bde CSMs and/or Ops SGM will attend rehearsal 01 0930 Feb 2007 at the Eagle Conference Room, IOT ensure all units understand their responsibility in implementing this policy.

3.B.3. Road Guards will be posted at the following locations from 0630-0800 on duty days. Soldiers will have right of way at all times on identified run routes during PT. Soldiers will wear a reflective vest and will have a flashlight to be used to aid in directing traffic during limited visibility. This will be rigidly enforced.

3.B.3.A. 1st BCT.
35th Street and Kentucky
42d Street and Kentucky

3.B.3.B. 2d BCT
42d Street and Tennessee
49th Street and Tennessee

3.B.3.C. 3d BCT
Airborne and Kentucky
Air Assault and Kentucky
Screaming Eagle Blvd and Kentucky

3.B.3.D. 4th BCT
Angels Rd and Desert Storm
Angels Rd and Market Garden

3.B.3.E. 101st CAB
Mabry and Market Garden
Glider and Market Garden

3.B.3.F. 159th CAB
Air Assault and Market Garden
Screaming Eagle Blvd and Market Garden

3.B.4. Units will place a barricade at intersections to prevent vehicles moving onto run routes during PT hours. Barricades will be emplaced no earlier than 0620, and no later than 0630. Barricades will be removed immediately at 0800. The following are unit responsibilities.

3.B.4.A. 1st BCT
47th Street and Kentucky

3.B.4.B. 2d BCT
49th Street and Kentucky
59th Street and Tennessee

3.B.4.C. 4th BCT
47th Street and A Shau Valley Rd
Desert Storm and Wickham
Lifeliner and Market Garden

3.B.4.D. 101st CAB
59th Street and Market Garden

3.C. Tasks to Other Combat/Combat Support Units. 101 Sustainment Bde and 101 STB

3.C.1. Effective 05 Feb 07, begin conducting PT on routes as outlined in Encl 1 and

revised CAM Reg 350-1, dated TBD.

3.C.2. Bde CSMs and/or Ops SGM will attend rehearsal 01 0930 Feb 2007 at the Eagle Conference Room, IOT ensure all units understand their responsibility in implementing this policy.

3.C.3. Road Guards will be posted at the following locations from 0630-0800 on duty days. Soldiers will have right of way at all times on identified run routes during PT. Soldiers will wear a reflective vest and will have a flashlight to be used to aid in directing traffic during limited visibility. This will be rigidly enforced.

3.C.3.A.101st Sustainment Bde
Air Assault and A Shau Valley Rd
Screaming Eagle Blvd and A Shau Valley Rd

3.B.3.b 101st STB
Normandy and Kentucky
35th Street and Tennessee

3.C.4. Units will place a barricade at intersections to prevent vehicles moving onto run routes during PT hours. Barricades will be emplaced no earlier than 0620, and no later than 0630. Barricades will be removed immediately at 0800. The following are unit responsibilities.

3.C.4.A. 101st Sustainment Bde
1st Street and A Shau Valley Rd
13th Street and A Shau Valley Rd
15th Street and A Shau Valley Rd

3.C.4.B. 101st STB
28th Street and Kentucky (to include a barrier)
28th Street and Tennessee (to include a barrier)

3.C.5. ACofS, G3/5/7/DPTM.

3.C.5.A. G-3 Operations. Provide all staff coordination for this change.

3.C.5.B. G-3 Training. Ensure CAM Reg 350-1 is revised to reflect change in policy.

3.C.6. Public Affairs Office (PAO). Disseminate the change in PT route information in the Fort Campbell Courier, Channel 9, and through BCT/BDE PAO personnel to ensure maximum dissemination of information ensuring this change reaches all Soldiers and civilians. Begin disseminating information NLT 29 JAN 07 and continue to publish/announce information through 23 FEB 07.
Publish articles according to the following guidance:
Publish teaser article during 26-29 Jan 2007

Publish full feature article describing details of policy change NLT 02 Feb 2007. Publish follow-up articles on 09, 16, and 23 Feb 2007

3.C.7. Garrison Command

3.C.7.A Director Public Works (DPW).

3.C.7.A.1. Provide and place signs marking the PT routes NLT 05 FEB 07. Provide and place signs marking roads that are 'Off Limits' to PT NLT 26 FEB 07. Provide and place signs prohibiting unit PT in specified areas NLT 26 FEB 07. Map showing locations for these signs may be found in Encl 1.

3.C.7.A.2. Provide temporary chain barriers at locations required by Encl 1 to prevent vehicle access at specified locations NLT 05 FEB 2007.

3.C.7.A.3. Affect the contracting for placing of drop-arm type barriers. These barriers will be in place NLT 30 APR 2007.

3.C.7.A.4. Designate cross walks at specified locations. These cross walks will have signs to indicate the troop crossing area to motorists, as well as a crossing lane marked on road surface.

3.C.3.B. Directorate of Emergency Services (DES).

3.C.3.B.1. Post verbal message boards during the week 05-09 FEB 2007 to assist in informing FTCKY population of change in policy.

3.C.3.B.2. Provide continuous feedback and law enforcement recommendations to ensure ongoing safety and security on FTCKY.

3.D. Coordination Instructions.

3.D.1. Effective 05 FEB 07, major unit commands are tasked to provide road guards as required in Change X, CAM Reg 350-1. Effective 05 FEB 07, DES is no longer responsible for all TCP/road guard requirements.

3.D.2 Unless on a specified PT route, unit, group and individuals will move from organizational areas via the quickest route, in formations no wider than three columns.

3.D.3 Unit and group runs, defined as platoon and above, will form into 3 columns to conduct runs once on specified PT routes. Runs will be conducted in accordance with CAM Reg 350-1. Unit personnel, to include cadence callers, will not cross the yellow line except to pass slower moving units to their front.

3.D.4 Foot marches may be conducted along specified PT routes. Units will march in a single column, and will stay to the outside of the solid white line to facilitate units

conducting unit runs.

3.D.5 Any individuals or units running slower than 9 minute per mile pace, run fall-outs, or personnel walking for PT will do so to the right side of the solid line. Walkers will give way to runners and foot marchers.

3.D.6 The PT footpath route around Clarksville Base, as well as the 17-mile footpath west of cantonment area, may be utilized for PT runs and foot marches.

3.D.7 All roads from each entrance to Fort Campbell (Gates 1-7 and 10) to the first intersection are off limits to anyone doing PT at any time of day. These include:

3.D.7.A Glider Ave from Morgan Road to Gate 7.

3.D.7.B Morgan Road from Reed Road to Gate 6.

3.D.7.C Forest Road from Gorgas Road to Gate 5.

3.D.7.D Screaming Eagle from Texas to Gate 4.

3.D.7.E Air Assault from Bastogne to Gate 3.

3.D.7.F Caretan from Bastogne to Gate 2.

3.D.7.G William C. Lee Road From Bastogne to Gate 1.

3.D.8. Units may apply for an exception to policy as necessary to conduct Bn or Bde unit runs.

4. SERVICE AND SUPPORT. N/A

5. COMMAND AND SIGNAL. POC this order is CPT Chad B. Bowser, G3 Operations Officer, 798-0251.

ACKNOWLEDGE:

SCHLOSSER
MG

OFFICIAL:

PEASE
G3/5/7/DPTM

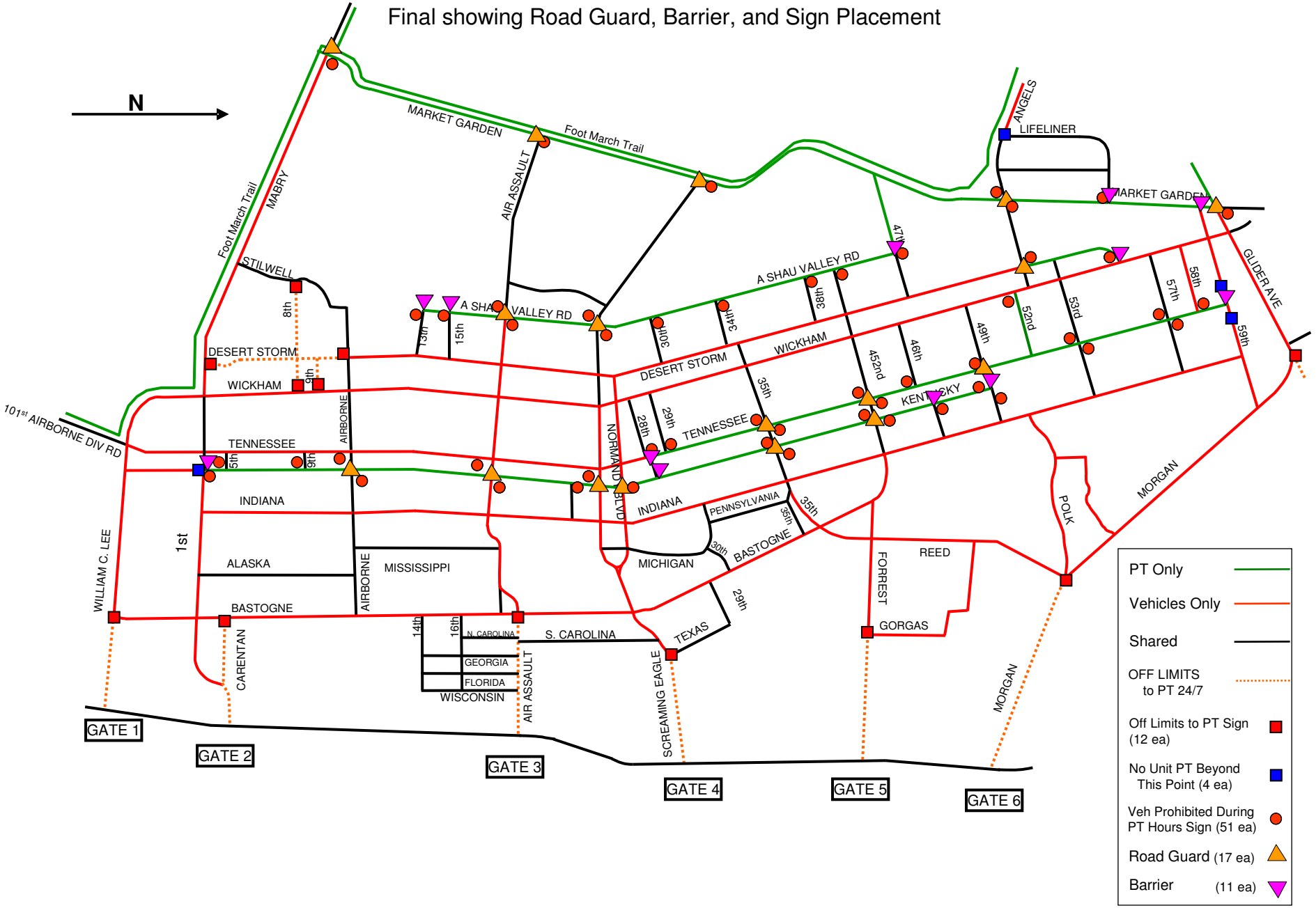
ENCL
Ft Campbell PT Route Diagram

DISTRIBUTION: A
Intranet Knowledge Share

ENCLOSURE 1 Fort Campbell PT Run/Foot March Route Effective 05 Feb 07

PT Route Effective 05 FEB 2007

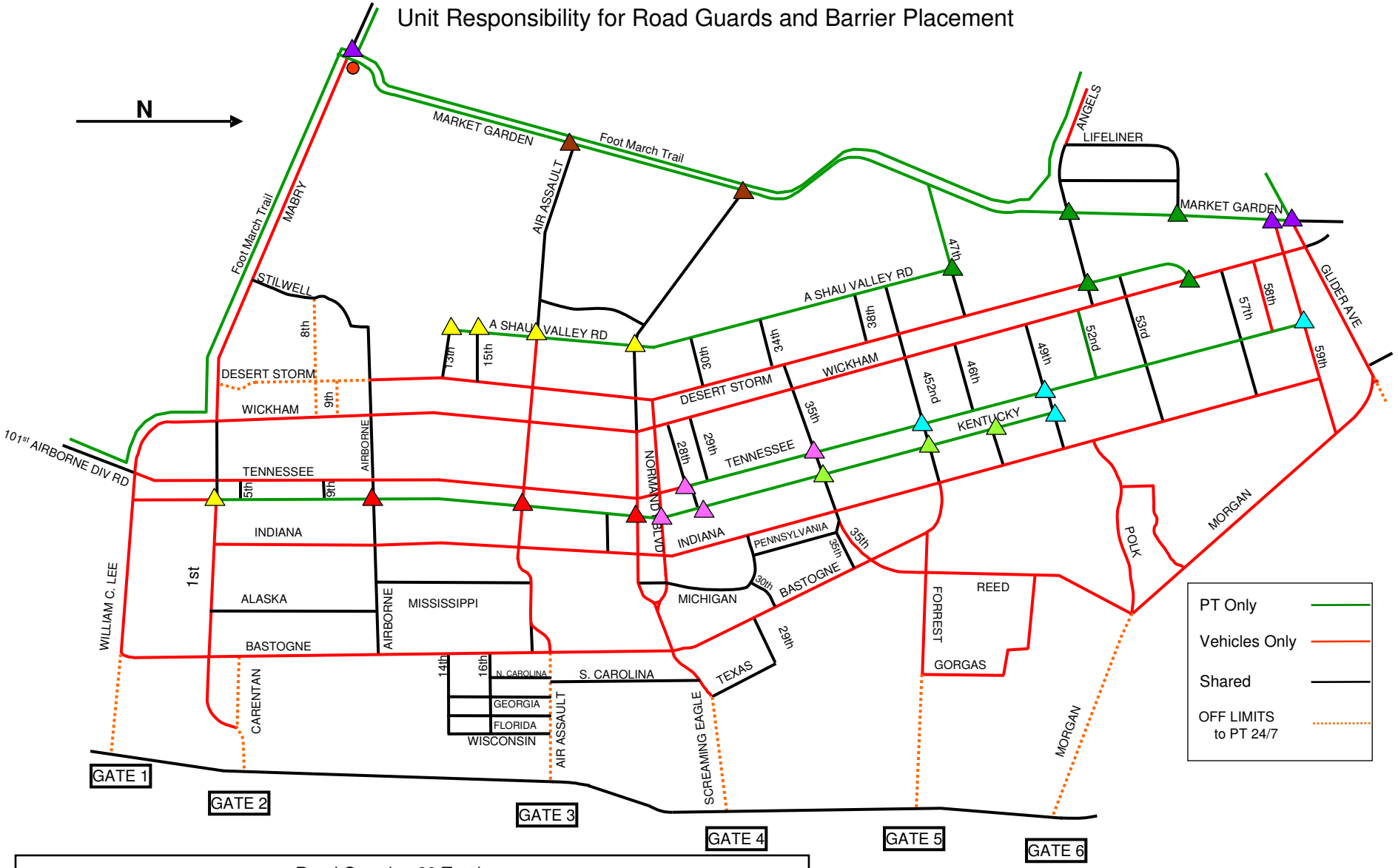
Final showing Road Guard, Barrier, and Sign Placement



Wednesday, December 21, 2011

PT Route Effective 05 FEB 2007

Unit Responsibility for Road Guards and Barrier Placement



APPENDIX CC

TENNESSEE NPDES PERMIT

STATE OF TENNESSEE

NPDES PERMIT

No. TN0080314

Authorization to discharge under the
National Pollutant Discharge Elimination System (NPDES)

Issued By

Tennessee Department of Environment and Conservation
Division of Water Pollution Control
401 Church Street
6th Floor, L & C Annex
Nashville, Tennessee 37243-1534

Under authority of the Tennessee Water Quality Control Act of 1977 (T.C.A. 69-3-101 et seq.) and the delegation of authority from the United States Environmental Protection Agency under the Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977 (33 U.S.C. 1251, et seq.)

Discharger:	**Ft. Campbell**
is authorized to discharge:	**Storm water runoff from outfalls SW1 through SW16**
from a facility located:	**in Montgomery County, Tennessee**
to receiving waters named:	**Fletcher's Fork and Little West Fork Creeks**

in accordance with effluent limitations, monitoring requirements and other conditions set forth herein.

This permit shall become effective on:	**April 1, 2008**
This permit shall expire on:	**February 28, 2013**
Issuance date:	**February 29, 2008**

Paul E. Davis, Director
Division of Water Pollution Control

CN-0759

RDAs 2352 and 2366

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PART I

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Ft. Campbell is authorized to discharge storm water runoff associated with construction activities to Fletcher's Fork and Little West Fork Creeks.

The storm water discharges shall be monitored by the permittee as specified below:

PERMIT

For outfalls SW1 through SW16

EFFLUENT CHARACTERISTIC	EFFLUENT GUDIELINES				MONITORING REQUIREMENTS	
	MONTHLY		DAILY			
	AVG. CONC. (mg/l)	AVG. AMNT. (lb/day)	MAX. CONC. (mg/l)	MAX. AMNT. (lb/day)	MSRMNT. FRQNCY.	SAMPLE TYPE
FLOW	Report (MGD) *		Report (MGD) *		Semi-annually	Estimate
pH**	REPORT				Semi-annually	Grab
FLOATING MATERIAL, COLOR, FOAM OR OIL SHEEN	REPORT				Semi-annually	Visual
TOTAL SUSPENDED SOLIDS (TSS)		--	REPORT	--	Semi-annually	Grab

(1) Only storm water outfalls from active construction sites will be sampled during this permit
* Flow shall be reported in Million Gallons per Day (MGD).
** pH analyses shall be performed within fifteen (15) minutes of sample collection.

There shall be no distinctly visible floating scum, oil or other matter contained in the storm water discharges. The discharges must not cause an objectionable color contrast in the receiving stream.

The storm water discharges shall not contain pollutants in quantities that will be hazardous or otherwise detrimental to humans, livestock, wildlife, plant life, or fish and aquatic life in the receiving stream.

Qualified third party personnel who have taken and successfully completed the Level I EPSC course will conduct the twice weekly inspection of each of the retention, or settling basins, associated with each storm water outfall and all other BMPs (best management practices).

B. MONITORING PROCEDURES

The permittee shall have on site a recording rain gauge. A log shall be kept of all rainfall events.

1. Representative Sampling

Samples and measurements taken in compliance with the monitoring requirements specified herein shall be representative of the volume and nature of the monitored discharge, and shall be taken after treatment and prior to mixing with uncontaminated storm water runoff or the receiving stream. Samples must be taken only from storm water outfalls associated with active construction sites.

2. Sampling Frequency

The sampling frequency is once every six months for each storm water outfall for active construction sites. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted.

3. Test Procedures

a. Test procedures for the analysis of pollutants shall conform to regulations published pursuant to Section 304 (h) of the Clean Water Act (the "Act"), as amended, under which such procedures may be required.

b. Unless otherwise noted in the permit, all pollutant parameters shall be determined according to methods prescribed in Title 40, CFR Part 136, as amended, promulgated pursuant to Section 304 (h) of the Act.

4. Recording of Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

a. The exact place, date and time of sampling;

b. The exact person(s) collecting samples;

c. The dates and times the analyses were performed;

d. The person(s) or laboratory who performed the analyses;

e. The analytical techniques or methods used, and;

f. The results of all required analyses.

g. The rainfall measurement for the sample event.

h. Estimate of discharge volume in million of gallons per day (MGD)

5. Records Retention

All records and information resulting from the monitoring activities required by this permit including all records of analyses performed and calibration and maintenance of instrumentation shall be retained for a minimum of three (3) years, or longer, if requested by the Division of Water Pollution Control.

C. DEFINITIONS

The **Monthly Average Concentration**, a limitation on the discharge concentration, in milligrams per liter (mg/L), is the arithmetic mean of all daily concentrations determined in a one calendar month period. For the purpose of this definition, a frequency of 2/Month is representative of 2 separate daily samples, each sample having been collected on a separate day during the monitoring period.

A **Grab Sample**, for the purposes of this permit, is defined as a single effluent sample of at least 100 milliliters (sample volumes <100 milliliters are allowed when specified per standard methods, latest edition) collected at a randomly selected time over a period not exceeding 15 minutes. The sample(s) shall be collected at the period(s) most representative of the total discharge.

For the purpose of this permit, a **Calendar Day** is defined as any 24-hour period.

For the purpose of this permit, **Semi-annually** means the same as "once every six months." Measurements of the effluent characteristics concentrations may be made anytime during a 6 month period beginning from the issuance date of this permit so long as the second set of measurements for a given 12 month period are made approximately 6 months subsequent to that time, if feasible.

For the purpose of this permit, **Annually** is defined as a monitoring frequency of once every twelve (12) months beginning with the date of issuance of this permit so long as the following set of measurements for a given 12 month period are made approximately 12 months subsequent to that time.

Dry Weather Flow shall be construed to represent discharges consisting of process and/or non-process wastewater only.

“**Operator**” for the purpose of this permit means any person associated with this project that meets either of the following two criteria:

a) This person has operational or design control over construction plans and specifications, including the ability to make modifications to those plans and specifications. This person is typically the owner or developer of the project or a portion of the project, and is considered the primary permittee; or

b) This person has day-to-day operational control of those activities at a project which are necessary to ensure compliance with a SWPPP for the site or other permit conditions. This person is typically a contractor or a commercial builder who is hired by the primary permittee, and is considered a secondary permittee.

It is anticipated that at different phases of a construction project, different types of parties may satisfy the definition of “operator.”

“Point source” means any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharged. This term does not include introduction of pollutants from non point-source agricultural and silvicultural activities, including storm water runoff from orchards, cultivated crops, pastures, range lands, and forest lands or return flows from irrigated agriculture or agricultural storm water runoff.

A **Qualifying Storm Event** is one which is greater than 0.1 inches and that occurs after a period of at least 72 hours after any previous storm event with rainfall of 0.1 inches or greater and results in a discharge from the sediment basin(s). Instances of rainfall occurring within 10 hours of each other will be considered a single rainfall event. Ten -year, 24-hour rainfall event, 25-year, 24-hour rainfall event, and 100-year, 24-hour rainfall event are mean precipitation events with a probable recurrence interval of once in 10 years, or 25 years, or 100 years, respectively, as defined by the National Weather Service in Technical Paper No. 40, ‘‘Rainfall Frequency Atlas of the United States,’’ May, 1961, or equivalent regional or state rainfall probability information developed from this source.

“**Registered Engineer**” and “**Registered Landscape Architect**” An engineer or landscape architect certified and registered by the Tennessee State Board of Architectural and Engineer Examiners pursuant to Section 62-202, Tennessee Code Annotated, to practice in Tennessee.

“**Storm Water Pollution Prevention Plan**“(SWPPP): A written plan required by this permit that includes site map(s), an identification of construction/contractor activities that could cause pollutants in the storm water, and a description of measures or practices to control these pollutants. It must be prepared and approved before construction begins. In order to effectively reduce erosion and sedimentation impacts, Best Management Practices (BMPs) must be designed, installed, and maintained during land disturbing activities. The SWPPP should be prepared in accordance with the Tennessee Erosion and Sediment Control Handbook. The handbook is designed to provide information to planners, developers, engineers, and contractors on the proper selection, installation, and maintenance of BMPs. The handbook is intended for use during the design and construction of projects that require erosion and sediment controls to protect waters of the state. It also aids in the development of SWPPPs and other reports, plans, or specifications required when participating in Tennessee's water quality regulations.

“**Wet weather conveyances**” are man-made or natural watercourses, including natural watercourses that have been modified by channelization, that flow only in direct response to precipitation runoff in their immediate locality and whose channels are above the groundwater table and which do not support fish or aquatic life and are not suitable for drinking water supplies. (Rules and Regulations of the State of Tennessee, Chapter 1200-4-3-.04(3)).

“Wet Weather Flow” shall be construed to represent storm water runoff which, in combination with all process and/or non-process wastewater discharges, as applicable, is discharged during a qualifying storm event.

D. REPORTING

1. Monitoring Results

Monitoring results shall be recorded and submitted semi-annually to the Division of Water Pollution Control. Submittals shall be postmarked no later than 15 days after the anniversary of the issuance date of this permit. Any communication regarding compliance with the conditions of this permit must be sent to:

TENNESSEE DEPT. OF ENVIRONMENT & CONSERVATION
DIVISION OF WATER POLLUTION CONTROL
COMPLIANCE REVIEW SECTION
401 CHURCH STREET
L & C ANNEX 6TH FLOOR
NASHVILLE TN 37243-1534

Any report or other information must be signed and certified by a responsible corporate officer as defined in 40 CFR 122.22, a general partner or proprietor, or a principal municipal executive officer or ranking elected official, or his duly authorized representative. Such authorization must be submitted in writing and must explain the duties and responsibilities of the authorized representative.

2. Additional Monitoring by Permittee

If the permittee monitors any pollutant specifically limited by this permit more frequently than required at the location(s) designated, using approved analytical methods as specified herein, the results of such monitoring shall be included in the calculation and reporting of the values required in the DMR form. Such increased frequency shall also be indicated on the form.

3. Falsifying Results and/or Reports

Knowingly making any false statement on any report required by this permit or falsifying any result may result in the imposition of criminal penalties as provided for in Section 309 of the Federal Water Pollution Control Act, as amended, and in Section 69-3-115 of the Tennessee Water Quality Control Act.

4. Outlier Data

Outlier data include analytical results that are probably false. The validity of results is based on operational knowledge and a properly implemented quality assurance program. False results may include laboratory artifacts, potential sample tampering, broken or suspect sample containers, sample contamination or similar demonstrated quality control flaw.

Outlier data are identified through a properly implemented quality assurance program, and according to ASTM standards (e.g. Grubbs Test, ‘h’ and ‘k’ statistics). Furthermore, outliers should be verified, corrected, or removed, based on further inquiries into the matter. If an outlier was verified (through repeated testing and/or analysis), it should remain in the preliminary data set. If an outlier resulted from a transcription or similar clerical error, it should be corrected and subsequently reported.

Therefore, only if an outlier was associated with problems in the collection or analysis of the samples and as such does not conform to the Guidelines Establishing Test Procedures for the Analysis of Pollutants (40 CFR §136), it can be removed from the data set and not reported on the Discharge Monitoring Report forms (DMRs). Otherwise, all results (including monitoring of pollutants more frequently than required at the location(s) designated, using approved analytical methods as specified in the permit) should be included in the calculation and reporting of the values required in the DMR form. You are encouraged to use “comment” section of the DMR form (or attach additional pages), in order to explain any potential outliers or dubious results.

E. SCHEDULE OF COMPLIANCE

Full compliance and operational levels shall be attained from the effective date of this permit.

PART II

A. GENERAL PROVISIONS

1. Duty to Comply

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Water Quality Control Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or denial of a permit renewal application.

2. Duty to Reapply

Permittee is not authorized to discharge after the expiration date of this permit. In order to receive authorization to discharge beyond the expiration date, the permittee shall submit such information and forms as are required to the Director of Water Pollution Control (the "Director") no later than 180 days prior to the expiration date. Such applications must be properly signed and certified.

3. Signatory Requirements

All applications, reports, or information submitted to the commissioner shall be signed and certified by the persons identified in 1200-4-5-.05(6)(a-c), making the following certification:

> “I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant

penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

All commercial builders, contractors and subcontractor must sign the certification statement found in Appendix 3. A copy of the signed certification statement must be kept at the construction site.

4. Right of Entry

The permittee shall allow the Director, the Regional Administrator of the U.S. Environmental Protection Agency, or their authorized representatives, upon the presentation of credentials:

a. To enter upon the permittee's premises where an effluent source is located or where records are required to be kept under the terms and conditions of this permit, and at reasonable times to copy these records;

b. To inspect at reasonable times any monitoring equipment or method or any collection, treatment, pollution management, or discharge facilities required under this permit; and

c. To sample at reasonable times any discharge of pollutants.

5. Availability of Reports

Except for data determined to be confidential under Section 308 of the Federal Water Pollution Control Act, as amended, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the Division of Water Pollution Control. As required by the Federal Act, effluent data shall not be considered confidential.

6. Proper Operation and Maintenance

a. The permittee shall at all times properly operate and maintain all facilities and systems (and related appurtenances) for collection and treatment which are installed or used by the permittee to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance also includes adequate laboratory and process controls and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems, which are installed by a permittee only when the operation is necessary to achieve compliance with the conditions of the permit. Backup continuous pH and flow monitoring equipment are not required.

b. Dilution water shall not be added to comply with effluent requirements to achieve BCT, BPT, BAT and or other technology-based effluent limitations such as those in State of Tennessee Rule 1200-4-5-.09.

7. Treatment Facility Failure

The permittee, in order to maintain compliance with this permit, shall control production, all discharges, or both, upon reduction, loss, or failure of the treatment facility, until the facility is restored or an alternative method of treatment is provided. This requirement applies in such situations as the reduction, loss, or failure of the primary source of power.

8. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State, or local laws or regulations.

9. Severability

The provisions of this permit are severable. If any provision of this permit due to any circumstance, is held invalid, then the application of such provision to other circumstances and to the remainder of this permit shall not be affected thereby.

10. Other Information

If the permittee becomes aware that he failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Director, then he shall promptly submit such facts or information.

B. CHANGES AFFECTING THE PERMIT

1. Planned Changes

The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

a. The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR 122.29(b); or

b. The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements under 40 CFR 122.42(a)(1).

2. Permit Modification, Revocation, or Termination

a. This permit may be modified, revoked and reissued, or terminated for cause as described in 40 CFR 122.62 and 122.64, Federal Register, Volume 49, No. 188 (Wednesday, September 26, 1984), as amended.

b. The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

c. If any applicable effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established for any toxic pollutant under Section 307(a) of the Federal Water Pollution Control Act, as amended, the Director shall modify or revoke and reissue the permit to conform to the prohibition or to the effluent standard, providing that the effluent standard is more stringent than the limitation in the permit on the toxic pollutant. The permittee shall comply with these effluent standards or prohibitions within the time provided in the regulations that establish these standards or prohibitions, even if the permit has not yet been modified or revoked and reissued to incorporate the requirement.

d. The filing of a request by the permittee for a modification, revocation, reissuance, termination, or notification of planned changes or anticipated noncompliance does not halt any permit condition.

3. Change of Ownership

This permit may be transferred to another party (provided there are neither modifications to the facility or its operations, nor any other changes which might affect the permit limits and conditions contained in the permit) by the permittee if:

a. The permittee notifies the Director of the proposed transfer at least 30 days in advance of the proposed transfer date;

b. The notice includes a written agreement between the existing and new permittees containing a specified date for transfer of permit responsibility, coverage, and liability between them; and

c. The Director, within 30 days, does not notify the current permittee and the new permittee of his intent to modify, revoke or reissue, or terminate the permit and to require that a new application be filed rather than agreeing to the transfer of the permit.

Pursuant to the requirements of 40 CFR 122.61, concerning transfer of ownership, the permittee must provide the following information to the division in their formal notice of intent to transfer ownership: 1) the NPDES permit number of the subject permit; 2) the effective date of the proposed transfer; 3) the name and address of the transferor; 4) the name and address of the transferee; 5) the names of the responsible parties for both the transferor and transferee; 6) a statement that the transferee assumes responsibility for the subject NPDES permit; 7) a statement that the transferor relinquishes responsibility for the subject NPDES permit; 8) the signatures of the responsible parties for both the transferor and transferee pursuant to the requirements of 40 CFR 122.22(a), “Signatories to permit applications”; and, 9) a statement regarding any proposed modifications to the facility, its operations, or any other changes which might affect the permit limits and conditions contained in the permit.

4. Change of Mailing Address

The permittee shall promptly provide to the Director written notice of any change of mailing address. In the absence of such notice the original address of the permittee will be assumed to be correct.

5. Typical Construction Site Operators

a. Owner/Developer

Ft. Campbell is the owner/developer. The owner/developer shall designate a person that has operational or design control over construction plans and specifications, including the ability to make modifications to those plans and specifications. An owner/developer's responsibility to comply with requirements of this permit extends until:

1) permit coverage is terminated in accordance with requirements of part Part II.B.2 above; or
2) operational or design control of the entire site (including, but not limited to, infrastructure, common areas, storm water drainage structures, sediment treatment basin, etc.) is transferred to one or more new owner(s)/operator(s).

b. Commercial builders

A commercial builder who purchases one or more lots from an owner/developer (initial permittee) for the purpose of constructing and selling a structure (e.g., residential house, non-residential structure, commercial building, industrial facility, golf courses, etc.) and has design or operational control over construction plans and specifications becomes a primary permittee for that portion of the site. The owner/developer or a lot owner to build a structure for an end user may also hire the commercial builder. In this case, the commercial builder is considered a new operator and must sign and submit the original of the certification statement found in Appendix 3 to the Nashville Field Office. A copy of the signed certification found in appendix 3 must be kept at the construction site.

c. Contractors

A contractor is considered a secondary permittee. This person has day-to-day operational control of those activities at a project, which are necessary to ensure compliance with a SWPPP for the site or other permit conditions (e.g., contractor is authorized to direct workers at a site to carry out activities required by the SWPPP or comply with other permit conditions).

A contractor is typically hired by the initial permittee or by the commercial builders. This person may include, but is not limited to a general contractor, grading contractor, erosion control contractor, sub-contractor responsible for any land disturbing activities and/or erosion prevention and sediment control (EPSC) implementation/maintenance, commercial builder hired by the owner/developer, etc. The contractor must sign and submit the original of Appendix 3 to the Nashville Field Office. A copy of the signed certification form found in Appendix 3 must be kept at the construction site.

C. NONCOMPLIANCE

1. Effect of Noncompliance

All discharges shall be consistent with the terms and conditions of this permit. Any permit noncompliance constitutes a violation of applicable State and Federal laws and is

grounds for enforcement action, permit termination, permit modification, or denial of permit reissuance.

2. Reporting of Noncompliance

a. 24-Hour Reporting

In the case of any noncompliance which could cause a threat to public drinking supplies, or any other discharge which could constitute a threat to human health or the environment, the required notice of non-compliance shall be provided to the Division of Water Pollution Control in the appropriate regional Field Office within 24-hours from the time the permittee becomes aware of the circumstances. (The regional Field Office should be contacted for names and phone numbers of environmental response personnel).

A written submission must be provided within five calendar days of the time the permittee becomes aware of the circumstances, unless the Director on a case-by-case basis waives this requirement. The permittee shall provide the Director with the following information:

i. A description of the discharge and cause of noncompliance;

ii. The period of noncompliance, including exact dates and times or, if not corrected, the anticipated time the noncompliance is expected to continue; and

iii. The steps being taken to reduce, eliminate, and prevent recurrence of the noncomplying discharge.

b. Scheduled Reporting

For instances of noncompliance which are not reported under subparagraph 2.a. above, the permittee shall report the noncompliance on the Discharge Monitoring Report. The report shall contain all information concerning the steps taken, or planned, to reduce, eliminate, and prevent recurrence of the violation and the anticipated time the violation is expected to continue.

3. Overflow

a. "***Overflow***" means the discharge to land or water of wastes from any portion of the collection, transmission, or treatment system other than through permitted outfalls.

b. Overflows are prohibited.

4. Rain Event Greater than Design Criteria or Upset

a. "***Upset***" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

b. An upset shall constitute an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the permittee demonstrates, through properly signed, contemporaneous operating logs, or other relevant evidence that:

i. An upset occurred and that the permittee can identify the cause(s) of the upset;

ii. The permitted facility was at the time being operated in a prudent and workman-like manner and in compliance with proper operation and maintenance procedures;

iii. The permittee submitted information required under "Reporting of Noncompliance" within 24-hours of becoming aware of the upset (if this information is provided orally, a written submission must be provided within five days); and

iv. The permittee complied with any remedial measures required under "Adverse Impact."

5. Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to the waters of Tennessee resulting from noncompliance with this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge. It shall not be a defense for the permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

6. Bypass

a. "***Bypass***" is the intentional diversion of wastewater away from any portion of a treatment facility or structural BMP. "Severe property damage" means substantial physical damage to property, damage to the treatment facilities, which would cause them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

b. Bypasses are prohibited unless the following 3 conditions are met:

i. The bypass is unavoidable to prevent loss of life, personal injury, or severe property damage;

ii. There are not feasible alternatives to bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment down-time. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass, which occurred during normal periods of equipment down-time or preventative maintenance;

iii. The permittee submits notice of an unanticipated bypass to the Division of Water Pollution Control in the appropriate environmental assistance center within 24-hours of becoming aware of the bypass (if this information is provided orally, a written submission must be provided within five days). When the need for the bypass is foreseeable, prior notification shall be submitted to the Director, if possible, at least 10 days before the date of the bypass.

c. Bypasses not exceeding limitations are allowed **only** if the bypass is necessary for essential maintenance to assure efficient operation. All other bypasses are prohibited. Allowable bypasses not exceeding limitations are not subject to the reporting requirements of 6.b.iii, above.

D. LIABILITIES

1. Civil and Criminal Liability

Except as provided in permit conditions for "**Bypassing,**" "**Overflow,**" and "**Upset,**" nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance. Notwithstanding this permit, the permittee shall remain liable for any damages sustained by the State of Tennessee, including but not limited to fish kills and losses of aquatic life and/or wildlife, as a result of the discharge of wastewater to any surface or subsurface waters. Additionally, notwithstanding this Permit, it shall be the responsibility of the permittee to conduct its wastewater treatment and/or discharge activities in a manner such that public or private nuisances or health hazards will not be created.

2. Liability Under State Law

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or the Federal Water Pollution Control Act, as amended.

PART III

OTHER REQUIREMENTS

A. TOXIC POLLUTANTS

The permittee shall notify the Division of Water Pollution Control as soon as it knows or has reason to believe:

1. That any activity has occurred or will occur which would result in the discharge on a routine or frequent basis, of any toxic substance(s) (listed at 40 CFR 122, Appendix D, Table II and III) which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

a. One hundred micrograms per liter (100 ug/l);

b. Two hundred micrograms per liter (200 ug/l) for acrolein and acrylonitrile; five hundred micrograms per liter (500 ug/l) for 2,4-dinitrophenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;

c. Five (5) times the maximum concentration value reported for that pollutant(s) in the permit application in accordance with 122.21(g)(7); or

d. The level established by the Director in accordance with 122.44(f).

2. That any activity has occurred or will occur which would result in any discharge, on a non-routine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

a. Five hundred micrograms per liter (500 ug/l);

b. One milligram per liter (1 mg/L) for antimony;

c. Ten (10) times the maximum concentration value reported for that pollutant in the permit application in accordance with 122.21(g)(7); or

d. The level established by the Director in accordance with 122.44(f).

B. REOPENER CLAUSE

If an applicable standard or limitation is promulgated under Sections 301(b)(2)(C) and (D), 304(B)(2), and 307(a)(2) and that effluent standard or limitation is more stringent than any effluent limitation in the permit or controls a pollutant not limited in the permit, the permit shall be promptly modified or revoked and reissued to conform to that effluent standard or limitation.

C. PLACEMENT OF SIGNS

Within sixty (60) days of the effective date of this permit, the permittee shall place and maintain a sign(s) at each outfall and any bypass/overflow point in the collection system. For the purposes of this requirement, any bypass/overflow point that has discharged five (5) or more times in the last year must be so posted. The sign(s) should be clearly visible to the public from the bank and the receiving stream or from the nearest public property/right-of-way, if applicable. The minimum sign size should be two feet by two feet (2' x 2') with one inch (1") letters. The sign should be made of durable material and have a white background with black letters.

The sign(s) are to provide notice to the public as to the nature of the discharge and, in the case of the permitted outfalls, that the discharge is regulated by the Tennessee Department of Environment and Conservation, Division of Water Pollution Control. The following is given as an example of the minimal amount of information that must be included on the sign:

CONSTRUCTION STORM WATER RUNOFF
Ft. Campbell
(Permittee's Phone Number)
NPDES Permit NO. TN0080314
TENNESSEE DIVISION OF WATER POLLUTION CONTROL
1-888-891-8332 ENVIRONMENTAL FIELD OFFICE - Nashville

D. ANTIDEGRADATION

Pursuant to the Rules of the Tennessee Department of Environment and Conservation, Chapter 1200-4-3-.06, titled "Tennessee Antidegradation Statement," and in consideration of the Department's directive in attaining the greatest degree of effluent reduction achievable in municipal, industrial, and other wastes, the permittee shall further be required, pursuant to the terms and conditions of this permit, to comply with the effluent limitations and schedules of compliance required to implement applicable water quality standards, to comply with a State Water Quality Plan or other State or Federal laws or regulations, or where practicable, to comply with a standard permitting no discharge of pollutants.

E. PROHIBITION OF NON-STORM WATER DISCHARGES

This permit does not authorize the discharge of non-storm water

PART IV

STORM WATER POLLUTION PREVENTION PLAN

A comprehensive SWPPP must be prepared The permittee must implement the SWPPP as written from commencement of construction activity until final stabilization is complete, or until the permittee does not have design or operational control of any portion of the construction site. Requirements for termination of site coverage are provided. Monitoring of storm water runoff from storm water outfalls will be required for Flow, Total Suspended Solids (TSS), and pH. In order to assist the permittee in the evaluation of the effectiveness of the SWPPP, benchmark values developed are provided.

Parameters of Concern	Benchmark
Flow	
Total Suspended Solids (TSS)	***150 mg/L***
pH (range)	***6.0 - 9.0***

At least one site-specific SWPPP must be developed for each construction project or site covered by this permit. Such SWPPP must be prepared in accordance with good engineering practices and the latest edition of the Tennessee Erosion and Sediment Control Handbook. The handbook is designed to provide information to planners, developers, engineers, and

contractors on the proper selection, installation, and maintenance of Best Management Practices (BMPs). The SWPPP must:

a) identify all potential sources of pollution which are likely to affect the quality of storm water discharges from the construction site;
b) describe practices to be used to reduce pollutants in storm water discharges from the construction site; and
c) assure compliance with the terms and conditions of this permit.

Once a definable area has been finally stabilized, the permittee may mark this on the SWPPP and no further SWPPP or inspection requirements apply to that portion of the site (e.g., earth-disturbing activities around one of three buildings in a complex are done and the area is finally stabilized, one mile of a roadway or pipeline project is done and finally stabilized, etc).

For more effective coordination of Best Management Practices (BMPs) and opportunities for cost sharing, a cooperative effort by the different operators at a site to prepare and participate in a comprehensive SWPPP is encouraged. Primary permittees at a site may, but are not required, to develop separate SWPPPs that cover only their portion of the project. In instances where there is more than one SWPPP for a site, the permittees must ensure the storm water discharge controls and other measures are compatible with one another and do not prevent another operator from complying with permit conditions. The comprehensive SWPPP developed and submitted by the initial permittee (typically owner/developer) must assign responsibilities to various operators (typically contractors) and coordinate all BMPs at the construction site. Assignment and coordination can be done by name or by job title.

The discharger will develop, document and maintain a storm water pollution prevention plan (SWPPP). The plan shall be signed by either a principal executive officer of a corporation, the owner or proprietor of a sole proprietorship, or a partner or general partner of a partnership. The SWPPP developed and implemented shall be site specific to the permitted facility with regard to the general terms and conditions outlined in the guidance manuals cited herein, and, at a minimum, shall contain the following items:

A. REGISTERED ENGINEER OR LANDSCAPE ARCHITECT REQUIREMENT

The narrative portion of the SWPPP may be prepared by an individual that has a working knowledge of erosion prevention and sediment controls, such as a Certified Professional in Erosion and Sediment Control (CPESC). For SWPPPs that include preparation of plans and specifications for any building or structure, including the design of sediment basins or other sediment controls involving structural, hydraulic, hydrologic or other engineering calculations, those SWPPPs shall be prepared by a licensed professional engineer or landscape architect in accordance with the Tennessee Code Annotated, Title 62, Chapter 2 and the rules of the Tennessee Architectural and Engineering Examiners Board. Engineering design of sediment basins and other sediment controls must be included in SWPPPs for construction sites involving disturbance of 10 or more acres. This requirement is in addition to any requirements of Title 62, Chapter 2 and the rules promulgated thereunder, including without limitation, any definition of the scope of practice of engineering or landscape architecture.

B. SIGNATURE REQUIREMENTS, PLAN REVIEW AND MAKING PLANS AVAILABLE

The SWPPP shall be signed by the operator(s) in accordance with subpart I.D, and if applicable, certified according to requirements in section. A copy of the SWPPP shall be retained on-site at the location.

The permittee shall make updated plans and inspection reports available upon request to the director, local agency approving erosion prevention and sediment control plan, grading plans, or storm water management plans.

The permittee shall post the permit near the main entrance of the construction site accessible to the public with the following information:

a) a copy of the permit for the construction project;
b) name, company name, E-mail address (if available), telephone number and address of the project site owner or a local contact person;
c) a brief description of the project; and
d) the location of the SWPPP if the site is inactive or does not have an on-site location to store the plan.

The permit must be maintained in a legible condition. If posting this information near a main entrance is infeasible due to safety concerns, or not accessible to the public, the permit shall be posted in a local public building. If the construction project is a linear construction project (e.g., pipeline, highway, etc.), the permit must be placed in a publicly accessible location near where construction is actively underway and moved as necessary. This permit does not provide the public with any right to trespass on a construction site for any reason, including inspection of a site. This permit does not require that permittees allow members of the public access to a construction site.

C. KEEPING PLANS CURRENT

The permittee must modify and update the SWPPP:

a) whenever there is a change in the scope of the project, which would be expected to have a significant effect on the discharge of pollutants to the waters of the state and which has not otherwise been addressed in the SWPPP;
b) whenever inspections or investigations by site operators, local, state or federal officials indicate the SWPPP is proving ineffective in eliminating or significantly minimizing pollutants from sources identified under this permit, or is otherwise not achieving the general objectives of controlling pollutants in storm water discharges associated with construction activity;
c) to identify any new operator (typically contractor and/or subcontractor) as needed to reflect operational or design control that will implement a measure of the SWPPP and
d) to include measures necessary to prevent a negative impact to legally protected state or federally listed fauna or flora (or species proposed for such protection). Amendments to the SWPPP may be reviewed by the division, the EPA or an authorized regulatory agency.

D. COMPONENTS OF THE SWPPP

The SWPPP shall include the following items:

1. Site description

a) a description of all construction activities at the site (not just grading and street construction);
b) the intended sequence of major activities which disturb soils for major portions of the site (e.g., grubbing, excavation, grading, utilities and infrastructure installation, etc.);
c) estimates of the total area of the site and the total area that is expected to be disturbed by excavation, grading, filling, or other construction activities;
d) a description of the topography of the site including an estimation of the percent slope and the variation in percent slope found on the site; such estimation should be on a basis of a drainage area serving each outfall, rather than an entire project;
e) any data describing the soil (data may be referenced or summarized) and how the soil type will dictate the needed control measures and the expected quality of any discharge from the site;
f) an estimate of the runoff coefficient of the site after construction activities are completed and how the runoff will be handled to prevent erosion at the permanent outfall and receiving stream;
g) an erosion prevention and sediment control map of the site with the proposed construction area clearly outlined. The map should indicate the boundaries of the permitted area, drainage patterns and approximate slopes anticipated after major grading activities, areas of soil disturbance, an outline of areas which are not to be disturbed, the location of major structural and nonstructural controls identified in the SWPPP, the location of areas where stabilization practices are expected to occur, surface waters including wetlands, sinkholes, and careful identification on the site map of outfall points intended for coverage under the general permit for storm water discharges from the site;
h) a description of any discharge associated with industrial activity other than construction storm water that originates on site and the location of that activity and its permit number;
i) identification of any stream or wetland on or adjacent to the project, a description of any anticipated alteration of these waters and the permit number or the tracking number of the Aquatic Resources Alteration Permit or Section 401 Certification issued for the alteration;
j) the name of the receiving water(s), and approximate size and location of affected wetland acreage at the site;
k) if applicable, identify and outline the buffer zones established to protect waters of the state located within the boundaries of the project;
l) for projects which will be subdivided, such as residential developments or industrial parks, the developer/owner must describe how he will prevent erosion and/or control any sediment from portions of the property that will be sold prior to completion of construction; once the property is sold, new operator must obtain coverage under this permit, and assume operational control and responsibility of that portion of the site;

m) for projects of more than 50 acres, the construction phases must be described; and
n) if only a portion of the total acreage of the construction site is to be disturbed, then the protections employed to limit the disturbance must be discussed, i.e., caution fence, stream side buffer zones, etc.

2. Description of storm water runoff controls

The SWPPP shall include a description of appropriate erosion prevention and sediment controls and other Best Management Practices (BMPs) that will be implemented at the construction site. The SWPPP must clearly describe each major activity which disturbs soils for major portions of the site (e.g., grubbing, excavation, grading, utilities and infrastructure installation, etc.):

a) appropriate control measures and the general timing for the measures to be implemented during construction activities; and
b) which permittee is responsible for implementation of which controls.

The SWPPP must include erosion control drawings showing the approximate location of each control measure along with a description of the timing during the construction process for implementing each measure (e.g., prior to the start of earth disturbance, as the slopes are altered and after major grading is finished).

3. Erosion prevention and sediment controls

a. General criteria and requirements

a) The construction-phase erosion prevention controls shall be designed to minimize the dislodging and suspension of soil in water. Sediment controls shall be designed to retain mobilized sediment on site.
b) All control measures must be properly selected, installed, and maintained in accordance with the manufacturer's specifications (where applicable) and good engineering practices. All control measures selected must be able to slow runoff so that rill and gully formation is prevented. When steep slopes and/or fine particle soils are present at the site, additional physical or chemical treatment of storm water runoff may be required, and must be fully described. If periodic inspections or other information indicates a control has been used inappropriately, or incorrectly, the permittee must replace or modify the control for relevant site situations.
c) If permanent or temporary vegetation is to be used as a control measure, then the timing of the planting of the vegetation cover must be discussed in the SWPPP. Delay in planting cover vegetation until winter months or dry months should be avoided, if possible.
d) If sediment escapes the construction site, off-site accumulations of sediment that have not reached a stream must be removed at a frequency sufficient to minimize offsite impacts (e.g., fugitive sediment that has escaped the construction site and has collected in a street must be removed so that it is not subsequently washed into storm sewers and streams by the next rain and/or so that it does not pose a safety hazard to users of public streets). Permittees shall not initiate remediation/restoration of a stream without consulting the division first. This permit does not authorize access to private property. Arrangements

concerning removal of sediment on adjoining property must be settled by the permittee with the adjoining landowner.

e) Sediment should be removed from sediment traps, silt fences, sedimentation ponds, and other sediment controls as necessary, and must be removed when design capacity has been reduced by 50%.
f) Litter, construction debris, and construction chemicals exposed to storm water shall be picked up prior to anticipated storm events or before being carried off of the site by wind (e.g., forecasted by local weather reports), or otherwise prevented from becoming a pollutant source for storm water discharges (e.g., screening outfalls, daily pick-up, etc.). After use, materials used for erosion prevention and sediment control should be removed or otherwise prevented from becoming a pollutant source for storm water discharges.
g) Offsite erodible material storage areas (also including overburden and stockpiles of dirt, etc.) used primarily by the permitted project are considered a part of the project and shall be addressed in the SWPPP and included in the fee calculation.
h) Pre-construction vegetative ground cover shall not be destroyed, removed or disturbed more than 10 days prior to grading or earth moving unless the area is seeded and/or mulched or other temporary cover is installed.
i) Clearing and grubbing must be held to the minimum necessary for grading and equipment operation.
j) Construction must be sequenced to minimize the exposure time of graded or denuded areas.
k) Construction must be phased for projects in which over 50 acres of soil will be disturbed. Areas of the completed phase must be stabilized within 15 days No more than 50 acres of active soil disturbance is allowed at any time during the construction project.
l) Erosion prevention and sediment control measures must be in place and functional before earth moving operations begin, and must be constructed and maintained throughout the construction period. Temporary measures may be removed at the beginning of the workday, but must be replaced at the end of the workday.
m) The following records shall be maintained on or near site: the dates when major grading activities occur; the dates when construction activities temporarily or permanently cease on a portion of the site; the dates when stabilization measures are initiated; inspection records and rainfall records.
n) Permittees shall maintain a rain gauge and daily rainfall records at the site, or use a reference site for a record of daily amount of precipitation.

b. Stabilization practices

The SWPPP shall include a description of interim and permanent stabilization practices, including site-specific scheduling of the implementation of the practices. Site plans should ensure that existing vegetation is preserved where attainable and that disturbed portions of the site are stabilized. Site plans should comply with buffer zone requirements applicable, in which construction activities, borrow and/or fill are prohibited. Stabilization practices may include: temporary seeding, permanent seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of trees, preservation of mature vegetation, and other appropriate measures. Use of impervious surfaces for final stabilization in lieu of a permanent vegetative cover should be avoided where practicable. No stabilization, erosion control or sediment

treatment measures are to be installed in a stream without obtaining an Aquatic Resource Alteration Permit (ARAP).

Stabilization measures shall be initiated as soon as possible in portions of the site where construction activities have temporarily or permanently ceased. Temporary or permanent soil stabilization at the construction site (or a phase of the project) must be completed not later than 15 days after the construction activity in that portion of the site has temporarily or permanently ceased. In the following situations, temporary stabilization measures are not required:

a) where the initiation of stabilization measures is precluded by snow cover or frozen ground conditions or adverse soggy ground conditions, stabilization measures shall be initiated as soon as practicable; or
b) where construction activity on a portion of the site is temporarily ceased, and earth disturbing activities will be resumed within 15 days.

Permanent stabilization with perennial vegetation (using native herbaceous and woody plants where practicable) or other permanently stable, non-eroding surface shall replace any temporary measures as soon as practicable. Unpacked gravel containing fines (silt and clay sized particles) or crusher runs will not be considered a non-eroding surface.

c. Structural practices

The SWPPP shall include a description of structural practices to divert flows from exposed soils, store flows or otherwise limit runoff and discharge of pollutants from exposed areas of the site. Such practices may include silt fences, earth dikes, drainage swales, sediment traps, check dams, subsurface drains, pipe slope drains, level spreaders, storm drain inlet protection, rock outlet protection, reinforced soil retaining systems, gabions, and temporary or permanent sediment basins. Structural controls shall not be placed in streams or wetlands except as authorized by a section 404 permit and/or Aquatic Resource Alteration Permit.

Erosion prevention and sediment control measures shall be designed according to the size and slope of disturbed drainage areas with the goal of detaining runoff and trapping sediment. In addition, erosion prevention and sediment controls shall be designed to control the rainfall and runoff from a 2 year, 24 hour storm, as a minimum. When clay and other fine particle soils are present at the construction site, chemical treatment may be used to minimize amount of sediment being discharged.

For an outfall in a drainage area of a total of 10 or more acres, a temporary (or permanent) sediment basin that provides storage for a calculated volume of runoff from a 2 year, 24 hour storm and runoff from each acre drained, or equivalent control measures, shall be provided until final stabilization of the site. Where an equivalent control measure is substituted for a sediment retention basin, the equivalency must be justified to the division. Runoff from any undisturbed acreage should be diverted around the disturbed area and the sediment basin. Diverted runoff can be omitted from the volume calculation. Sediment storage expected from the disturbed areas must be included and a marker installed signifying the need for cleanout of the basin.

All calculations of drainage areas, runoff coefficients and basin volumes must be provided in the SWPPP. The discharge structure from a sediment basin must be designed to retain sediment during the lower flows. Muddy water to be pumped from excavation and work areas must be

held in settling basins or filtered or chemically treated prior to its discharge into surface waters. Water must be discharged through a pipe, well-grassed or lined channel or other equivalent means so that the discharge does not cause erosion and sedimentation. Discharged water must not cause an objectionable color contrast with the receiving stream.

4. Storm water management

The SWPPP shall include a description of measures that will be installed during the construction process to control pollutants in storm water discharges that will occur after construction operations have been completed.

For projects discharging to waters considered impaired by sediment or habitat alteration due to in-channel erosion, the SWPPP shall include a description of measures that will be installed during the construction process to control pollutants and any increase in the volume of storm water discharges that will occur after construction operations have been completed. For steep slope sites, the SWPPP shall also include a description of measures that will be installed to dissipate the volume and energy of the storm water runoff to pre-development levels.

This permit only addresses the installation of storm water management measures, and not the ultimate operation and maintenance of such structures after the construction activities have been completed, the site has undergone final stabilization, and the permit coverage has been terminated. Permittees are only responsible for the installation and maintenance of storm water management measures prior to final stabilization of the site, and are not responsible for maintenance after storm water discharges associated with construction activity have been eliminated from the site. All permittees are encouraged to limit the amount of post construction runoff, if not required by local building regulations, in order to minimize in-stream channel erosion in the receiving stream.

Construction storm water runoff management practices may include: storm water detention structures (including wet ponds); storm water retention structures; flow attenuation by use of open vegetated swales and natural depressions; infiltration of runoff onsite; and sequential systems (which combine several practices).

Velocity dissipation devices shall be placed at discharge locations and along the length of any outfall channel to provide a non-erosive velocity flow from the structure to a water course so that the natural physical and biological characteristics and functions are maintained and protected (no significant changes in the hydrological regime of the receiving water). The SWPPP shall include an explanation of the technical basis used to select the practices to control pollution where flows exceed pre-development levels.

5. Inspection Schedule, Inspector training and certification

Inspectors must have successfully completed the “Fundamentals of Erosion Prevention and Sediment Control” course, or an equivalent course, for individuals involved in land-disturbing activities which provides a working knowledge of erosion prevention and sediment controls. An engineer or a landscape architect that prepared the drainage and structure design portion of the SWPPP may also conduct the required inspections.

a) Inspections described in paragraphs b, c and d below, shall be performed at least twice every calendar week. Inspections shall be performed at least 72 hours apart. Where sites or portion(s) of construction sites have been temporarily stabilized, or runoff is unlikely due to winter conditions (e.g., site covered with snow or ice), such inspection only has to be conducted once per month until thawing results in runoff or construction activity resumes. Inspections requirements do not apply to definable areas that have been finally stabilized Written notification of the intent to conduct only monthly inspections and the justification for such request must be submitted to the local Environmental Field Office, and division's Nashville Central Office
b) Qualified personnel (provided by the permittee or cooperatively by multiple permittees) shall inspect disturbed areas of the construction site that have not been finally stabilized, areas used for storage of materials that are exposed to precipitation, structural control measures, locations where vehicles enter or exit the site, and each outfall.
c) Disturbed areas and areas used for storage of materials that are exposed to precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion prevention and sediment control measures identified in the SWPPP shall be observed to ensure that they are operating correctly.
d) Outfall points (where discharges leave the site or enter waters of the state) shall be inspected to determine whether erosion prevention and sediment control measures are effective in preventing significant impacts to receiving waters. Where discharge locations are inaccessible, nearby downstream locations shall be inspected. Locations where vehicles enter or exit the site shall be inspected for evidence of offsite sediment tracking.
e) Based on the results of the inspection, any inadequate control measures or control measures in disrepair shall be replaced or modified, or repaired as necessary, before the next rain event if possible, but in no case more than 7 days after the need is identified.
f) Based on the results of the inspection, the site description identified in the SWPPP and pollution prevention measures identified in the SWPPP of this permit shall be revised as appropriate, but in no case later than 7 days following the inspection. Such modifications shall provide for timely implementation of any changes to the SWPPP, but in no case later than 14 days following the inspection.
g) Inspections shall be documented and include the scope of the inspection, name(s) and title of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the storm water pollution prevention plan (including the location(s) of discharges of sediment or other pollutants from the site and of any control device that failed to operate as designed or proved inadequate for a particular location), and actions taken. Inspection documentation will be maintained on site and made available upon request. Inspection reports must be submitted to the division within 10 days of the request.

6. Other items needing control

a) No solid materials, including building materials, shall be placed in waters of the state, except as authorized by a section 404 permit and/or Aquatic Resource Alteration Permit.
b) Off-site vehicle tracking of sediments and the generation of dust shall be minimized. A stabilized construction access (a point of entrance/exit to a construction site) shall be described and implemented, as needed, to reduce the tracking of mud and dirt onto public roads by construction vehicles.
c) For installation of any waste disposal systems on site, or sanitary sewer or septic system, the SWPPP shall provide for the necessary sediment controls. Permittees must also comply with applicable state and/or local waste disposal, sanitary sewer or septic system regulations for such systems to the extent these are located within the permitted area.
d) The SWPPP shall include a description of construction and waste materials expected to be stored on-site with updates as appropriate. The SWPPP shall also include a description of controls used to reduce pollutants from materials stored on site, including storage practices to minimize exposure of the materials to storm water, and spill prevention and response.
e) A description of storm water sources from areas other than construction and a description of controls and measures that will be implemented at those sites.

A description of measures necessary to prevent “taking” of legally protected state or federal listed threatened or endangered aquatic fauna and/or critical habitat (if applicable). The permittee must describe and implement such measures to maintain eligibility for coverage under this permit.

TN0080314.DOC

RATIONALE

Ft. Campbell
NPDES PERMIT NO. TN0080314
Clarksville, Montgomery County, Tennessee

Permit Writer: Jim McAdoo

A. DISCHARGER

Ft. Campbell
2nd Brigade Combat Team Complex
Clarksville, Montgomery County, Tennessee

Official Contact Person:
Mr. Dan Etson
Fort Campbell Water Progam Manager
Fort Campbell, KY
270-798-9784

Nature of Business:
Phased construction of barracks, motor pools, cafeteria, administration and other buildings

SIC Code(s):	**1542 - General Contractors – Nonresidential Buildings, Other Than Industrial Buildings and Warehouses**
Industrial Classification:	**Secondary without ELG**
Discharger Rating:	**Minor**

B. PERMIT STATUS

Application for permit received December 13, 2007

Watershed Scheduling

Environmental Field Office: Nashville
Primary Longitude: -87.46666 Primary Latitude: 35.6000
Hydrocode: 5130206 Watershed Group: 4
Watershed Identification: Red River
Target Reissuance Year: 2009

C. FACILITY DISCHARGES AND RECEIVING WATERS

Ft. Campbell proposes to construct, in phases over the next six years, the 2nd Brigade Combat Team Complex on a 183 acre site of the105,000 acres facility. Four phases of the expansion are planned be begin simultaneously in 2008 with the remaining phases started between 2009 an 2012. Storm water discharges from all the phases, outfalls SW1 through SW516, would go into wet weather conveyances to Fletcher's Fork and Little West Fork Creeks. Appendix 1 summarizes discharges and the receiving stream information.

D. APPLICABLE EFFLUENT LIMITATIONS GUIDELINES

There are no effluent guidelines for the discharges from this operation. Standards of performance are therefore established in accordance with existing state regulations using available treatability information.

E. PREVIOUS PERMIT LIMITS AND MONITORING REQUIREMENTS

Because this is a new permit application, no previous permit limits are available.

F. HISTORICAL MONITORING AND INSPECTION

Because this is a new permit application, there are no histrorical monitoring or inspection records.

G. NEW PERMIT LIMITS AND MONITORING REQUIREMENTS

The proposed new permit limits have been selected by determining a technology-based limit and evaluating if that limit protects the water quality of the receiving stream. If the technology-based limit would cause violations of water quality, the water quality-based limit is chosen. The technology-based limit is determined from EPA effluent limitations guidelines if applicable (see Part IV); or from State of Tennessee maximum effluent limits for effluent limited segments per Rule 1200-4-5-.08; or by way of operational and/or treatability data. Furthermore, effluent limitations in this permit must comply with any approved Total Maximum Daily Load (TMDL) studies. Appendix 2 lists all proposed effluent limitations and monitoring requirements to be included in the new permit.

The storm water discharges associated this activities are defined in 40 CFR 122.26(b)(14) construction category (x). Effluent limitations for storm water outfalls SW1 through SW16 will represent only wet weather discharges from this site. Dry weather discharges are not authorized by this permit. The definition of wet weather flow can be found in Part I, Section C of this permit.

Outfalls SW1 thur SW16

Monitoring of flow quantifies the load of pollutants to the stream. Flow shall be reported in Million Gallons per Day (MGD) and monitored at the time of sample collection.

Storm water runoff parameters to be monitored and reported were determined by reviewing the Tennessee Storm Water Multi-Sector General Permit for Industrial Activities (TMSP) and the Storm Water Discharges Associated with Construction Activities NPDES permit (CGP).

There are no effluent guidelines for storm water discharges from the Ft. Campbell facility. The new permit will not establish effluent limitations, but will require reporting of effluent characteristics for storm water outfalls SW1 through SW16. Nevertheless, certain "Benchmarks" will be established for each of the monitored parameters.

The division is not assigning limits for these parameters at this time since it is the intent of the division that the permittee institutes a Storm Water Pollution Prevention Plan (SWPPP) in order to minimize the discharge of these pollutants from storm water outfalls. It is the opinion of the division that the best method for dealing with potential pollution associated with storm water discharges from the Ft. Campbell facility is through implementation of an aggressive SWPPP, coupled with discharge monitoring to verify SWPPP effectiveness. Monitoring of storm water runoff from storm water outfalls will be required for Flow, Total Suspended Solids (TSS), and pH. In order to assist the permittee in the evaluation of the effectiveness of the SWPPP, benchmark values developed are provided.

Parameters of Concern	Benchmark
Flow	
Total Suspended Solids (TSS)	***150 mg/L***
pH (range)	***6.0 - 9.0***

Generally, for storm water runoff samples, a grab sample is considered adequate for effluents from holding ponds or other impoundments with a retention period of greater than 24-hours (Instructions - EPA Form 3510-2F: Application for Permit to Discharge Storm Water Associated with Industrial Activity, Item VII, General Instructions, Page I-3).

The division recognizes that a "first flush" sample would be the most accurate representation of the maximum daily value for various pollutants in the storm water runoff. Furthermore, storm water sampling requirements included in the Tennessee Multi-Sector General Permit require analysis of grab samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed one hour) of when the runoff or snowmelt begins discharging. Every effort should be made to collect a "first flush" sample representative of the daily maximum values for sampled parameters.

The new permit will contain a Storm Water Pollution Prevention Plan (SWPPP) developed to regulate storm water runoff. This SWPPP is meant to ensure that runoff from the site is not a significant source of pollution to the receiving stream. The discharger will develop, document and maintain the SWPPP. The effectiveness of this SWPPP will be investigated after the results of the storm water runoff monitoring have been submitted. At that time, should the results so dictate, the division maintains the authority to institute specific numeric limitations for the monitored parameters.

H. ANTIDEGRADATION

Tennessee's Antidegradation Statement is found in the Rules of the Tennessee Department of Environment and Conservation, Chapter 1200-4-3-.06 and in consideration of the department's directive in attaining the greatest degree of effluent reduction achievable in municipal, industrial, and other wastes, the permittee shall further be required, pursuant to the terms and conditions of this permit, to comply with the effluent limitations and schedules of compliance required to implement applicable water quality standards, to comply with a State Water Quality Plan or other State or Federal laws or regulations, or where practicable, to comply with a standard permitting no discharge of pollutants. This statement outlines the criteria for the Exceptional Tennessee Waters and Outstanding National Resource Waters (ONRWs), as designated by the Water Quality Control Board. Other surface waters not specifically identified and/or designated as either Exceptional Tennessee Waters or ONRWs are evaluated on the basis of 1200-4-3-.06(2) and (3) and are referred to as waters with either unavailable conditions or available conditions. Waters with unavailable conditions may be identified by the division as not meeting existing criteria and appears on a list of impacted waters per Section 303(d) of the Clean Water Act.

The division has not made a stream tier determination of the receiving waters associated with the subject discharge(s). Additionally, this water is fully supporting its designated uses. The department has maintained, and shall continue to assess, the water quality of the stream to assure that the water quality is adequate to protect the existing uses of the stream fully, and to assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for non-point source control.

I. PERMIT DURATION

The proposed limitations meet the requirements of Section 301(b)(2)(A), (C), (D), (E), and (F) of the Clean Water Act as amended. It is the intent of the division to organize the future issuance and expiration of this particular permit such that other permits located in the same watershed and group within the State of Tennessee will be set for issuance and expiration at the same time. In order to meet the target reissuance date for the watershed and following the directives for the Watershed Management Program initiated in January, 1996, the permit will be issued for a 5 year term.

APPENDIX 1

FACILITY DISCHARGES AND RECEIVING WATERS

FACILITY DISCHARGES AND RECEIVING WATERS

OUTFALLS SW1-16	
LONGITUDE	LATITUDE
-87.466	35.6

RECEIVING STREAM DISCHARGE ROUTE
Little West Fork Crrek

FLOW (MGD)	DISCHARGE SOURCE
Variable	Storm water runoff
0.0000	TOTAL DISCHARGE

STREAM LOW FLOW (CFS) *	7Q10	1Q10	30Q5
	8.6	7.6	8.0
(MGD)	5.6	4.9	5.2

STREAM USE CLASSIFICATIONS (WATER QUALITY)				
AQUATIC LIFE	RECREATION	IRRIGATION	LIVESTOCK & WILDLIFE	DOMESTIC WATER SUPPLY
X	X	X	X	X
INDUSTRIAL	NAVIGATION			
X	X			

Treatment: Chemical oxidation, chemical precipitation, sedimentation,aerated lagoons, flocculation, ammonia stripping

* Reference: Flow Duration and Low Flows of Tennessee Streams through 1992 by George S. Law and Jess D. Weaver. Water Resources Investigations Report 95-4293 prepared by the U.S. Geological Survey in Cooperation with the Tennessee Department of Environment and Conservation and the Tennessee Valley Authority. Nashville, Tennessee, 1996, p. 66.

The following table lists the storm water outfalls with the project phases.

Outfall	Project Number	Construction Year
1	68783	2008
2	64903, 61055	2008, 2012
3	64903, 58511, 61055	2008, 2011, 2012
4	64903, 58511	2008, 2011
5	64903, 58511	2008, 2011
6	64903, 58511	2008, 2011
7	64903	2008
8	65147	2008
9	65147 (1)	2008
10	65147 (1)	2008
11	65147 (1)	2008
12	65147 (1)	2008
13	65147	2008
14	68877, 58511	2008, 2011
15	Phase 3	2008
16	Phase 4	2011

(1) This project may not impact this outfall.

APPENDIX 2

NEW PERMIT GUIDELINES AND MONITORING REQUIREMENTS

PERMIT

For outfalls SW1 through SW16

EFFLUENT CHARACTERISTIC	EFFLUENT GUDIELINES				MONITORING REQUIREMENTS	
	MONTHLY		DAILY			
	AVG. CONC. (mg/l)	AVG. AMNT. (lb/day)	MAX. CONC. (mg/l)	MAX. AMNT. (lb/day)	MSRMNT. FRQNCY.	SAMPLE TYPE
FLOW	Report (MGD) *		Report (MGD) *		Semi-annually	Estimate
pH**	Range 6.0 - 9.0				Semi-annually	Grab
FLOATING MATERIAL, COLOR, FOAM OR OIL SHEEN	REPORT				Semi-annually	Visual
TOTAL SUSPENDED SOLIDS (TSS)	--	--	150.0	--	Semi-annually	Grab

(1) Only storm water outfalls from active construction sites will be sampled during this permit
* Flow shall be reported in Million Gallons per Day (MGD).
** pH analyses shall be performed within fifteen (15) minutes of sample collection.

APPENDIX DD

FORT CAMPBELL
LOCKING DEVICES

SECTION 08700
Hardware

Ft. Campbell Requirements:

Fort Campbell utilizes an "*I/C - 7 pin Insta-Key*" integrated master keying system. Interchangeable cores provided shall be compatible with the existing "*I/C - 7 pin Insta-Key*" system. The *I/C - 7 pin Insta-Key* lock system is the standard lock system for Troop housing. Combination locks used in secured areas shall be Mass Hamilton X09 type. The "*I/C - 7 pin Insta-Key*" system is *also* encouraged for all other building types. Biting list is to be added to keying schedule. Four blank keys are to be provided with each change key.

Electric locks shall be stand alone Best BASIS “G” system with encoders and kiosh as required (See Attachment at end of this section for ording data). All key over-rides - see Insta-Key above..

Prefer knobs instead of levers except where ADA access is required.

Panic device hardware shall be touch pad type.

Install kickplates on doors in heavy use areas.

Concealed door closers shall not be avoided without prior DPW approval.

Require door stops at all interior and exterior locations.

Use and specify Hasp and Pad locks on exterior doors to mechanical/ electrical rooms.

Electrical Pad-mounted Transformer locks shall be included in the contract.

Furniture locks are repaired/replaced on case by case basis by the Ft. Campbell Lockmaster. No standardization of furniture locks is possible.

Instructions to Designers:

1. Modify specifications paragraphs to include each of the above features as they apply to the project.

2. The Installation POC regarding keys is Mr. Ayers (270) 798-3581.

STANLEY Pete Graham
Security Systems Sales — Louisville, KY
Stanley Security Solutions, Inc
May 6, 2007 Best Access Systems
Fort Campbell 11947 Cumberland Rd.
Attn: Bob Ayers Fishers, IN 46037
16th & Bastogne Cell 5024397115 Fax 502 326 4245
Fort Campbell, KY pgraham@stanleyworks.com
www.bestaccess.com
127-000994IL

Ref: Basis G Electronic Locksets

Bob,

The following is the list of part numbers for the battery operated electronic Jocksets for the barrack doors. All locks are designed for standard 1-3/4" thick doors.

The locks can use the government issued I.D. card. These locks will use track 3 of the magnetic stripe.

Barrack Doors - These are the (3) types of magnetic stripe card readers with lever handle trim.

Cylindrical — 93KG7DVI5MS-S3-626

Mortise - 45HG7DV

Exit Device — EXG7EV1 5MS-626-HAND-MANUF.-TYPE

Example: EXG7EV1 5MS-626-RHR-PH2-RM
Specify one each of the following Manuf. and Type in part number above for exit device trim:

MANUF.- Precision — PHI or PH2
Von Duprin 99 — VD9
Sargent 8000 — SA8 — only available for rim device
TYPE-Rim -RM
Mortise - MO
Vertical Rod VR

The manufacturers the devices through bolt to are Precision 1000 or 2000 series, Von Duprin 99 series or Sargent 8000 series. These will work with either rim, mortise, surface or concealed vertical rod devices. The exit device trim will work with either the night latch or classroom function devices.

Attachment Page 1/2

The programming equipment for the locksets and for encoding your 1.0. cards, you will need the following parts:

Basis G - BAS-SWS-G - for server - Programming Software

- BAS-SWC-G — for each additional user location — Programming Software

- BASD-CAB - Programming Cable, connects to lockset

- VPD-T15 - Driver Bit, for battery compartment

- VPD-CLN - Magnetic stripe reader cleaning cards (bx 50)

- BASD-MSE- Magnetic stripe card encoder and software

- HP-PDA - PDA programming device

- HP-PDA-CAB- PDA programming cable - connects to BASD-CAB.

- VPD-BB - Replacement battery pack for Basis G lock.

The Kiosk Station allows for a user to obtain a temporary card after hours until a new permanent ID card is re-issued.

BASD - ID Express Station — Kiosk

BASD - IDEXPRESS-SWS - Kiosk Software

VPA-PVC - Magnetic stripe cards, non-encoded (bx 500)

Once you have the software set up you can add any amount of locks to the system. Locks do not have to be re-programmed to handle lost cards or room changes.

* For high traffic exterior and common doors you will want to hardwire the access control devices such as panic bars, locksets, electric strikes, etc. and use the Basis ET605 System to integrate the Basis G database.

APPENDIX EE

CONCRETE GRINDING REQUIREMENTS

CONTRACT SPECIFICATIONS

The Contractor will be required to perform on-site grinding of one hundred percent (100 %) of any concrete, asphalt and masonry materials (hereafter "ground concrete") generated at any project that produces greater than twenty (20) cubic yards of concrete. The Contractor must use as much ground concrete as possible on-site at the project location,* thereafter delivering any remaining ground concrete to a designated storage area located in the rear area of the installation. All ground concrete used on-site at the project location must be approved by the Contracting Officer for use at the project location.

The Contractor will be required to crush the concrete into three (3) sizes and dump each load of ground concrete into the appropriate-sized pile as follows:

1. 6" minus – 2" minimum rip rap;
2. 2" minus – 1" minimum gravel; and
3. 1" minus crusher run.

Please note that all delivered ground concrete shall be placed in piles according to size of ground product – NO EXCEPTIONS.

At this time, the designated storage site will only be used for one construction/demolition project. The Contractor shall prepare the area selected for the ground concrete storage site and then construct a fence around the area to enable site management and stockpile maintenance. The fenced area shall also have a locking gate, and the Contractor and the Corps of Engineers will monitor quality control and quality assurance to ensure that, prior to the dumping of any loads of ground concrete:

1. Metals and steel rebar have been removed from the concrete;
2. The concrete has not been contaminated with trash or other materials prior to delivery; and
3. The area is not used as a dumping ground for other wastes.

The Contractor COR and DPW Environmental Division, Pollution Prevention Branch, will require a QC signature of quality of ground concrete, to include the approximate amount of metals in the ground product and size (grade) of the ground product.

The Contractor will be responsible for removing and recycling any metals, including reinforcing steel, from the concrete. All metals will become the property of the Contractor for salvaging/recycling. Weights of any metals recycled are to be reported to personnel at DPW Environmental Division, Pollution Prevention Branch.

Contractor is also to provide the size and quantity of ground concrete generated at the project location to personnel at DPW Environmental Division, Pollution Prevention Branch.

The stockpiled ground concrete shall be used within one year.

DPW Environmental will select the storage location and will have use of any of the ground concrete located at the site. DPW Roads & Grounds will also have access to the ground concrete and the storage area. If it is found that the materials are not being utilized quickly enough to use up within one year's time, other contractors may be permitted to obtain materials from the storage area.

The Environmental Division will obtain any permits applicable to this requirement, including a Storm Water Pollution Prevention Plan, as well as ensure that any permits and environmental controls are monitored for compliance. The Environmental Division will furnish the specifications for grinding concrete.

The success of the project will determine if the storage site will be used for another project or be restored to its previous condition. If it is determined that it will be restored to its previous condition, this will be the responsibility of the Contractor to finalize. At the completion of the project, the fenced site and the fence shall become the property of Range Control.

* Please note that ground concrete may also be used on site as substrate placed under constructed Green Spaces following excavation at the project location, thereby reducing the quantity of stockpiled ground concrete, reusing the ground concrete, and enhancing soil drainage, subject to approval by the Contracting Officer.

APPENDIX FF

RADON REDUCTION GUIDELINES

U.S. ARMY RADON REDUCTION PROGRAM GUIDEBOOK

FOR

FT CAMPBELL

OPEN FILE REPORT

Prepared for
U.S. ARMY FT. CAMPBELL
Environmental Division
Fort Campbell, Kentucky

Prepared by
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831-6283
managed by
UT-BATTELLE, LLC
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-00OR22725

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ABBREVIATIONS

ACH	air change rate
AR	Army Regulation
ARRP	Army Radon Reduction Program
ASD	active soil depressurization
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ATD	alpha track detector
BEIR	Biological Effects of Ionizing Radiation (Committee on)
CA	charcoal absorption
cfm	cubic foot per minute
CIAQ	Federal Interagency Committee on Indoor Air Quality
COE	Corps of Engineers (U.S. Army)
CRM	continuous radon monitor
DA	U.S. Department of the Army
DODDS	Department of Defense Dependent Schools
DOE	U.S. Department of Energy
DP	differential pressure
EACM	episodic air change measurement
EPA	U.S. Environmental Protection Agency
ER	equilibrium ratio
ERV	energy recovery ventilation
FAS	forced air system
HEPA	high-efficiency particulate air
IRAA	Indoor Radon Abatement Act
KART	karst assisted radon transport
LFE	lateral field extension
LLD	lower level of detection
MMM	multimedia migration
MSDS	Material Safety Data Sheet
NEHA	National Environmental Health Association
NRSB	National Radon Safety Board
O&M	operation and maintenance
OMA	Operation and Maintenance Army
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
PFET	pressure field extension test
PQL	practical quantization limit
PWBC	Public Works Business Center
QA/QC	quality assurance/quality control
RAC	relative air change
RDP	radon decay product
REP	radon entry pathway
RMCO	radon management control officer (U.S. Army)
RPD	relative percent difference
RRNC	radon resistant new construction

SAM	supplemental air makeup
SMD	submembrane depressurization
SP	shell pressurization
SPT	subslab permeability test
SSD	subslab depressurization
UFC	Unified Facilities Guide Specification
USAEHA	U.S. Army Environmental Hygiene Agency
USGS	U.S. Geological Survey
WHO	World Health Organization
WL	working level
WLM	working level month

DEFINITIONS AND TERMS

assessment: The testing of all ground-contact rooms.

blank: A radon detector that is returned to the laboratory unexposed in order to measure the background of the device.

closed building conditions: During the radon test, the unit's windows and exterior doors are closed except for routine entrances and exits.

collocated: Radon test devices that are placed within 12 in. of each other during a simultaneous measurement.

duplicate: Radon measurements that are performed using two radon testing devices at the same time.

mitigation: The corrective action taken in buildings or rooms that have been found to have radon levels ≥4 pCi/L.

normal testing conditions: The building is occupied, and the building's mechanical systems (e.g., heating and cooling systems) are operating under typical seasonal conditions.

picocurie per liter (pCi/L): A common unit of measurement of the concentration of radioactivity in a fluid (liquid or gas). A picocurie per liter corresponds to 0.037 radioactive disintegrations per second in every liter of fluid. For radon testing purposes, pCi/L is the unit of measure of radon gas. EPA and NAVRAMP have set an action level of 4 pCi/L.

picocurie per liter per day (pCi/L-day): A measure of the detector dose; 1 pCi/L-day is the dose a detector receives if it is exposed to 1 pCi/L for 1 day.

screening: Radon testing in a representative statistical subset of rooms in a building.

spike: A radon detector exposed at a laboratory to a known radon concentration. When used in conjunction with field-testing, spikes measure the accuracy of the survey radon results.

radon: A naturally occurring, odorless, colorless, radioactive gas caused by the breakdown of uranium. Studies have shown that many years of exposure to elevated indoor levels of radon increase the risk of contracting lung cancer.

renovation: Repairs or upgrades that have an impact on the radon level within a building or room.

test type: A two letter code assigned to a specific radon measurement to document the reason why the radon test was performed.

INTRODUCTION

This project was conducted in support of the Environmental Division under U.S. Department of Energy (DOE) Proposal 2211-T234-06 for the performance of radon testing and mitigation for the U.S. Army at Ft Campbell, Kentucky. DOE tasked the Oak Ridge National Laboratory (ORNL) to aid with the implementation and management of this agreement.

The purpose of this document is to summarize current radon policy for Ft Campbell and to provide guidance for the implementation of radon resistant new construction, radon testing, mitigation, and radon system maintenance activities within Operation and Maintenance Army (OMA) buildings located at Ft Campbell, Kentucky.
In addition, where needed, the document also contains sections that document the rationale behind certain policy decisions. Therefore, this document should be used as the primary reference for all radon activities at Ft Campbell. By design, the document is structured in an open file format that allows for the insertion of new sections and the revision of existing ones without changing or restructuring the entire report. The revision date of each section is included in its heading.

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1. BACKGROUND AND REFERENCE INFORMATION
Revision Date: October 22, 2009

1.1 OVERVIEW OF RADON GAS

Radon is a naturally occurring, odorless, colorless, radioactive gas caused by the breakdown of uranium (Fig. 1.1). Because uranium is a common substituent found in soil and rock matrixes throughout the world (on average about 3 g of natural uranium per ton), detectable quantities of radon can be measured everywhere. However, within certain rock formations (limestone, granite, shale, phosphate, and pitchblende), higher levels of uranium and its decay product radon are present. When radon is generated, it immediately begins diffusing toward the surface. In the outdoors, radon rarely reaches concentrations of concern; however, within enclosed spaces, such as buildings, radon can accumulate to levels in excess of federally mandated exposure limits for radiation workers. Because these geological formations are fairly common within the United States, measurable quantities of radon have been detected and reported in all 50 states (Fig. 1.2). In fact, the U.S. Environmental Protection Agency (EPA) has estimated that 1 in every 15 homes has elevated radon levels (*A Citizen's Guide to Radon, Fourth Edition*, June 2001). Because of the prevalence of indoor elevated radon, radon exposure represents over half of the average annual radiation exposure for the typical U.S. citizen (Fig. 1.3).

In the early 1980s little was understood about the mechanisms of radon transport and its retention inside buildings. The key assumption at that time was that for a building to have an indoor radon problem, a significant uranium source needed to be close at hand. It was postulated, therefore, that a radiological potential map showing uranium deposits would greatly assist in identifying areas of the United States that would require radon testing. Limited studies conducted in Colorado and Pennsylvania in the mid 1980s tended to support this hypothesis. However, these studies were performed mostly in areas with high levels of uranium covered with medium to highly permeable soils. Because of this assumed correlation between geology and radon potential, the *Indoor Radon Abatement Act of 1988* (IRAA) directed the EPA to identify areas of the United States and its territories that have the potential to produce harmful levels of indoor radon (Public Law 100-551, TSCA Sections 307 and 309 in Title III of the *Toxic Substances Control Act of 1988*). These characterizations were to be based on both geological data and indoor radon levels in homes and other structures. To assist with the geological requirements of the law, EPA entered into an Interagency Agreement with the U.S. Geological Survey (USGS). From 1989 through 1992, EPA and USGS reviewed existing radiological maps, performed radon and geological surveys, and summarized all available radon data sets. The culmination of this effort was the publication in 1993 of the first EPA Map of Radon Zones (a more recent updated edition of the map is shown in Fig. 1.2). Concurrent with the release of EPA's radon potential map, USGS began publishing a series of open-file reports (series 93–292) that provided more geological detail for each of the EPA regions. Subsequent updates of the map and open-file reports in later years

included U.S. Territories and Commonwealths (e.g., Puerto Rico, Guam, American Samoa, and the Virgin Islands).

However, while reviewing and compiling the data for the radon potential map, EPA and USGS identified buildings with elevated levels of radon in areas that had only trace levels of uranium, thorium, and radium in the underlying soil and geology. In addition, some areas that were known radiological "hot spots" exhibited a significantly lower than expected percentage of buildings with elevated radon. After further review and study, the conclusion was reached that the geologic radon potential was only part of predicting radon levels in a particular area. Factors such as the type and state of the geological formation (e.g., solid, layered, or fractured), local building codes, soil moisture content, depth and permeability, and weather all played a contributing role. Therefore, in 1993, the EPA and USGS included with the release of the radon potential map a disclaimer that the map should not be used as an indicator whether to test and recommended that all homes should be tested regardless of geographic location.

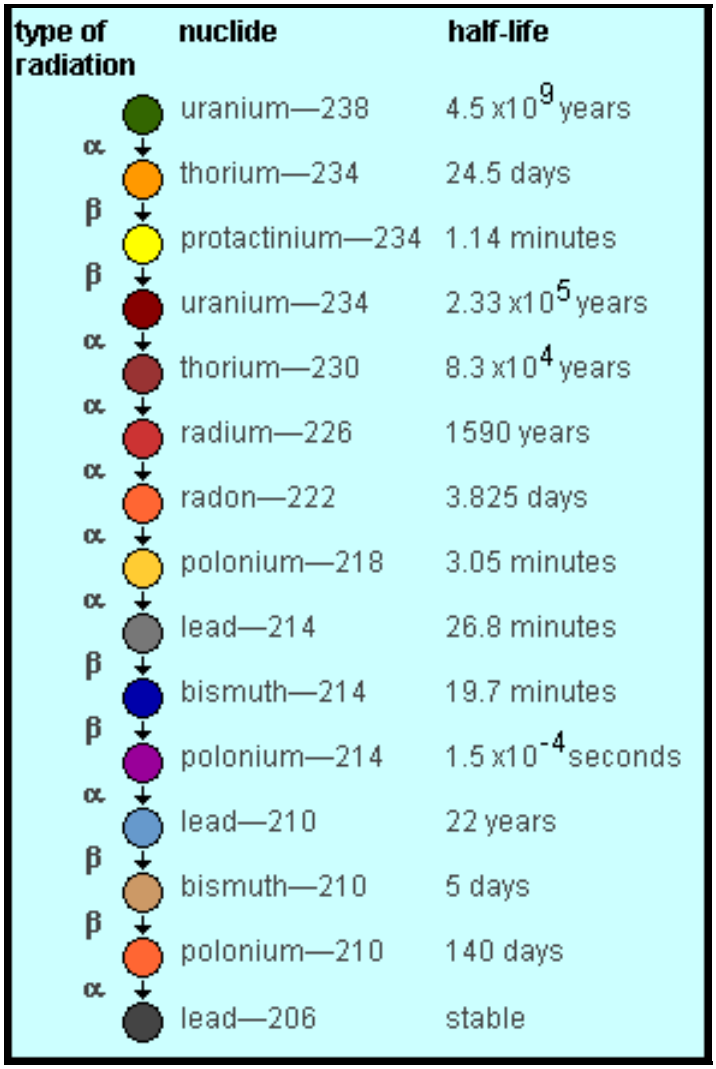


Fig. 1.1. The uranium decay series.

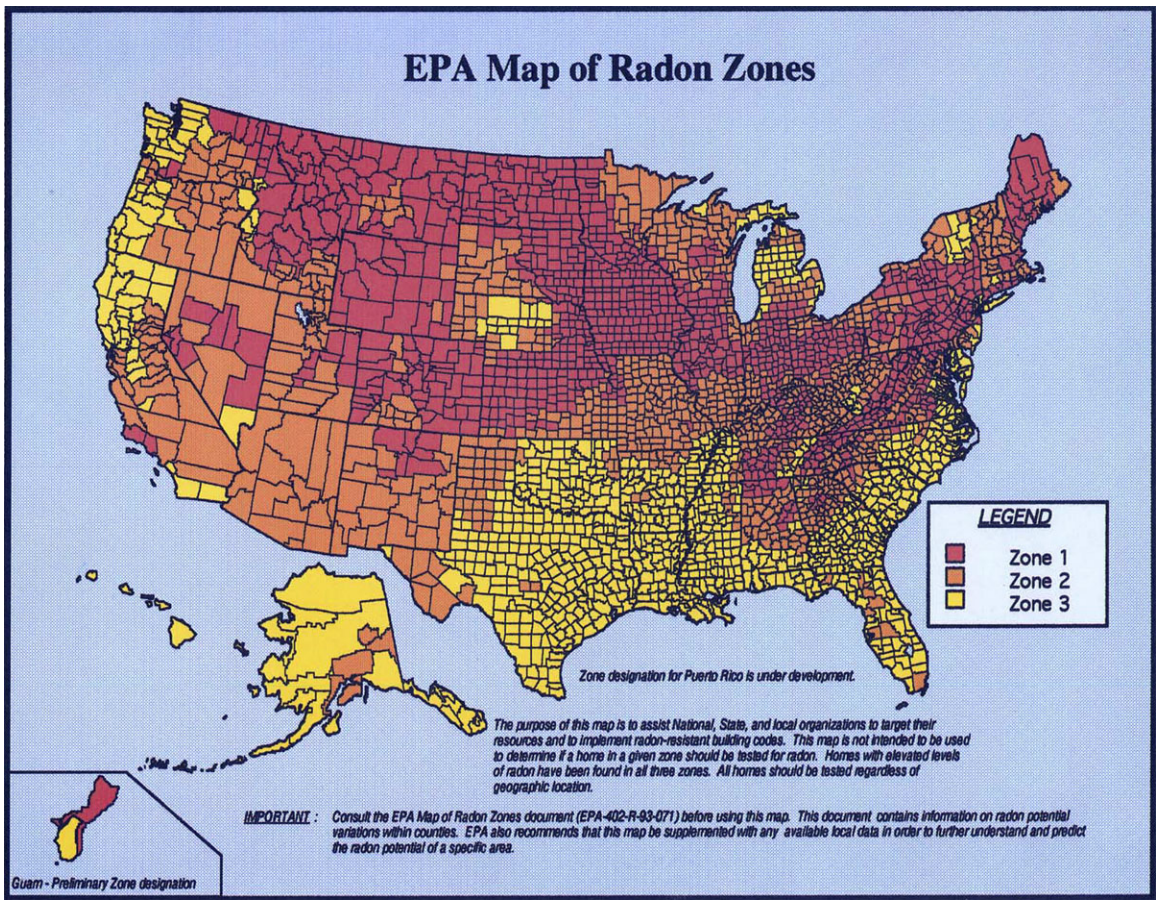


Fig. 1.2. U.S. radon potential map.

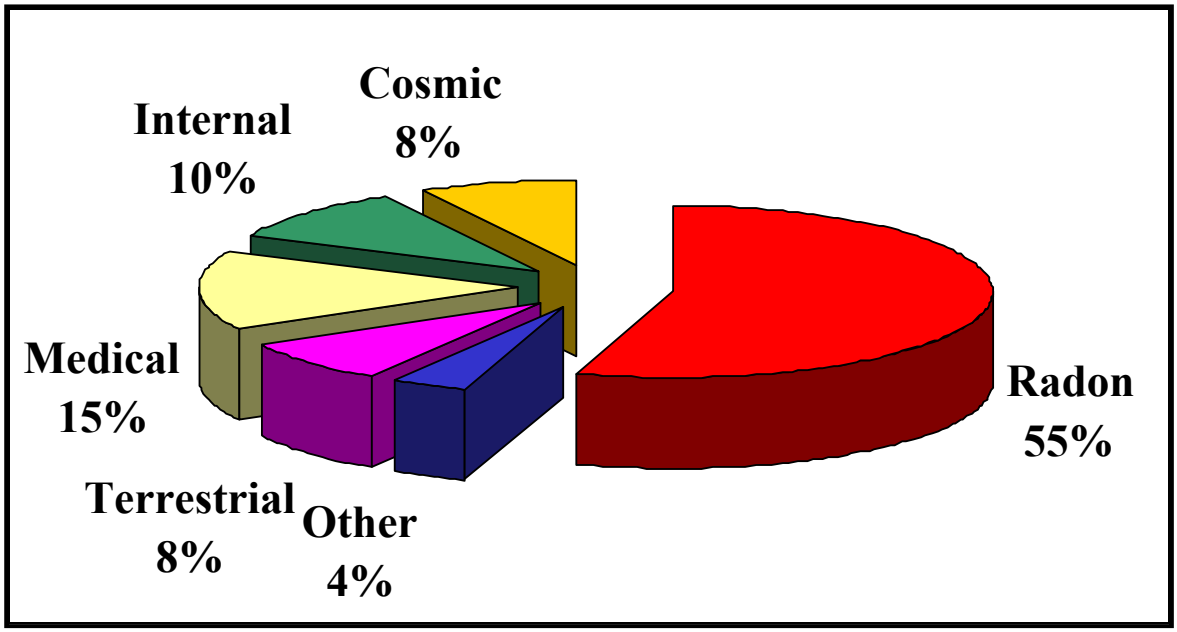


Fig. 1.3. Sources of radiation exposure for the average U.S. citizen.

1.1.1 The Radon Decay Series

Radon, the only gas in the uranium decay series, has a radioactive half-life of 3.82 days. The subsequent radioactive decay products, more commonly referred to as radon progeny, consist of four short-lived radon progeny [polonium-218 (^{218}Po), lead-214 (^{214}Pb), bismuth-214 (^{214}Bi), and polonium-214 (^{214}Po) (Fig. 1.4)] and three long-lived radon progeny [lead-210 (^{210}Pb), bismuth-210 (^{210}Bi), and polonium-210 (^{210}Po)]. Of these seven progeny, typically only the short-lived progeny are considered a health risk. Unlike radon, which is chemically inert, radon progeny are chemically reactive metals that can attach to walls, floors, and airborne particles, or combine with water vapor and other gases in the air. The portion of the radon progeny attached to particles in the ambient atmosphere is called the *attached fraction,* whereas *unattached fraction* refers to suspended individual atoms or ultrafine particle clusters. Radon progeny that attach to walls or other surfaces are considered to be "plated out" and therefore removed from the air and can no longer be inhaled. When the short-lived radon progeny are inhaled, a portion of them can attach to the lining on the bronchioles of the lung. Because of their short half-lives, the lung cannot clear itself of these materials before they undergo radioactive decay. Of particular importance are polonium-218 and polonium-214, which emit highly energetic alpha particles. These alpha particles can strike sensitive cells in the bronchial tissue and cause damage that could lead to lung cancer. It is these two polonium radionuclides that produce the bulk of the radiation dose to the lung and create the greatest source of risk of lung cancer from exposure to radon and radon progeny.

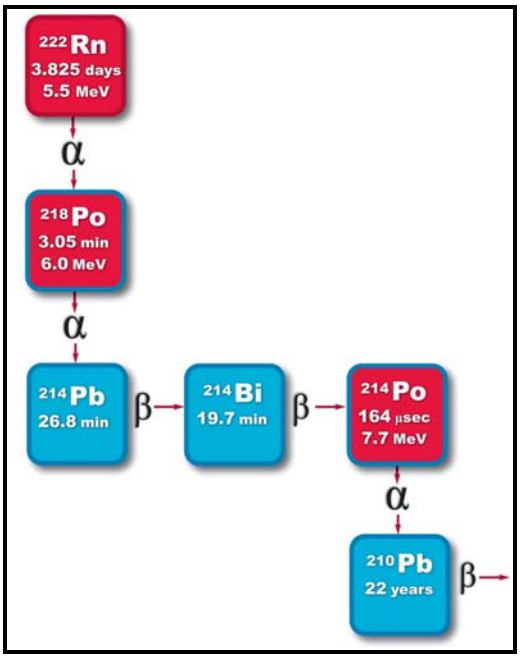


Fig. 1.4. Abbreviated radon decay series.

1.1.2 Radon Emanation in Rock and Soil

Radon is a naturally occurring, odorless, colorless, radioactive gas caused by the breakdown of uranium. In nature, uranium is found in varying amounts throughout the earth's crust, primarily in the mineral form of tyuyamunite [$Ca(UO_2)_2(VO_4)_2 \cdot 6(H_2O)$]. However, certain rock formations—primarily light-colored volcanic rocks, granites, dark shales, sedimentary rocks that contain phosphate, and metamorphic rocks derived from these rocks—contain higher than average uranium content (e.g., >3 ppm of natural uranium per ton). Because soil is essentially weathered rock mixed with organic matter, tyuyamunite is also found in soil at the same concentration as in the rock from which the soil was derived.

Because radon is a gas, it has much greater mobility than uranium and radium, which are fixed in the solid matrix of rocks and soils. However, for radon to be a concern, it has to migrate (diffuse or flow) from the rock or soil and become entrapped within a building. The term "radon emanation efficiency" refers to the overall ease with which radon moves from its natural matrix into the environment by a diffusion and/or flow mechanism. This efficiency is dependent upon the density of the matrix, the degree of fracture, the size of the pore spaces between the grains, and the moisture content. In addition, the efficiency is also time-sensitive, because the most common isotope of indoor radon (radon-222) has a relatively short half-life of 3.8 days. Therefore, in most cases, if radon is going to make a measurable contribution to the indoor levels, it must escape from the matrix and enter the building within less than 5 half-lives (*Relationships Between Geology, Equivalent Uranium Concentration, and Radon in Soil Gas, Fairfax County, Virginia,* USGS Report 1988-18). If radon is generated within a dense rock with minimal pore size, at most it could migrate only a few centimeters (Tanner 1964). Therefore, in this type of rock, only radon generated within the top few centimeters of the surface could escape and potentially migrate into a building. Conversely, if the rock has a low density and a large pore size and is fractured, the migration of radon can be on the order of hundreds or thousands of feet (Akerblom 1984, Sextro 1987, and Wilson 1991).

Regardless of the primary source of radon (e.g., rock or soil grain), before radon can enter a building, it usually must past through a layer of soil. The method (e.g., flow or diffusion) and speed of radon's movement through soils are controlled by the amount of water present in the pore space (the soil moisture content), the percentage of pore space in the soil (the porosity), and the interconnectedness of the pore spaces, which determines the soil's ability to transmit water and air (USGS, Otton 1992). The term *soil permeability* refers to the overall air flow characteristics of a particular soil and is an indicator of the relative ease with which radon moves from its natural matrix into the environment by a diffusion and/or flow mechanism. As with radon transport through rock, extremely dense, nonporous soils (e.g., low-permeability soils, <1.5 cm/h) can significantly reduce the amount of radon available for incorporation into a building. Likewise, if radon is able to move easily in the pore space (e.g., high-permeability soils,

>15 cm/h), then it can travel a greater distance before it decays, and it is more likely to collect in high concentrations inside a building (Nagada 1994 and USGS, Otton 1992).

In summary, the presence of high levels of uranium in the soil and/or rock is not the sole precursor of elevated indoor radon potential. Radon must first emanate from the rock or soil grain and find a pathway through the soil to the building. In dense rock and nonporous compacted soils, the reservoir of radon available for transport into a building can be limited to just the first few inches of rock and/or soil under a building. However, in high-emanation-efficiency rock and/or soil matrixes in contact with a permeable soil, even negligible levels of uranium can produce a high soil gas concentration.

1.1.3 Behavior of Indoor Radon Concentrations

Radon, a gas at ambient temperatures and pressures, migrates from the surrounding soil into buildings through cracks in concrete slabs and basement foundation blocks and through air spaces around pipes. It can also collect in crawl spaces and then flow into living and work areas. The flow of radon into the living area of a building is caused by both natural diffusion and pressure-assisted flow. However, natural diffusion usually contributes only a small amount of radon within a building; in most cases, radon above ambient levels can be attributed to pressure-assisted flow.

The process of pressure-assisted flow can be either natural or man-made. The rising and exiting of warm air within a building causes natural pressure-assisted flow or thermal stack effect. As warm air rises, makeup air is pulled into the building through slab and wall imperfections. If the imperfections are in contact with soil, the building radon concentration increases. Man-made enhancement of radon entry is primarily the result of slight negative pressure created by the operation of a furnace, air-conditioning system, ventilation fan, or clothes dryer. Episodic weather conditions, such as wind and rain, can also induce transient increases in the building radon level.

The physics of radon transport and retention in a building are very complex. The radon source term is the total quantity of radon entering the structure per unit of time (pCi/h). Studies by EPA and DOE have identified more than ten variables that contribute to the source term (e.g., radium content of the soil, emanation efficiency of the soil matrix, soil permeability, various temperatures, shell and subslab pressures). After radon has entered a structure, many other variables either enhance or dilute it. The term relative air change (RAC) refers to the rate at which outdoor air infiltrates into the building shell and inside air is exhausted (because of both natural and man-made causes). Generally speaking, if the radon source term is greater than the RAC, then elevated radon will result. Because of these variables, there is no certain way to predict the radon level of a particular building; the only sure way is to test.

Although radon diffusing through concrete can contribute to the indoor radon level, the main driving force for most buildings is the pressure differential caused by the stack effect (the rising and escape of warm air in a building through the upper floors) and the

negative pressures caused by the operation of mechanical exhaust systems within a building (e.g., clothes dryers, ventilation devices, combustion furnaces). In addition, episodic weather conditions, such as wind and rain, can induce a pressure differential resulting in transient increases in the building radon level.

Although the physics of radon transport into and retention in a building are complex (more than ten variables have been identified to date), it can be approximated as a simple dilution ventilation problem using a source term (pCi/h) into a fixed volume (ft^2), with a known ventilation rate (h-1). Because the volume of a structure is fixed, the equation can be further simplified to demonstrate that elevated radon in a building is strongly linked to the overall ventilation rate of the building, meaning that buildings with high ventilation rates have lower elevated radon potential. Conversely, buildings with lower ventilation rates have higher elevated radon potential. However, the relationship between ventilation rate and radon concentration is not 1 to 1; at a constant source term, halving the ventilation rate doubles the radon concentration (EPA, *Radon Reduction Techniques for Detached Housing*, EPA/625/5-87/017, 1988). This variable, ACH, is a function of how tightly the building was constructed and is regulated by the requirements of local building and energy codes. Nationally, the ACH ranges for residential construction are from 0.25 h^{-1} in colder (e.g., Minnesota) or hot and humid (e.g., Florida) climates to over 1.5 h^{-1} in the temperate tropical areas (e.g., Hawaii). The significance of the relationship between indoor radon levels and a building's ACH is as follows. Assume for a source term that you have 500 pCi/L of soil gas (average for most parts of the United States) under a slab that results in a 2-pCi/L radon level (the approximate indoor national average) for a house with an ACH of 1 h^{-1} (typical for homes built in Hawaii). The same home in Tennessee, under identical conditions but with a typical ACH of 0.5 h^{-1}, would have a radon level of 4 pCi/L. However, if the home were located in the upper Midwest, at a typical ACH of 0.25 h^{-1}, the home would have 8 pCi/L. Therefore, when considering elevated indoor radon potential, in addition to the geological variables found in soil and rock, local building practices must be taken into account.

Unlike other common indoor environmental concerns (e.g. lead-based paint and asbestos), indoor radon concentration can vary significantly from day to day and from season to season. The day-to-day variation in radon concentration is usually caused by episodic weather events such as rain and wind but can also be caused by actions of the building occupants (e.g., leaving doors or windows open, see Fig. 1.5). For these reasons EPA recommends that all short-term testing be performed during normal weather patterns and under closed building conditions. With respect to seasonal variation (e.g., heating vs cooling season), the range observed is dependent upon the geographical region and climate. For example, in the northeast winter radon concentrations are typically 50% higher vs 25% in the southeast. Opinions vary as to why this is observed (e.g., increased stack effect in the winter, prolonged periods of closed building conditions, ground freeze, and snow cover), but most experts agree that it is the combination of many things and not just a single cause. In addition, certain geological features such as Karst topography have also demonstrated the capacity for seasonal variation (Gammage et al., 1992). Because of these day-to-day and seasonal variations, BEIR VI (1998) conceded that although all

exposure to radon increases the risk of contracting lung cancer, the need for corrective action should be based on an integrated 1-year average, not on short-term excursions.

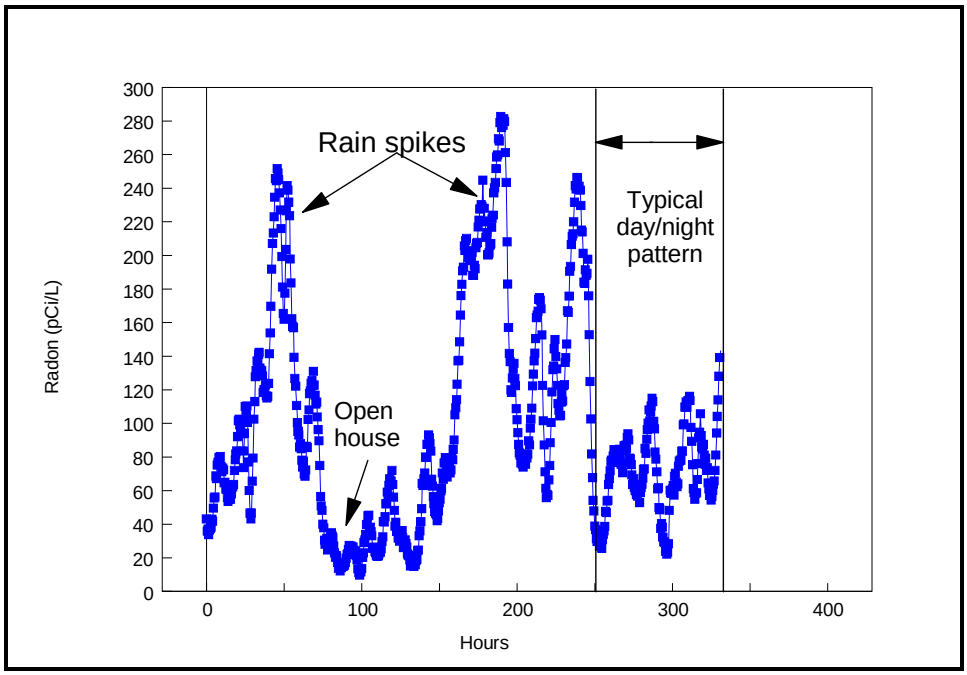


Fig. 1.5. Example of short-duration events on radon concentration.

1.1.4 Distribution of Radon Within nonresidential Buildings

Residential studies by EPA have shown that on the same level, the radon concentration does not vary significantly from room to room in most homes. It is for these reasons that other than recommending that the test be performed on the lowest occupied level, EPA protocols do not specify which rooms to test (EPA 402-R-92-003, May 1993). However, unlike residential buildings, the distribution of radon within nonresidential buildings does vary significantly from room to room. In fact, studies by DOE have found that for buildings >2000 ft^2 with elevated radon, over 95% of the time, only one in four rooms tested positive (Wilson et al 1991.). With respect to using statistical means to estimate the extent of elevated radon potential in large buildings, statistical analysis of large nonresidential data sets (Wilson et al.) has found that over 70% of the time, the elevated result(s) would not have been predicted at a 95% confidence. Further modeling of the radon data, whereby the objective was to predict the presence of one room with elevated radon in a building, found with 95% confidence that 95% of the rooms needed to be tested (DOE, DOE/HWP-96, 1990). It is for all these reasons that EPA recommends the testing of all occupied ground contact rooms in its nonresidential testing protocol (EPA 402-R-92-014, July 1993).

As to why this disparity in room to room concentration occurs, there are many accepted reasons. For one, slabs in nonresidential buildings are larger, meaning a greater volume of radon can accumulate in the fill area under the slab. In addition because of higher load

considerations, large buildings typically have more internal footings and expansion joints per unit area of slab than residential construction. Also, large buildings tend to have more numerous floor penetrations for water, sanitary, electrical, and communications. Another difference is interior design; to prevent the spread of smoke during a fire, floor to ceiling fire walls are typically used throughout the building. This design feature tends to isolate rooms and areas from each other within the building by reducing the natural flow of air from one zone to another. Last but not least is the fact that large buildings have larger mechanical systems, which move significant volumes of air. If these systems are not balanced, certain areas of the building may become depressurized relative to the soil beneath it. If openings are present within the slab in those rooms, the concentration of radon soil gas entering those rooms will increase significantly. In fact, studies by the DOE have found that in nonresidential buildings with elevated radon, approximately one-third are directly attributed to the elevated radon. In addition, another third was attributed to a combination of mechanical and building design features. In summary, the distribution of room to room radon concentrations in large buildings is different from residential simply because the buildings are designed and conditioned differently.

1.2 RADON EXPOSURE RISKS

For many years, radon was not considered a health problem in residential buildings; however, in 1984, private homes in the Reading Prong area of Pennsylvania were discovered to have levels of radon in excess of federally mandated exposure limits for radiation workers. Nero et al. (1986) estimated that about one million American homes have radon levels in excess of 8 picocuries per liter (pCi/L). In 1988, studies by the National Research Council and the Committee on Biological Effects of Ionizing Radiation (BEIR) found that excessive exposure to radon progeny resulted in a higher-than-predicted number of deaths from lung cancer in mining populations (BEIR et al. 1988). Based on this and other information, the EPA estimated that from 5000 to 20,000 lung cancer deaths per year are attributable to radon exposure (*A Citizen's Guide To Radon*, OPA-86-004, 1986). In 1996 the World Health Organization (WHO) acknowledged that worldwide, radon exposure was the second leading cause of lung cancer behind smoking (WHO, April 1993). More recently, BEIR VI (1999) reinvestigated the health risks associated with radon exposure. Using information from previous studies and supplementing it with information from more recent laboratory studies, the committee estimated that approximately 11,000 lung cancer deaths per year were attributed to exposure to radon (BEIR VI, 1998). These mortality estimates make exposure to radon the second-leading cause of lung cancer behind smoking. However, statistically speaking, an individual's lifetime risk to dying from radon lies between the risks of being killed by a drunk driver and drowning (Fig. 1.6). Individual relative risk from radon exposure is summarized in Table 1.1. These findings were borne out by other studies noted by WHO in 2009 (WHO, 2009).

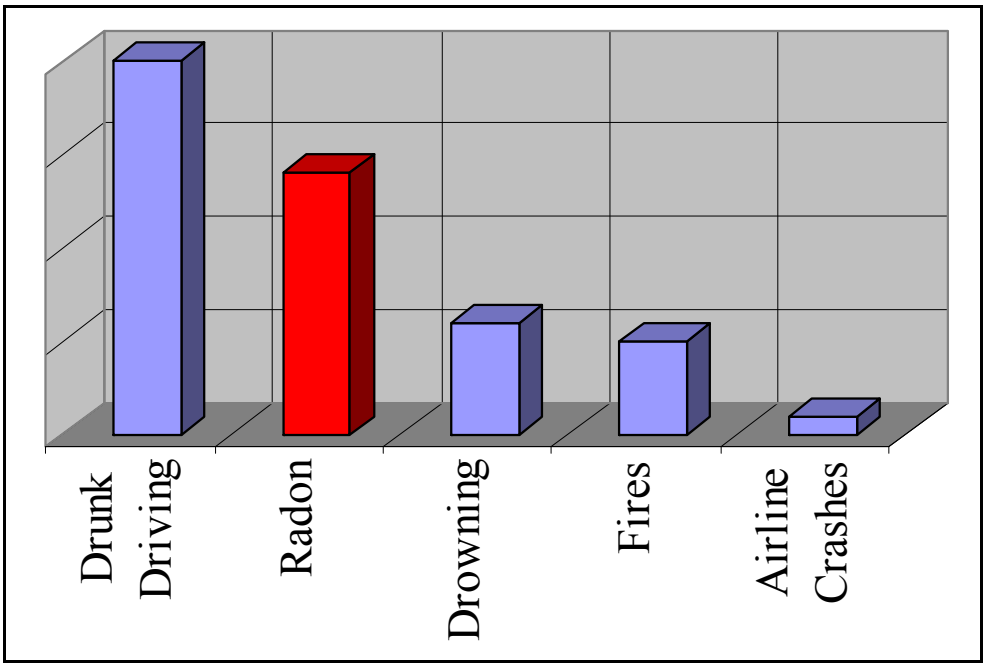


Fig. 1.6. Lifetime relative risks to radon exposure.

Table 1.1. Lifetime exposure risks from radon

Lifetime exposure at radon levels (pCi/L)	Smoker's lifetime relative risks	Nonsmoker's lifetime relative risks
200		More than 60 times the lung cancer risks of nonsmokers
20	100 times the risk of drowning	Risk of being killed in a violent crime
15		One pack/day smoker
10	100 times the risk of dying in a home fire	
8		10 times the risk of being killed in an airplane crash
4	100 times the risks of dying in a plane crash	Risk of downing
2	Twice the risk of dying in a car crash	Risk from dying in a home fire

Source: U.S. Environmental Protection Agency, *A Citizen's Guide To Radon*, OPA-86-004, 1986.

1.2.1 EPA Corrective Action Guidelines

In 1986 EPA published the first of three subsequent editions of *A Citizen's Guide to Radon*. Unlike other EPA publications, the follow-up editions did not supersede or replace previous editions; they only provided additional information and, in the case of subsequent editions (the most recent is EPA 402-K-07-009, revised May 2007), a more user-friendly format. The key points in these documents are as follows:

1. There are no safe levels of radon. Exposure to the average outdoor level found in the United States is roughly equivalent to 20 chest X-rays per year.
2. Because of the cost of reducing the radon levels in homes, EPA established a guideline of 4 pCi/L as an action level based on reducing the radon risk to the general population at a reasonable cost.
3. In the subsequent editions, the significantly increased risks of radon exposure and smoking were also included.

In the 1986 edition of *A Citizen's Guide to Radon*, EPA provided a recommended timeline for corrective action (Table 1.2). This timeline, although excluded from later editions, is still a useful guide in determining when to take corrective action. However, EPA recommends in all three editions that corrective action be taken as soon as possible

Table 1.2. *A Citizen's Guide to Radon* corrective action schedule

EPA Radon Action Levels (pCi/L)	Recommended Actions
0 to < 4	No action required
4 to < 20	Mitigate within a few years
20 to < 200	Mitigate within a few months
≥ 200	Mitigate within several weeks

Source: U.S. Environmental Protection Agency, A Citizen's Guide To Radon, OPA-86-004, 1986.

1.3 RADON MEASUREMENT

1.3.1 Types of Radon Measurements

As defined by EPA, radon measurements are of two distinct types: short term (2 to 90 days) and long term (91 to 365 days). The advantage of short-term measurements is that radon data can be collected quickly. In addition, because detectors are in the field for less time, the potential for field attrition is much lower. With respect to accuracy and cost, both types of measurements are comparable. However, unlike most pollutants, indoor radon levels are constantly changing. Studies by EPA and DOE have found that indoor radon levels can vary by as much as a factor of 10 from one season to another. Also, other studies have shown that the indoor concentration of radon can increase by a factor of 2 to 10 during short-duration weather events (e.g., rain, periods of high winds, and cold snaps, see Fig. 1.7). Because of these variations, EPA bases the health risks of radon exposure on an integrated annual average. When performing a short-term test, EPA recommends that the measurement be performed under closed building conditions, which means that in a heating climate, the test should be performed ideally at the season midpoint with the building closed (e.g., windows and doors kept closed at all times) and not during periods of abnormal weather conditions. In addition, if the test is <4 days in duration, the house must be closed for at least 12 h prior to the placement of the testing device.

A long-term measurement offers the advantage of integrating the impact of short-duration weather effects over a longer period of time. Also, a long-term measurement can be performed during normal living conditions, thus minimizing the impact of radon testing on either work or living activities.

Because of these and other considerations, EPA recommends that any radon test be performed for as long as possible in order to provide the most accurate representation of the annual average. Because corrective action can be expensive, EPA recommends that follow-up measurements be performed in cases where elevated radon was detected and, in particular, in cases where abnormal weather occurred during the test period. Generally speaking, the higher the initial radon result, the more confidence one has that elevated radon is present. If the initial radon result is ≥10 pCi/L, EPA recommends immediate short-term measurements be performed.

1.3.2 Types of Radon Gas Detectors

EPA divides short-term measurement devices into two categories, continuous and integrating. Continuous radon monitors (CRMs) typically measure radon gas or radon decay products in air. These measurements are performed in real time, meaning that the radon concentration can be measured and studied at fixed time intervals. To measure

radon, room air is either pumped or diffused into a counting chamber that detects the ion particles generated by the radioactive decay of radon and its progeny. The counts per unit of time measured by the detector are then transmitted to a recording device (electronic or printer), where they are converted into picocuries per liter. Detection methods for CRMs include ion-trap, pulse ion-chamber, scintillation cell, or silicone integrated circuit detector. The typical exposure period for CRMs, as for most short-term devices, is 2 to 7 days. However, the chief advantage of CRMs over passive devices is the ability to "see" what is occurring by recording radon concentration as a function of time. When the instrument is downloaded and the data plotted, the impact of episodic weather events and other nonstandard tests (e.g., doors and windows left open) can be measured and quantified (Fig. 1.7). If used properly, CRMs are the most accurate of all short-term radon measurement devices. For example, most commercially available instruments are typically within 5% of the true radon concentration (vs 15 to 25% for integrating devices). However, the disadvantage is the high initial purchase cost, $500 to $25,000 per CRM. Also, CRMs must be maintained and require periodic calibration.

Integrating devices average the radon exposure by absorption, physical damage to a film, or the loss of surface electrical potential. A key difference between integrating devices and continuous devices is that after the measurement has been performed, integrating devices are analyzed in an off-site laboratory. If integrating devices are used in high-priority, short-term measurements (e.g., real estate transactions or confirmation measurements), EPA recommends that the measurement be performed with collocated duplicate detectors. Common examples of integrating radon detectors for short-term measurements are charcoal canisters and electrets.

A charcoal canister consists of an airtight container with a known quantity of activated carbon. To sample radon, the carbon is exposed to the area tested (typically, by removing the lid) for a period of 2 to 7 days. During the exposure period, the radon in the air is absorbed into the charcoal granules. At the end of the sampling period, the canister is sealed and returned to the laboratory for gamma spectroscopy analysis. After analysis, the corrected gamma counts per minute divided by the time of exposure are proportional to the radon concentration. The main advantage of using charcoal is its low unit cost. In large quantities, charcoal test kits can be obtained for under $5 per measurement (price includes canister and analysis). However, certain technical and logistical considerations can negate this cost advantage. Because charcoal permits the continual absorption and desorption of radon, this device does not give a true, integrated measurement over the exposure time. This means that the reported result may be significantly biased by either episodic or random events during the last 8 to 12 h of exposure. Another consideration is that all charcoal-based radon detectors have a maximum exposure limit. Because absorption sites within the charcoal granules are not specific, water and certain organic vapors compete with radon. Over time, these active absorption sites become irreversibly saturated with water, preventing further radon absorption. If water saturation occurs, the test must be repeated. Another consideration is holding time. At the laboratory, gamma spectroscopy analysis measures the quantity of radon presently absorbed in the charcoal. Because radon-222 (the most common isotope of radon) has a half-life of 3.8 days, it is imperative that the canister be read within 2 weeks of the conclusion of sampling.

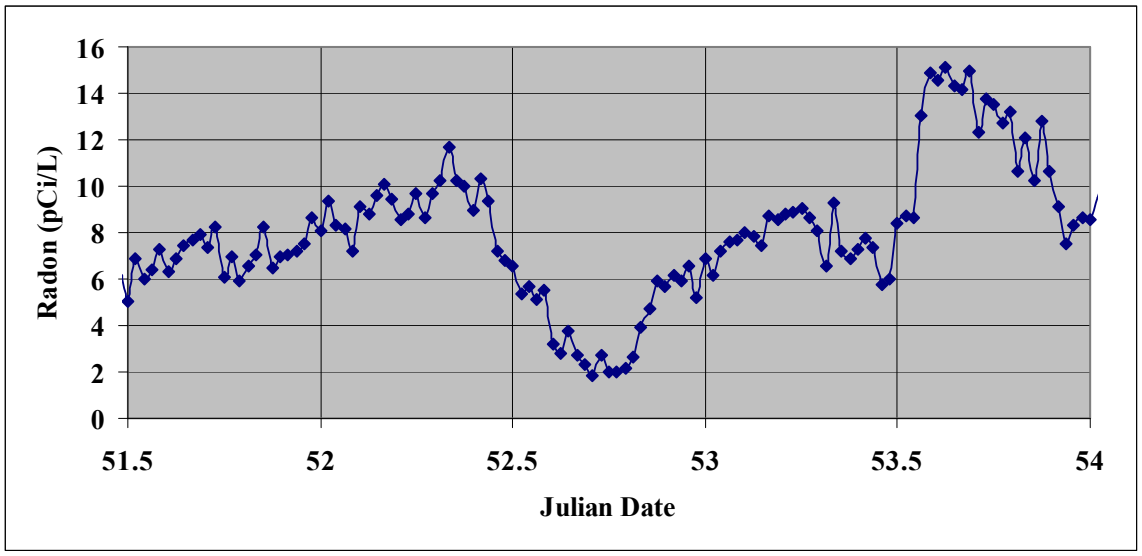


Fig. 1.7. Example of a continuous radon measurement.

Electret-based radon detectors consist of two distinct parts: the ion chamber and the electret (Fig. 1.8). The ion chamber is a specially designed holder for the electret, which is made of electrically conducting plastic. This feature permits the uniform discharge of any static energy generated by the decay of radon or radon daughters in the air inside the chamber. An electret consists of an electrically charged wafer of Teflon that has been treated to hold a stable electrostatic potential. This potential attracts oppositely charged ions that collect on the electret surface, thus neutralizing the surface charge and reducing the electrostatic potential. The surface potential is measured before and after exposure, using a specially designed voltage reader. The decrease in surface potential during exposure is proportional to the concentration of radon integrated over time. When new, the voltage of an electret is between 700 and 750 V, and the electret can be reused until the voltage drops below 200 V. The discharge rate, or volts per unit of time per radon concentration, depends on the volume of the ion chamber and on the sensitivity of the electret. High-sensitivity electrets discharge at a rate 11 times that of low-sensitivity electrets. For short-duration tests, such as 90 day tests, a higher discharge rate is needed for better accuracy. For example, a 90 day measurement conducted at 1 pCi/L of radon with a low-sensitivity electret would yield only a 6 V drop, whereas a high-sensitivity electret would yield a 66 V drop. The higher voltage drop results in an accuracy increase of about 50% in this example. Conversely, for longer exposures, such as 240 days, the drop in voltage for the high-sensitivity electret would be 176 V, or 35% of the usable voltage for the electret. The lower-sensitivity electret would drop by only 16 V, losing only 3% of its usable voltage.

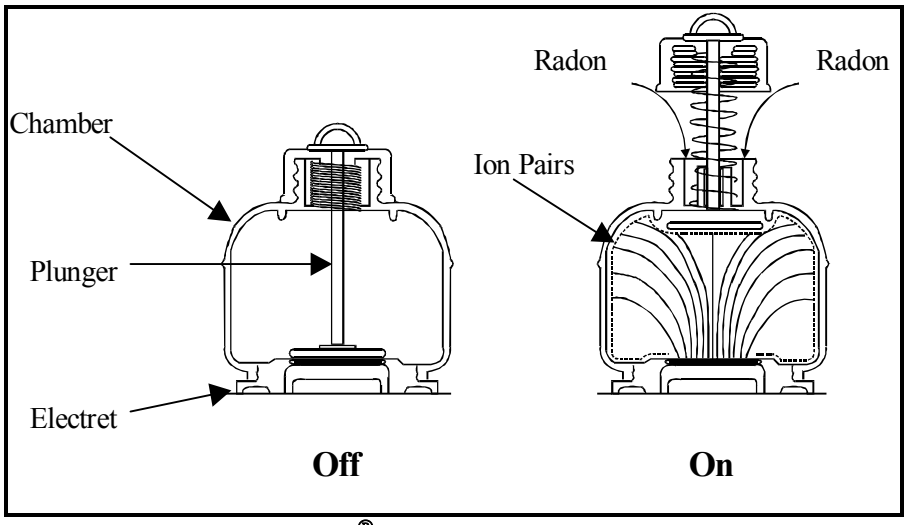


Fig. 1.8. E-Perm® electret-based radon detector.

As with charcoal, one of the major advantages of electret-based radon measurements is the low cost per measurement. Because electret-based detectors are reusable, electret measurements also can be performed for less than $5 (excluding field labor). Unlike charcoal canisters, electrets can be placed for more than 7 days and are insensitive to water and organic vapors. In addition, electrets are true integrating devices, meaning they are not dependent upon the last 8 to 12 hours of exposure. The total voltage discharge is proportional to the average radon concentration during the exposure period. Most important, electret readers are field portable; that is, detector analysis can be performed at the job location. However, unlike charcoal, an electret does have an upper limit for radon exposure. For new electrets, the maximum usable dose is approximately 250 pCi/L-days (1 pCi/L-day = 1 pCi/L exposure for 1 day). Therefore, each time an electret is used, care must be taken to ensure that sufficient usable voltage remains to perform the measurement.

For long-term measurements (>90 days), using CRMs is generally not considered cost-effective. Instead, either electrets or alpha track detectors (ATDs) are used (Picture 1.1). ATDs, the oldest and best understood of long-term measurements, work on the principle of counting physical damage (tracks) to an acrylic chip (CR-39) caused by alpha particles generated during the radioactive decay of radon. During the deployment of an ATD, radon diffuses through a filtered membrane (in the most common type of ATD). If radon undergoes radioactive decay while in the holder, the subsequent radon daughters are attracted to the CR-39. If the daughters deposit on the surface of the CR-39, subsequent alpha decay will leave a submicroscopic track on the surface of the CR-39. After the ATD is retrieved, it is returned to the laboratory for development and analysis. This is performed by disassembling the ATD, removing the CR-39 chip from the holder, and placing the CR-39 chip in a heated caustic solution (potassium or sodium hydroxide) for about 12 to 24 h (depending on the vendor). This caustic development or etching enlarges the alpha tracks so that they can be viewed and counted under a microscope. The tracks per unit of area (track density) as a function of time (days) are proportional to the radon concentration (pCi/L).

Picture 1.1. Typical alpha track detector.

1.3.3 Measurement of Radon Decay Products

Although measuring radon gas in air is the most common method used today by radon testing companies within the United States, another method measures the radiological activity of radon progeny that have become attached to particles suspended in air. To perform this measurement, the equilibrium ratio (ER) must either be determined or assumed. Simply speaking, the ER is the percentage of radon daughters attached to particles that are suspended in air. The ER is calculated by dividing the total concentration of radon decay products (RDPs) present by the concentration that would exist if the RDPs were in radioactive equilibrium with the radon gas concentration present. Therefore, at equilibrium (i.e., at an equilibrium ratio of 1.0), 1 Working Level (WL) of RDPs would be present when the radon concentration was 100 pCi/L. However, because of ventilation and plate-out (the attachment of an RDP to the wall, floor, or object within the room), the ratio can never be 1.0. Residential studies performed by EPA found typically an average ER of 50% (the range was from 30% to 70%) for typical residential structures with average air recirculation rates.

In most nonresidential buildings, however, the ERs are consistently lower, ranging from 5% to 30% with an average ER of 25%. The exact reasons for the lower average ER are subject to debate. But most nonresidential buildings are nonsmoking, do not have pets, have more efficient heating and air-conditioning filters, and are usually cleaned more frequently. Therefore, for the most part, the common sources for residential particles in air are absent.

To convert from units of WL to equivalent gas concentration in pCi/L, the WL is multiplied by 100 and then divided by the ER (Equation 1.1). For example, 0.02 WL (RDPs) × 100 / 0.5 (50% ER assumed) would equal an equivalent gas concentration of

4.0 pCi/L. It is important to note that if the ER is assumed, the gas concentration should be identified as "equivalent gas concentration" to avoid confusion. Table 1.3 shows equivalent gas concentration in picocuries per liter (pCi/L) at various WL concentrations and ER at a 4 pCi/L gas concentration.

$$\text{Radon (pCi/L)} = \frac{\text{WL X 100}}{\text{ER}}$$

Equation 1.1. Conversion from gas to WL.

Table 1.3. Equivalent gas concentrations at 4 pCi/L for various equilibrium ratios

Equilibrium Ratio	Working Level	Equivalent Gas Concentration (pCi/L)
0.05	0.002	0.4
0.1	0.004	0.8
0.2	0.008	1.6
0.3	0.012	2.4
0.4	0.016	3.2
0.5	0.02	4.0
0.6	0.024	4.8
0.7	0.028	5.6

For many years EPA set the action level for measuring RDP at 0.02 WL (EPA 402-R-92-003, 1993, and EPA 402-K-06-093, November 2006), which is equivalent to a 4.0 pCi/L gas concentration at an ER of 0.5 (the default value recommended by EPA if the ER is unknown). But in 2007 EPA lowered the action level from 0.02 to 0.016 WL (the gas concentration action level remained unchanged at 4.0 pCi/L) and decreased the assumed ER to 0.4 (EPA 402-K-07-009, revised May 2007).

The most common WL measurement devices are CRMs or electrets which consist of a pump, filter paper, and detector. The basic principle of operation is that dust particles with the RDPs attached become trapped on the filter paper. The detector then measures the alphas emitted by Po-218 and Po-214 as a function of time and flow rate. Studies have shown that even common occurrences within buildings can change the ER and, in turn, affect the WL measurement. For example, simple routine occurrences such as smoking, lighting a candle, cooking, dusting, or vacuuming have resulted in doubling the response of the WL meter. Conversely, increasing the amount of air movement within a building by turning on a ceiling fan or the heating and air-conditioning blower can reduce the response of the WL meter by up to 1 order of magnitude.

As to why this is observed, in the first case, the generally accepted theory is that the generation of additional airborne particles increases the number of sites suitable for RDP attachment and their subsequent capture on the instrument's filter paper. This results in the increase in measured WL. In the latter case, the causes for the decrease in instrument response are not as clear. As a result, two divergent but viable theories have been

proposed. In the first theory it is assumed that the RDPs, once adhered to an airborne particle, become irreversibly attached. As these particles (including the attached RDP) collide with a fixed object in the room, they become "stuck" and become removed from the breathing zone. For RDPs that are not attached to particles, the increase in air velocity increases the probability that they will also collide with a fixed object in the room and become irreversibly attached. However, the other theory assumes that some of the RDPs are not irreversibly attached to airborne particles. By increasing the air velocity in the room, the frequency and the energy of collisions between air molecules and attached RDP increase. As a result, some of the attached RDPs are dislodged and become unattached once again. Because these unattached RDPs (more accurately visualized as molecules) are small enough to pass through the filter paper on the WL meter and not become trapped, the instrument would not be able to measure the emitted alphas.

The importance of what exactly is happening with the unattached RDP is not academic. It has a direct bearing on the dose and hence the risk of contracting lung cancer. It is generally acknowledged that the respiratory system filters out a significant number of RDPs attached to large particles in the nose and throat. The greater risk comes from the RDP attached to smaller particles which manage to get past the body's natural defenses and penetrate deeper into the lung. In addition, it is also well known and accepted that unattached RDPs have a 20–30 times greater efficiency in delivering a dose to lung tissue. Therefore, any increase in unattached RDP concentration, no matter how small, in the breathing zone would significantly increase the dose to lung tissue.

Because of the higher risk associated with ERs >50% (3 pCi/L at 0.65 ER is equivalent in risk to 4 pCi/L), EPA rationalized that WL measurements should continue to be listed as a viable testing method. However, these measurement uncertainties (in particular where the ER is unknown or highly variable) and the difficulty in interpreting the data were the primary reasons that WL measurements generally fell out of favor with the radon testing industry.

1.3.4 Radon in Water

The ^{222}Rn concentration in ground water is due to the decay of ^{226}Ra contained within the rock and soil surrounding the aquifer. As the radon gas is generated, it diffuses through the soil and rock and then percolates through the water. Because radon is soluble in water (230 cm^3/kg at 20°C) it can concentrate to levels much higher than that of the dissolved ^{226}Ra.

Two methods for the measurement of radon in water have been recommended by the EPA for routine measurements. The emanation method, in which radon is degassed from the water and transferred into a Lucas scintillation cell, has a detection limit of approximately 0.05 Bq/L (1 pCi = 0.037 Bq) for a sample volume of 100 mL (Crawford 1989). In the liquid scintillation method, the water is injected directly into a scintillation solution and counted in an automated liquid scintillation device; this method has a

detection limit of about 0.4 Bq/L using a sample volume of 10 mL (Prichard and Gesell 1977) and EPA Method 913 (EPA Report EMSL/LV, June 1991). All methods require careful sampling because of the rapid loss of radon from the water when it is agitated and open to the atmosphere. The EPA [*Fed. Regist.,* 56(138): 33050 (1991)] estimated a practical quantization limit (PQL) for radon in water (based on the ability of laboratories to measure radon within reasonable limits of precision and accuracy) to be about 10 or 11 Bq/L (1 pCi/L = 37 Bq/m^3).

1.4 OVERVIEW OF RADON MITIGATION

1.4.1 Types of Radon Mitigation

EPA divides radon mitigation into two basic categories: passive and active. Passive mitigation is defined as a nonmechanical means of radon abatement or control. Examples of passive mitigation include sealing cracks, balancing an existing mechanical system, or increasing the natural ventilation rate of the building substructure (i.e., crawl space). For the remaining lifetime of the building, passive radon techniques are generally considered the most cost-effective means of radon control. Typically, installation costs for a passive system are less than half those of an active system, and a passive system has no operation and maintenance (O&M) costs (i.e., energy for operation). Unfortunately, successful passive mitigation has proved difficult because all radon entry pathways within a house must be identified and negated. However, noted success has been observed in buildings with drainage sumps, French and perimeter drains, and major openings exposed to soil (e.g., wall pipe penetrations and beam pockets). For buildings in which these significant soil gas conduits are not present, the effectiveness of passive mitigation measures is greatly reduced.

Active mitigation entails the use of mechanical means, such as a fan or blower, to control radon entry into the living area. Generally speaking, all active mitigation methods can be grouped into two categories: pre-entry and post-entry mitigation. Pre-entry mitigation is a technique that retards radon entry into the living area. Typical examples are shell pressurization (SP) and active soil depressurization (ASD). SP, the oldest radon mitigation method, retards radon entry by mechanically introducing sufficient outdoor air to induce a positive pressure across the slab and into the soil (Fig. 1.9). ASD consists of two main types of mitigation techniques, subslab depressurization (SSD) and submembrane depressurization (SMD). For buildings with slabs or basements, SSD is a common means of radon control. This method uses a pipe that is inserted through the slab, and a fan is connected to the pipe (Fig. 1.10). When the fan is activated, the area beneath the slab (subslab) is depressurized. The resulting depressurization prevents radon entry into the living area by redirecting the subslab radon into the pipe for discharge into the atmosphere, where it is harmlessly diluted. However, the overall effectiveness of SSD is limited by pre-existing conditions under the slab that can impede the extension of the vacuum field.

For buildings with crawl spaces, SMD is usually used. By placing a polymeric membrane, such as a plastic sheet, on the floor of the crawl space and depressurizing underneath the membrane with a fan, the radon can be collected and discharged into the atmosphere away from the building.

Post-entry mitigation involves the treatment of the contaminated air inside the building. For example, energy recovery ventilation (ERV) involves the exchange of contaminated indoor air with fresh uncontaminated outdoor air (Fig. 1.11). Another method, charcoal absorption (CA), removes radon from the air by entrapment in an activated charcoal bed. However, CA systems are not recommended because of the high installation and costs. Another mitigation method not recommended involves high-efficiency air filtration systems that remove particulates from air (similar in design to the portable high-efficiency particulate air filtration used by asbestos abatement companies). Although studies have shown that these methods do reduce the concentration of radon daughters in air, there are questions in the scientific community as to whether there is an analogous reduction in risk. In addition, when one considers the initial cost of the filtration unit and the annual maintenance cost (the filters are expensive and must be changed monthly), the difference in cost for more traditional and proven mitigation methods is insignificant.

For nonresidential buildings, additional mitigation methods include mechanical balance (i.e., restoring the forced air and exhaust systems to their original design specifications) and the sealing of subslab ductwork. For individual room mitigation, a supplemental air makeup (SAM) system can be installed to control radon by increasing a room's ventilation rate. Typically a SAM system draws 75 to 250 cfm of conditioned air from an adjoining hallway or large room known to have low levels of radon and discharges it into the room (Fig. 1.12).

Because of the diversity in style and construction of OMA buildings, it is unlikely that a single mitigation design would be applicable to all buildings. Because the installation and maintenance of a building's radon mitigation system can be costly, it is highly recommended that building-specific mitigation diagnostics (measurements that assist in the selection of a mitigation system) be conducted to ensure that a proper mitigation system selection is made.

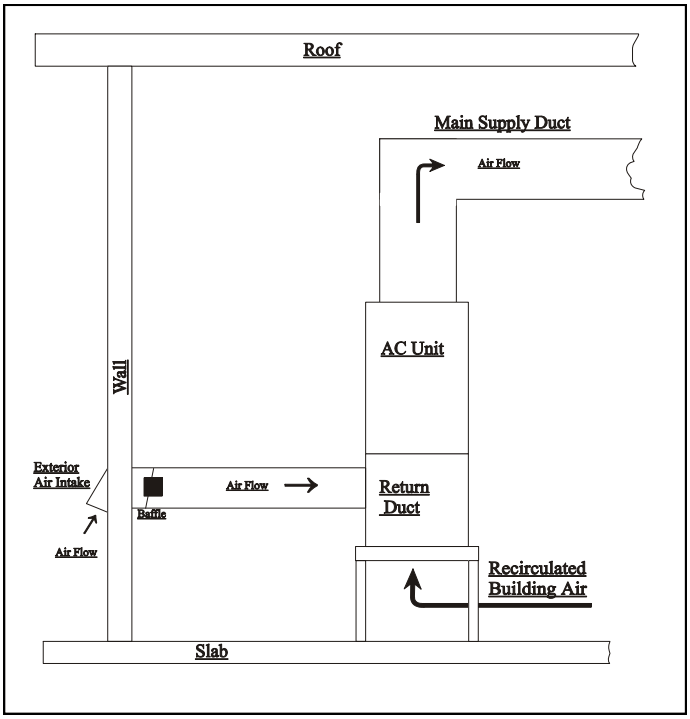


Fig. 1.9. Typical shell pressurization system.

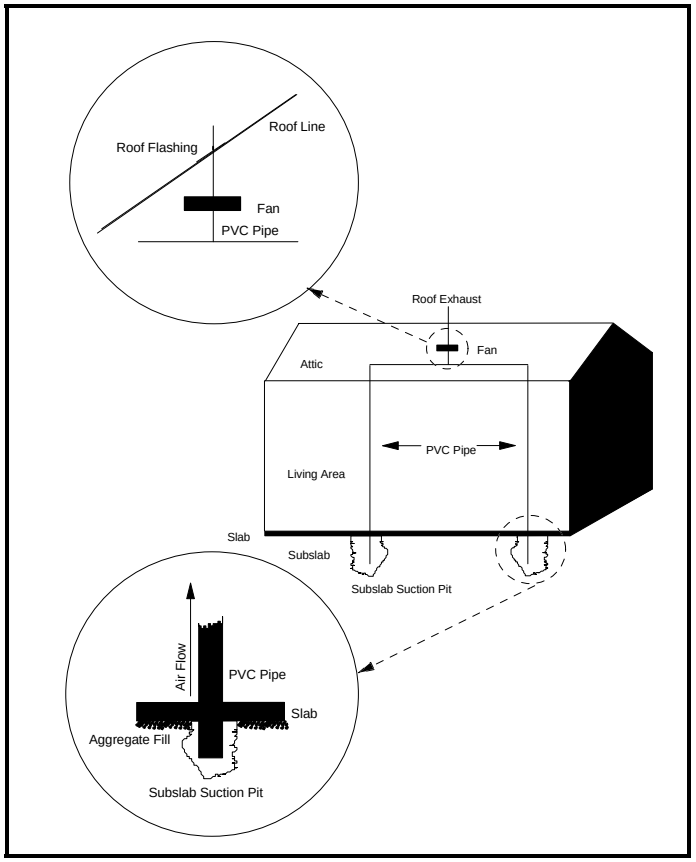


Fig. 1.10. Generic view of a subslab depressurization system.

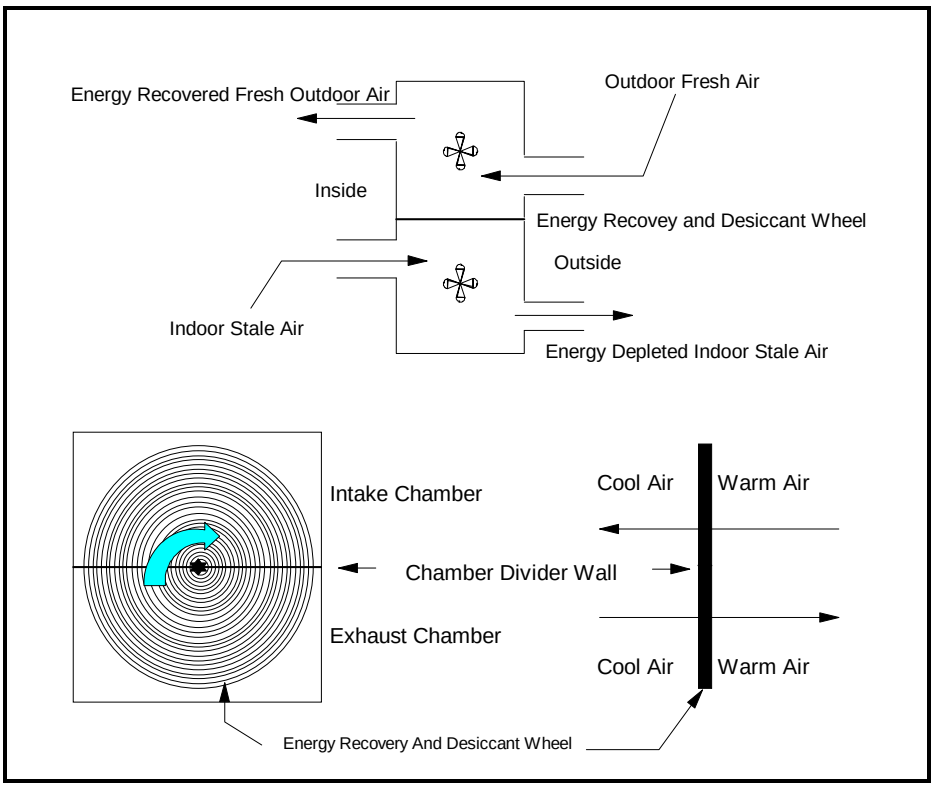


Fig. 1.11. Energy recovery ventilation overview.

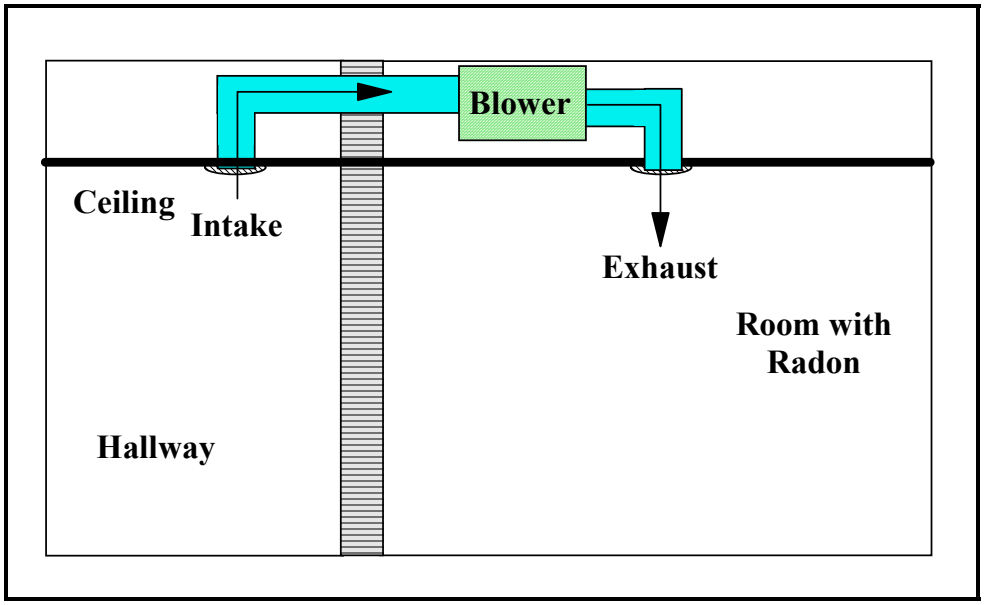


Fig. 1.12. Supplemental air-makeup mitigation.

1.4.2 Considerations in Mitigation Selection

Two essential considerations in the selection of a radon mitigation system are initial installation costs and long-term maintenance costs. In addition, other cost variables may influence the choice and design of systems, including

- the quantity of systems and the difficulty of installing them;
- the selected systems' preventive and routine, long-term maintenance;
- the method by which the mitigation systems would be installed;
- the long-term impact of mitigation installation on proposed and planned renovations; and
- the type of contracting mechanism (e.g., economy of scale).

The costs associated with some of these issues can be minimized if, to the best extent possible, the mitigation system and design are standardized for each type of building identified as having elevated radon.

During the planning stages, other issues must be addressed prior to the initiation of radon mitigation:

- energy consumption and long-term maintenance costs,
- aesthetics,
- noise reduction,
- minimal loss of living space,
- local and state requirements,
- proposed and pending renovations, and
- understanding of the occupants' concerns.

Before these concerns can be addressed, the most efficient and practical mitigation method must be selected for each building type with elevated radon. To assist in the selection of the mitigation system (e.g., SSD or SP), diagnostics are performed in each of the building types with elevated radon.

If all mitigation systems were equivalent in installation and O&M costs, the decisions would be greatly simplified. However, the three most common types of mitigation (SP, ERV, and SSD) differ significantly in installation and O&M costs. For example, using a simple intake grill, SP mitigation costs approximately $500 to install. However, the annual operation cost (e.g., energy costs associated with conditioning the air) and the maintenance costs (e.g., cleaning filters and rebalancing the system) are significantly higher than for ERV and SSD. Because O&M of a building's radon mitigation system is permanent for the remaining life cycle of the building, the true cost of mitigation must be looked at over a much longer period. Figure 1.13 compares the 10 year life-cycle energy consumption cost and the initial installation cost for each of the mitigation systems. For SP and ERV, the higher operation costs reflect the added cooling load for the intake of

outside air and maintenance. Because of cost considerations like these, whenever feasible, SSD should be preferred over ERV and SP.

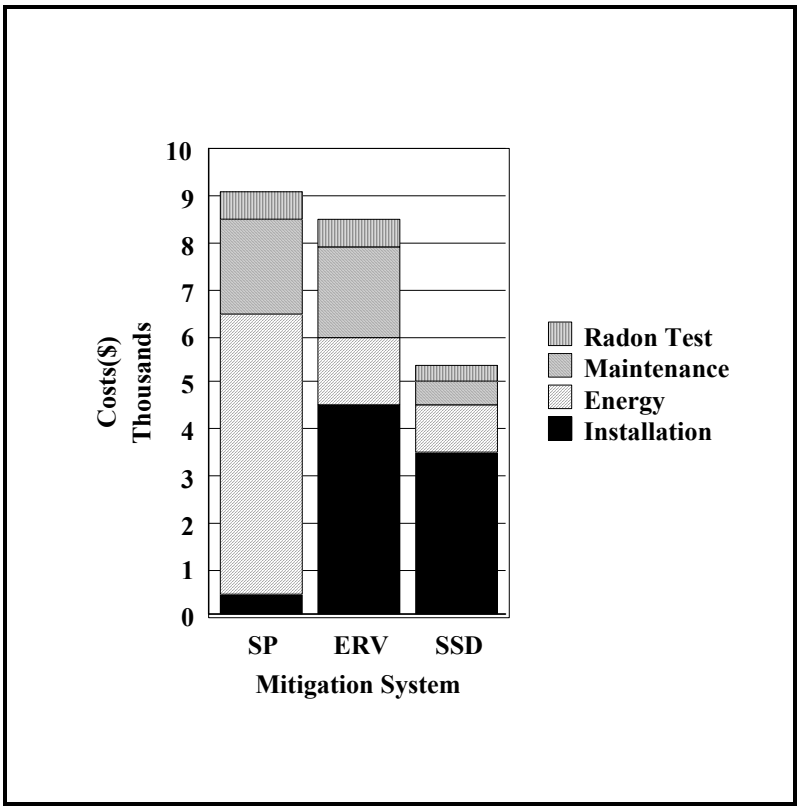


Fig. 1.13. Comparative 10 year cost for radon mitigation.

1.4.3 Radon Mitigation Diagnostic Measurements

There are many alternatives for radon mitigation. Selection of the correct mitigation system for a building is essential for a long-term, cost-effective solution. If a poor selection is made, the radon problem may not be abated, the operational expense (energy penalty) may be higher, the system may fail shortly after installation, or the radon level may increase. If any of these problems occur, then the effort and funds expended for the task would be wasted. To assist in the selection process, EPA recommends that a series of scientific tests, called mitigation diagnostics, be performed before mitigation. These diagnostics gather technical information on the characteristics of the building, and this information can then be used to determine the most appropriate mitigation means for the building. Table 1.4 summarizes typical mitigation diagnostics performed to determine the best mitigation method in nonhousing buildings.

Table 1.4. Mitigation diagnostic summary

Diagnostic Test	Description	Mitigation System
Radon entry pathway	Performs continuous radon measurements in suspected entry pathways	Passive sealing
Air change	Measures the air turnover rate of the unit	Energy recovery ventilation
Shell leakage	Determines the quantity of outdoor air required to pressurize the building to 4 Pa	Shell pressurization
Lateral field extension and subslab permeability	Quantifies the amount of vacuum required to adequately evacuate the subslab. Assists in the selection of suction point locations and fan size	Subslab depressurization
Differential pressure	Measures the differential pressure across the building shell relative to the outside	Passive mitigation via balancing of existing mechanical systems
Mechanical balance	Quantifies the volume of air being supplied or discharged at a mechanical register	Passive mitigation via balancing of existing mechanical systems

1.4.4 Radon Measurement Results Diagnostic

As was shown in Table 1.5, there are 6 basic diagnostic tests generally used to assist with the selection and design of a radon mitigation system. To aid in the selection of diagnostics, a close examination of the building's radon data vs flow plan is performed. Generally speaking, buildings with multiple rooms with elevated radon fall into one of the following categories (Fig. 1.14):

- random, no discernable pattern;
- uniform, all rooms are about the same;
- linear, all the elevated rooms are aligned;
- clustered, all the elevated rooms are in the same area of the building; and
- combinations of the four patterns in exceptionally large buildings.

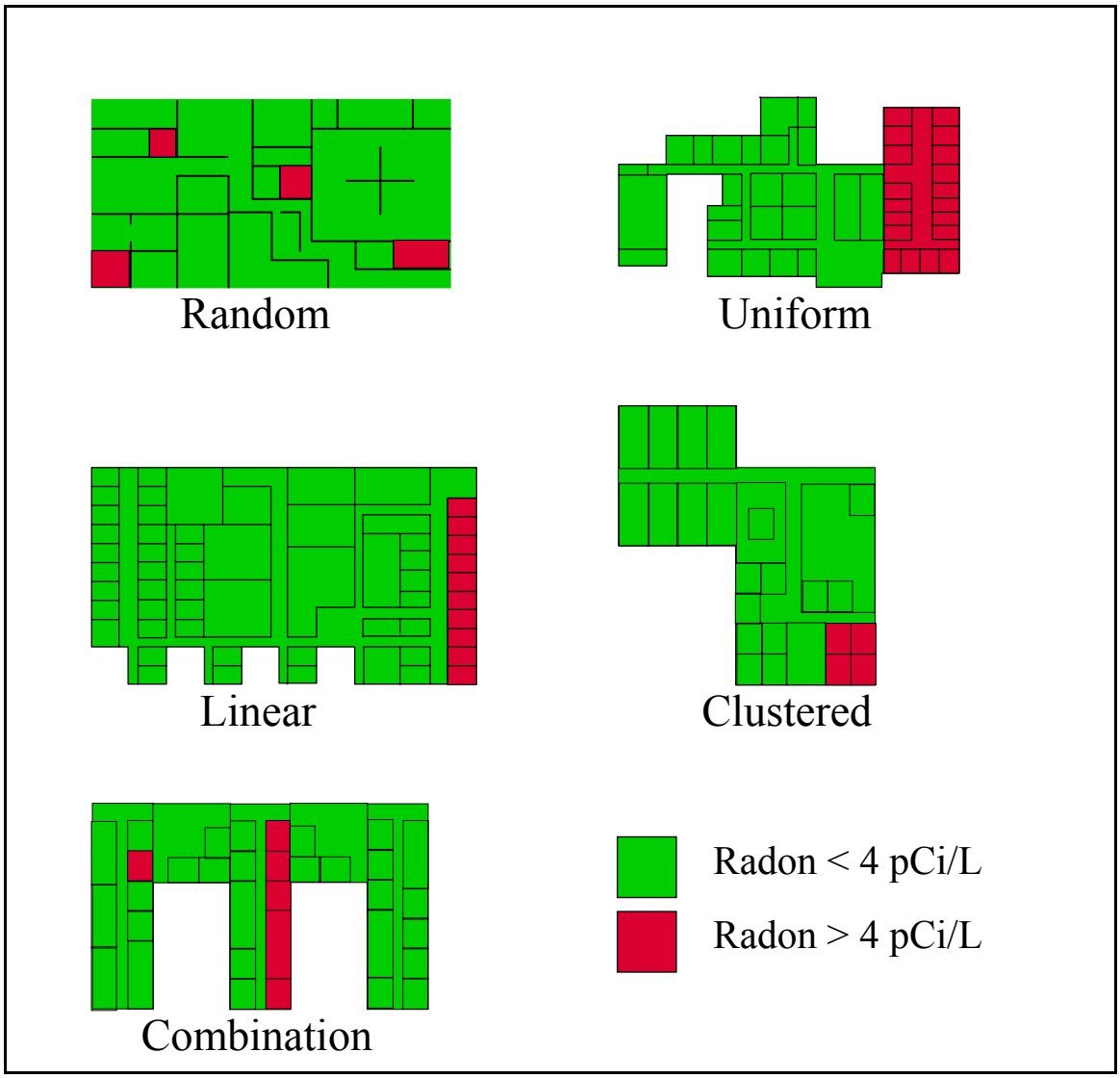


Fig. 1.14. Distribution patterns of elevated radon in nonresidential buildings.

Analysis of historical data has shown that certain types of patterns sometimes indicate a potential problem in the building. For example, a uniform pattern where all the rooms in the building are at or near the same concentration indicates that the radon is being mined and distributed by the building's mechanical system. Therefore, during the diagnostics a close examination of all the building's mechanical components should be performed. However, buildings with linear patterns tend to indicate rooms with substandard ventilation or a possible expansion joint in the slab. Consequently, in addition to consulting the building's structural plans, a mechanical diagnostic should be performed as well.

1.4.5 Episodic Air-Change Diagnostic

In a typical residential building, almost all of the ventilation is natural, which means air enters and exits the building through cracks in the building's shell and through openings found around windows and doors. However, air exhaust systems, such as range and bathroom fans and clothes dryers, can make a sizable contribution to the building's ventilation. From a purely economic standpoint, the lower the ventilation rate, the lower are the energy costs. However, reducing a building's ventilation rate increases the buildup of moisture and indoor air pollutants that may cause health problems. To provide a healthy and comfortable indoor environment, the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) recommends various air turnover rates related to space usage. For example, for single-family dwellings, a minimum rate of 0.35 air changes per hour is recommended (ASHRAE Standard 62-1989, Tables 2.1–2.3), whereas chemical laboratories can require as many as 18 air changes per hour. To measure a building's ventilation rates, an episodic air change measurement (EACM) is performed. Trace quantities of non-chlorofluorocarbon containing tracers (1 to 5 ppm) are injected into the building, and the rate of loss of the tracer is monitored as a function of time (hours). To measure this loss per unit of time, instrumentation specific to the tracer gas and capable of measuring the gas in real time must be used. The data are recorded either on a strip chart recorder or to an electronic data logger. Resolution of data collection must be on the order of one data point for every 2 min. By calculating the inverse slope of the natural logarithm of the instrument voltage versus time in hours, the air change rate (ACH) of the area sampled can be estimated (Fig. 1.15). The duration of an EACM is dependent on the current building's ACH. In very tight houses (i.e., ACH < 0.1), one measurement of 1 to 2 h is sufficient. However, in houses with very high ventilation rates (i.e., ACH > 1), several measurements may have to be performed. The deciding factor for a successful EACM is the linearity of the data plot (Fig. 1.15). An acceptable EACM is one with at least 1 h of data with a linear correlation coefficient of at least 0.99.

With respect to ranges of ACH in residential buildings, joint studies performed in 300 homes by EPA and DOE in 1985 found that the prevailing ACH rate for homes was generally dependent on the age of the building, the local climate, building codes, and the cost for energy. The homes with the lowest ACH were typically found in the northern and southernmost parts of the United States. Rates in these areas ranged from 0.1 to 0.3 ACH. The homes with the highest rates were found in the mid-south (e.g., Tennessee and Georgia), where rates ranged from 0.3 to 1.0 ACH.

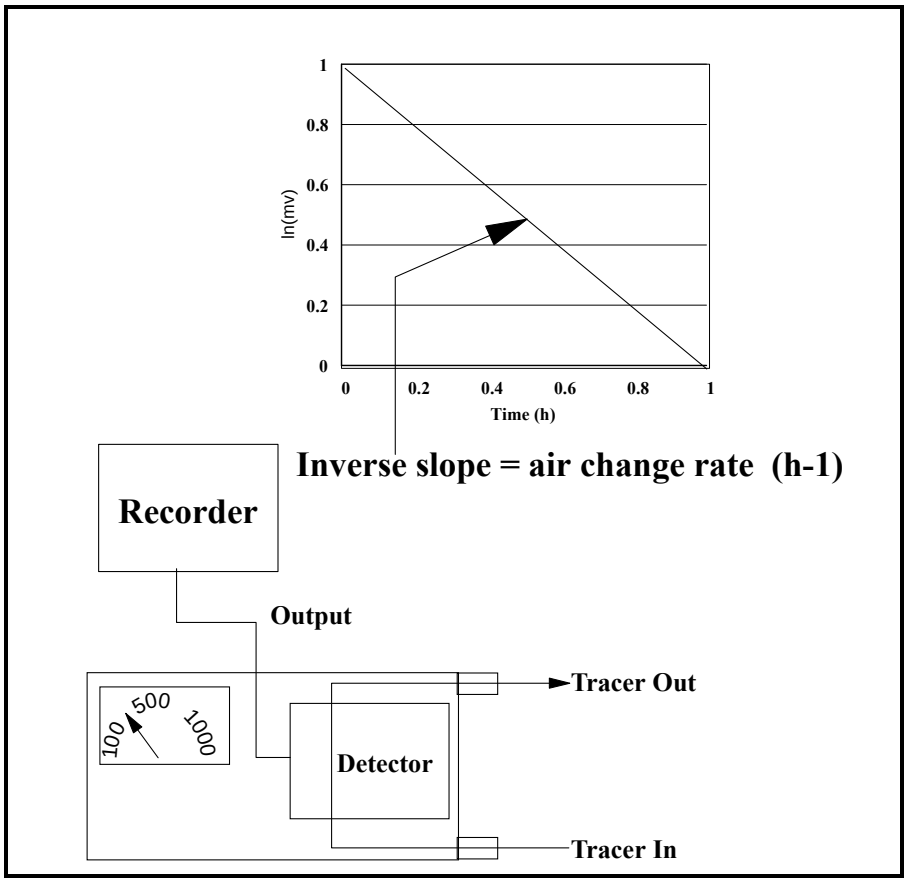


Fig. 1.15. Air change apparatus.

1.4.6 Blower Door Diagnostic

Blower door diagnostic tests quantify the leakage area (ft^2) of a building's shell. The fundamental principle of the measurement is that as pressure across the shell increases, the air flowing through cracks and crevices will increase in an attempt to balance the induced vacuum. Based on the flow and pressure data collected, one can calculate the average shell leakage under certain conditions.

To perform the blower door diagnostic, the blower doorframe and fan are inserted into the doorframe of an exterior door (Fig. 1.16). By adjusting the speed of the fan, the induced shell pressure at different fan pressures can be measured. The fan pressure is proportional to the volume of air removed from the building per minute (ft^3/min or cfm). The shell pressure is proportional to the area of leakage present within the building. By plotting the natural logarithm of the house pressure in pascals (Pa) versus the natural logarithm of the fan air flow in cubic feet per minute, a line is generated. Using the equation for the generated line (i.e., $y = mx + b$), one can calculate the volume of air needed (cfm) to pressurize the house to a given pressure (Pa). The shell leakage area (in.) is then calculated by multiplying the cfm at 4 Pa by a fan-specific calibration constant.

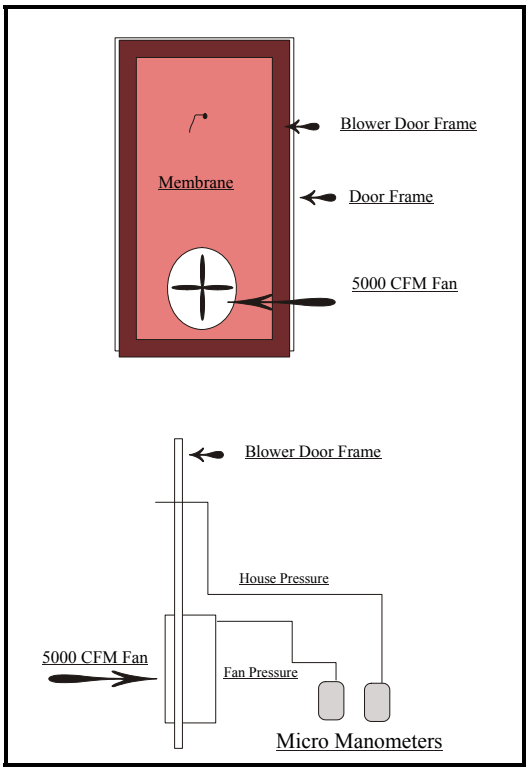


Fig. 1.16. Blower door apparatus.

1.4.7 Subslab Diagnostic Measurements

Knowing the radius of the lateral field extension (LFE) is an integral part of the design of an SSD system. In general, for an SSD system to be successful, the system pressure field (or, more precisely, the vacuum field) should cover at least 75% of the subslab surface area. At coverage less than this, the probability of a successful mitigation decreases. However, if the LFE is known before mitigation, the number of suction points, their locations, and the vacuum requirements for the SSD fan are easily determined.

To measure the LFE, a pressure field extension test (PFET) is performed. To conduct PFET, a 1.5 in. diagnostic hole is drilled through the slab at a possible SSD suction point. Six to ten perimeter field extension holes (3/8 in.) are drilled at varying distances (1 to 20 ft) from the diagnostic hole. With the use of a small, variable-speed, wet/dry vacuum cleaner, a constant vacuum is applied across the slab (typical vacuums, depending on subslab conditions, are 500 Pa, 1000 Pa, or 5000 Pa). Using a micromanometer, the quantity of vacuum (Pa) present beneath the slab is then measured in the 3/8-in. extension holes. The extent of the vacuum field is then plotted on the building floor plan as a function of distance from the 1.5 in. diagnostic hole. To quantify the extent of the LFE, between 4 and 20 extension holes are usually required. Ideally, the depressurization field should extend concentrically beneath the slab around the 1.5 in. diagnostic hole, with the LFE limits being defined as areas of the slab with less than 2 to 5 Pa of vacuum. The distance in feet from the diagnostic hole to the 2 to 5 Pa line is the LFE radius. Figure 1.17 illustrates a typical subslab diagnostic apparatus.

In conjunction with PFET, a subslab permeability test (SPT) is usually performed. During the design of an SSD system, proper fan selection is critical for long-term continuous performance. A typical error many mitigation contractors make is in the selection of a fan with too high a flow demand for a given pressure. For all mitigation fans, a minimal air flow needs to be maintained to keep the fan motor cool. Fan manufacturers provide fan performance curves (pressure vs flow) that indicate minimal flow requirements at a given pressure. SPT measures the ease with which air moves through the aggregate/soil beneath the slab (i.e., flow for a given vacuum). This property of porous materials is called permeability. To measure permeability beneath a slab, it is necessary to record the flows through a slab penetration. As in PFET, a 1.5 in. hole is drilled through the slab. A measurement stand, consisting of a 1 in. pipe in a wooden flange, is inserted into the hole. A small, variable-speed, industrial vacuum cleaner evacuates the subslab air through the 1 in. pipe, in which an anemometer (air velocity meter) and a micromanometer (pressure meter) are installed (Fig. 1.17). By varying the speed of the vacuum cleaner, the flow required to produce a given pressure can be measured. An *x/y*-data plot of the data pairs can be used then to select the proper fan for the SSD system. Figure 1.18 illustrates the most common mitigation fan performance curves.

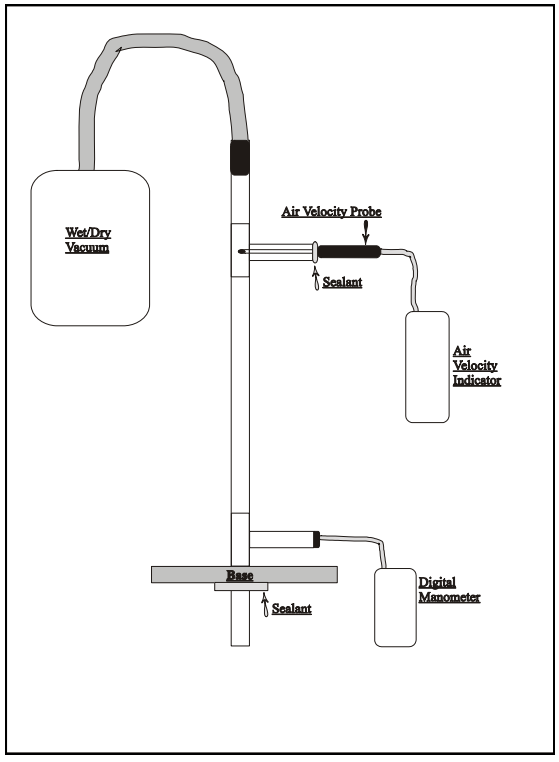


Fig. 1.17. Subslab diagnostic apparatus.

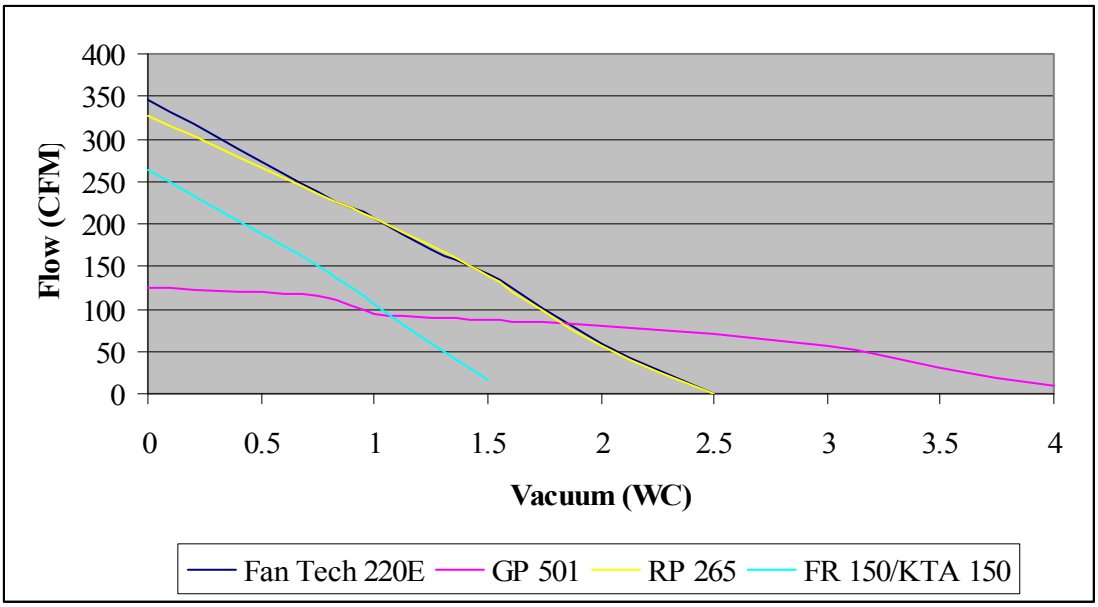


Fig. 1.18. Typical subslab fan performance curves.

1.4.8 Lateral Field Extension in Subslab Depressurization

For buildings with slabs or basements, SSD is the most common means of radon control. This method uses a pipe inserted through the slab, with a fan connected to the pipe. When the fan is activated, the area beneath the slab (subslab) is depressurized. The resulting depressurization prevents radon entry into the living area by redirecting the subslab radon into the pipe for discharge into the atmosphere, where it is harmlessly diluted. The most critical aspect of an SSD system is the ability to project a vacuum field beneath the slab. When vacuum is applied to a subslab, the vacuum field extends concentrically from the suction hole with decreasing vacuum as a function of distance. For most applications, if a minimum vacuum of 2 to 5 Pa is obtained under all parts of the slab, then radon reduction is usually achieved. However, the likelihood of achieving full reduction decreases as the vacuum coverage under the slab decreases (i.e., the percentage of subslab with <2 Pa vacuum). To compensate for the vacuum loss, additional suction points are added to the slab in areas where the vacuum field is low or nonexistent. To determine the number and location of suction points, a diagnostic is performed to measure the distance from the suction point to the 2 to 5 Pa contour (Fig. 1.19) at a constant vacuum. This distance to the 2 to 5 Pa contour is called the LFE.

LFE reduction as a function of distance is dependent on the resistance that the evacuating air encounters moving through the subslab material. The most permeable subslab material (e.g., subslab material that has the greatest LFE) is pre-washed, >0.5 in. stone. Fill material, such as ground coral and compacted soil, significantly reduces LFE. In materials such as these, LFE may be so short as to eliminate SSD as a practical mitigation option.

Subslab obstructions such as interior footers can prevent the vacuum from reaching all areas of the slab (note 0 Pa in lower right room in Fig. 1.20). If obstructions are encountered, either an additional suction point or a jumper [Fig. 1.21(A)] is used. Essentially, a jumper is a tunnel through the slab and above the footer that allows the vacuum to extend into the enclosed area [Fig. 1.21(B)]. However, if interior footers have good aggregate beneath them, then the vacuum field will not be impeded and could extend for a considerable distance [Fig. 1.22 (A)]. For multi-family buildings (e.g., duplexes and townhouses), this sub-footer extension could result in achieving radon mitigation in one or more adjacent units. This type of mitigation, called collateral mitigation, is illustrated in Fig. 1.22.

If compact aggregate, compacted soil, or variable aggregate densities are present beneath the slab, then the LFE can become nonuniform or greatly reduced. Depending on the severity of LFE perturbation, the SSD system may become complicated, or the method may be eliminated as a mitigation option. In aggregates of varying densities, the vacuum gradient will bias toward the more permeable side (Fig. 1.23). For this problem, a second suction point would be required in the nonevacuated portion of the slab. In cases with highly compacted aggregate or compacted coral, the LFE may not extend sufficiently for successful mitigation (Fig. 1.24). However, in some cases, adding an additional suction point (Fig. 1.25) or a more powerful fan will provide the needed coverage. The most difficult of all vacuum fields to work with is the “doughnut” field extension (Fig. 1.26). In this case, the aggregate around the building’s foundation is loosely packed, but the center portion of the building has had its subslab fill compacted. This results in an elliptically shaped field extension pattern around the foundation but with no extension into the center of the subslab. However, mitigation can occur if the major radon source term is located in the more permeable foundation aggregate. If it is not, then radon reduction will not be complete. Note that it is not unusual for a large or complex subslab to have more than one LFE pattern. In these cases, each slab section is treated independently.

Before installing an SSD system, it is important to determine which of the previously mentioned vacuum extensions exists beneath the slab. More than anything else, this determination will establish the feasibility and flexibility of designing an SSD mitigation system.

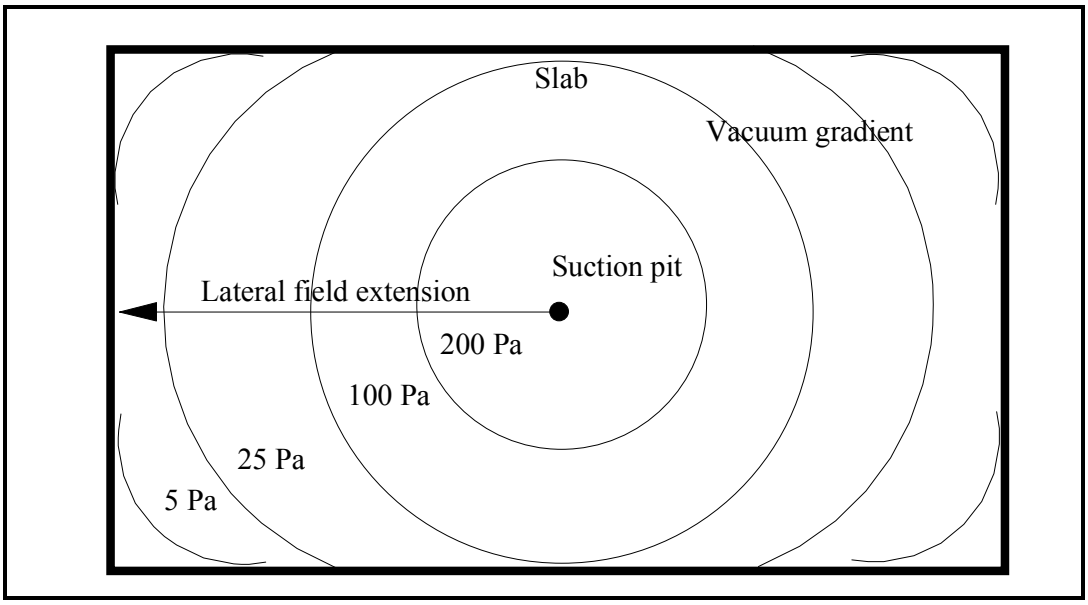


Fig. 1.19. Uniform vacuum gradient under the slab.

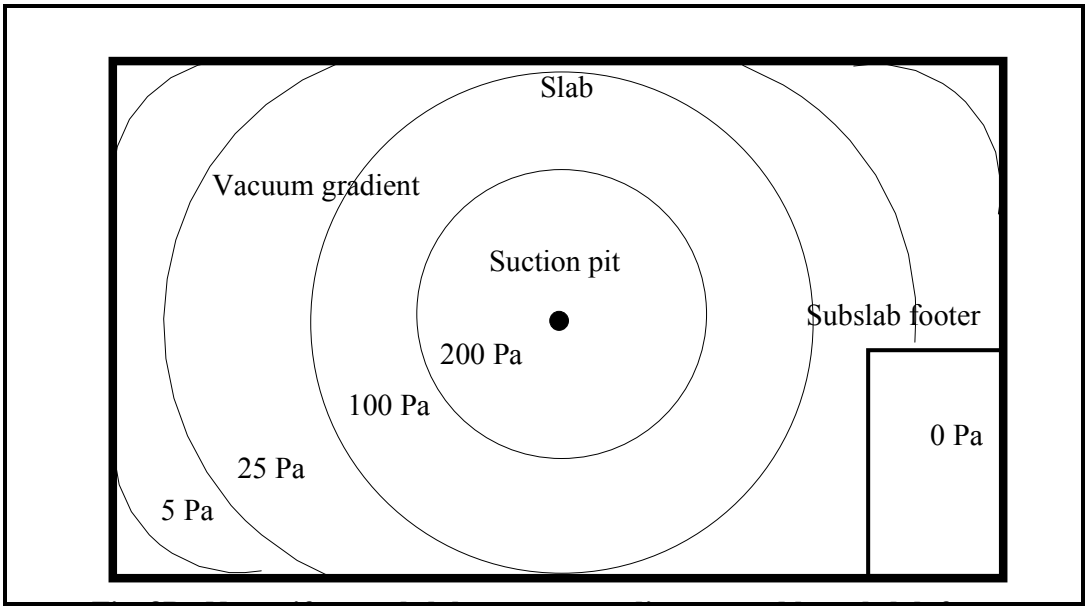


Fig. 1.20. Non-uniform vacuum gradients.

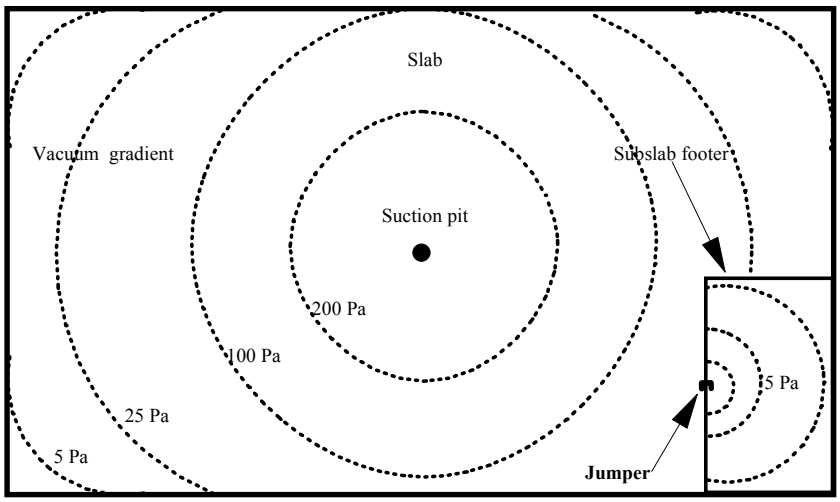


Fig. A. Increased field extension with jumper

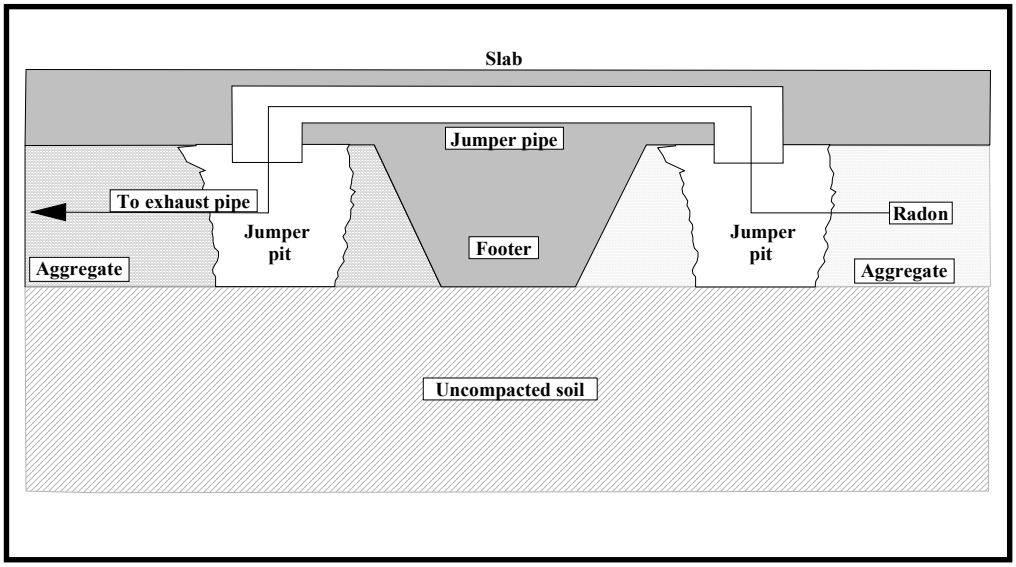


Fig. B. Cross-section of footer jumper

Fig. 1.21. Subslab jumpers.

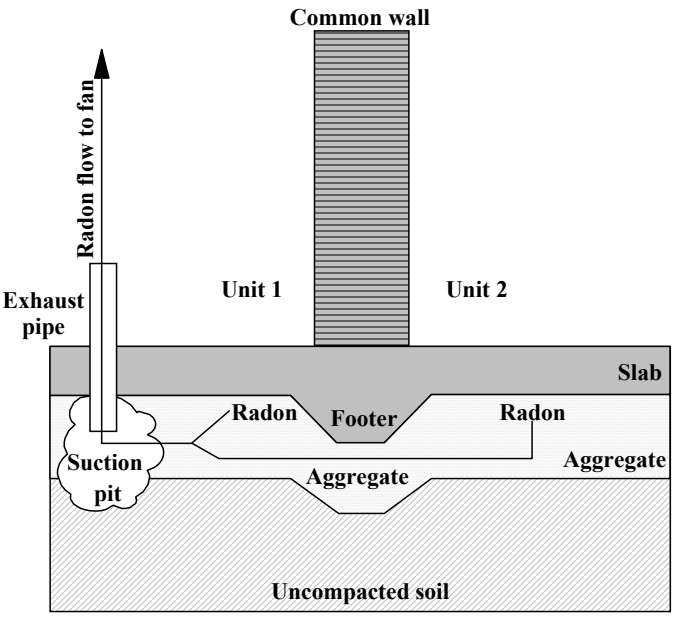


Fig. A. Collateral communication under the footer

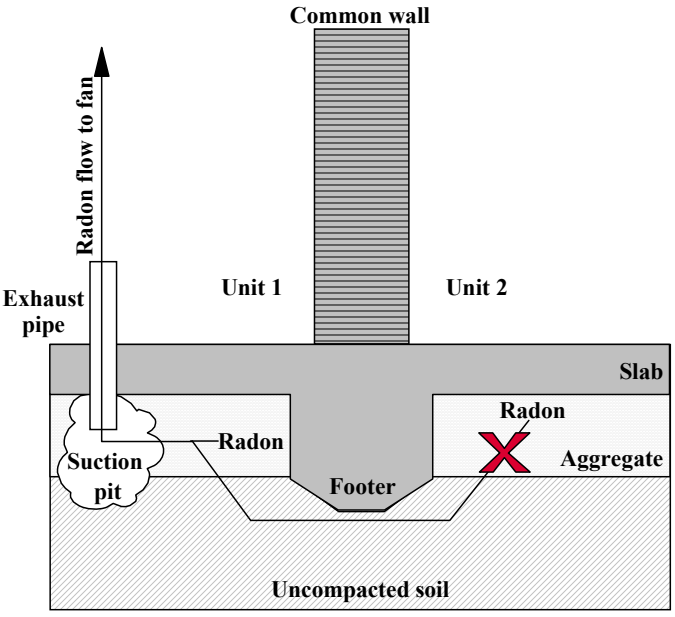


Fig. B. No communication under the footer

Fig. 1.22. Collateral mitigation.

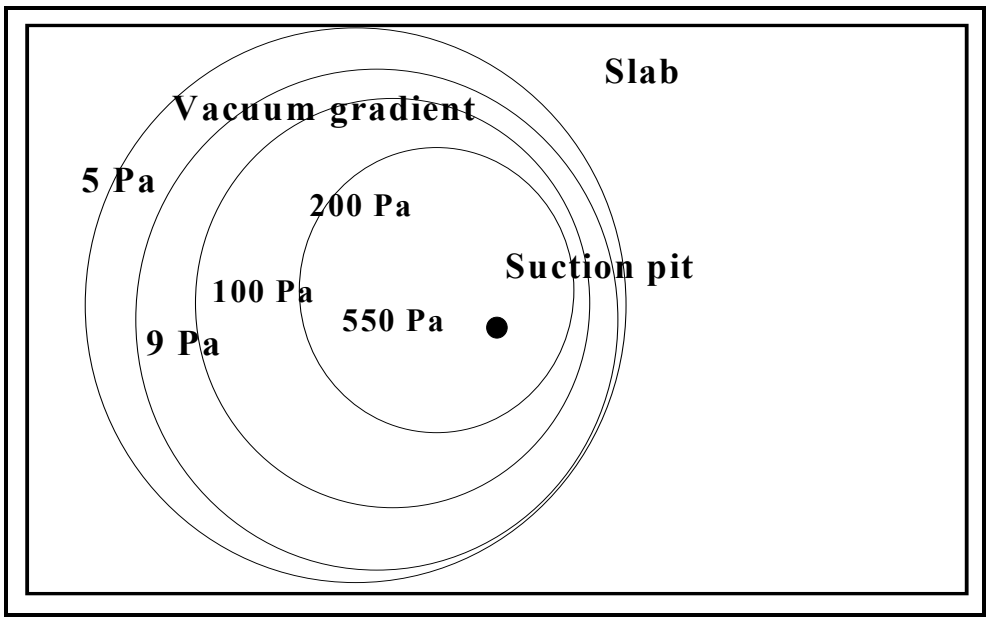


Fig. 1.23. Biased, uniform subslab gradient.

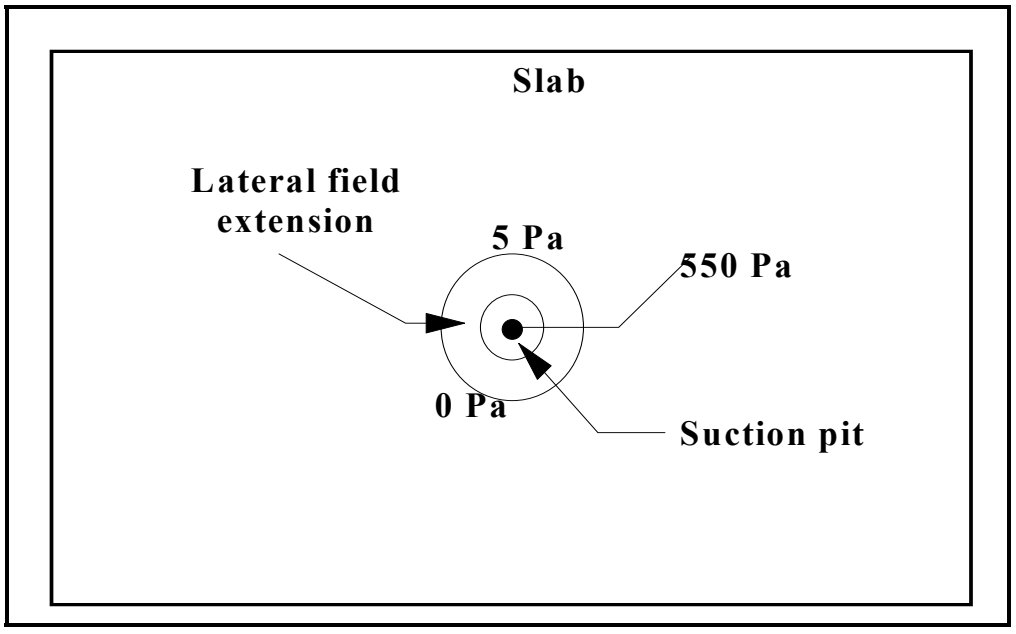


Fig. 1.24. Lateral field extension in tight soils or aggregate.

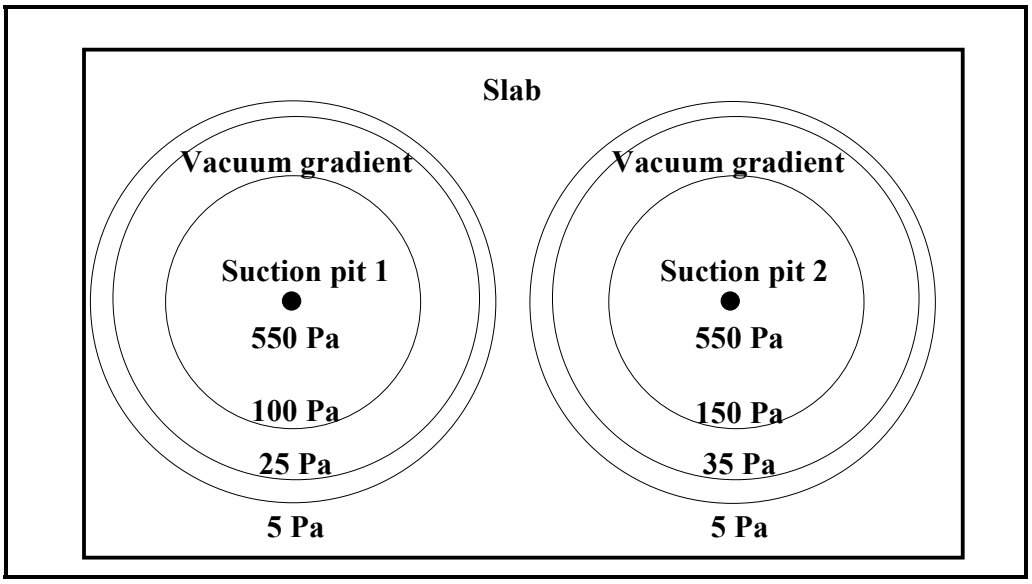


Fig. 1.25. Uniform vacuum gradients in tight aggregate.

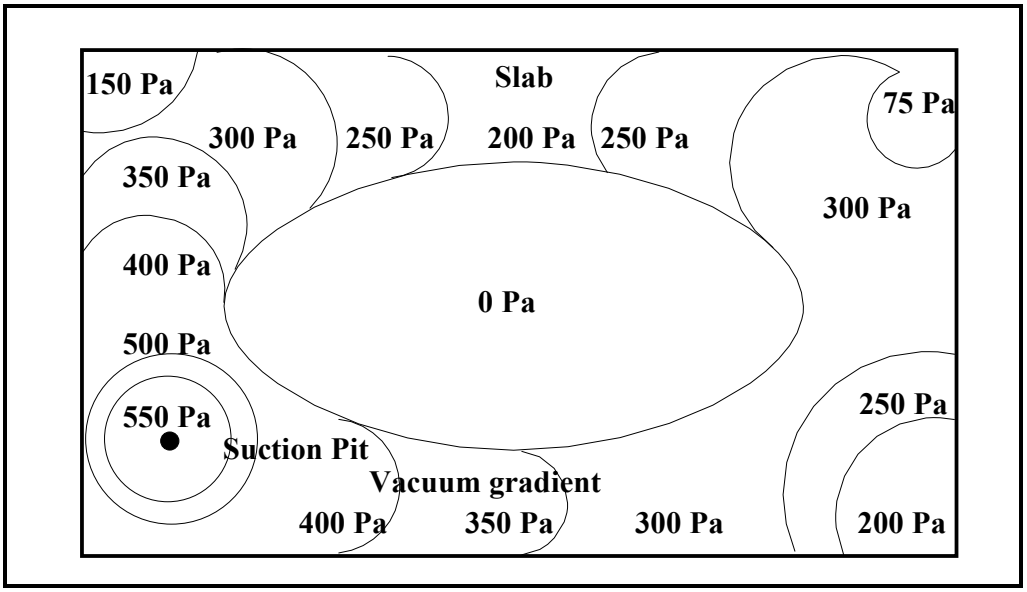


Fig. 1.26. Doughnut-shaped vacuum gradient.

1.4.9 Shell Differential Pressure

Under ideal conditions, a building with a forced air system (FAS) should be under neutral or slightly positive pressure with respect to the outdoors. If all rooms within the building have identical pressure with respect to the outdoors, then the system is balanced. If this is not true, then the FAS is called imbalanced. An imbalanced FAS results in higher operating costs and may decrease occupant comfort. If the imbalance results in certain rooms being depressurized with respect to the outdoors, increased radon entry into the room is the result.

To determine if an FAS is imbalanced, individual room pressure measurements relative to the outdoors [differential pressure (DP)] are performed. This measurement is performed using an electronic digital micromanometer with <1 Pa sensitivity. To perform the measurement, with the FAS blower on, a reference DP measurement is made from one area to the outside. All other areas are then measured sequentially, relative to the last area measured. Once normalized to the outdoors, all room DP measurements should be neutral (i.e., DP = 0) or positive and be within 1 to 2 Pa of one another. Significant differences, particularly rooms with >10 Pa of vacuum relative to the outdoors, should be balanced and the radon remeasured before taking other mitigation measures.

With respect to SP mitigation, the shell pressure must be maintained at a minimum of 4 Pa to retard radon entry. Operation of exhaust systems can result in the shell pressure dropping below the 4 Pa minimum. To measure the impact of these air exhaust systems, DP measurements (referenced to the outdoors) are also performed by individually cycling the air exhaust systems found inside the house on and off. Using the pressure flow curve generated by the blower door diagnostic, air exhaust flows for each of the air handlers can be estimated. With this information, and estimating the duty cycle of each of the air movers, the volume of additional air loss is then estimated. By adding this volume to the 4 Pa cfm determined by the blower door diagnostic, the minimal volume of air needed to perform SP is estimated.

1.4.10 Mechanical Balance

Within a nonresidential building the FAS should maintain all rooms of the building at a neutral to slightly positive pressure relative to the outdoors. When significant pressure imbalances are noted during the shell differential pressure diagnostics, the building's mechanical drawings should be consulted to verify the supply and exhausted specifications for the particular room or area. If the DP measurement is contrary to what the plans had specified, a flow-hood measurement should be performed on the room's supply and exhaust to determine which one (or both) is out of specification. To perform the diagnostic, a flow-hood apparatus (Fig. 1.27) is placed over the supply and, if present, the return grill and the flows measured. If the results are >15% of the volume listed in the plans and specifications, adjustments may be required. If adjustments are made, the flows in all rooms in line with that ductwork should be rechecked as well.

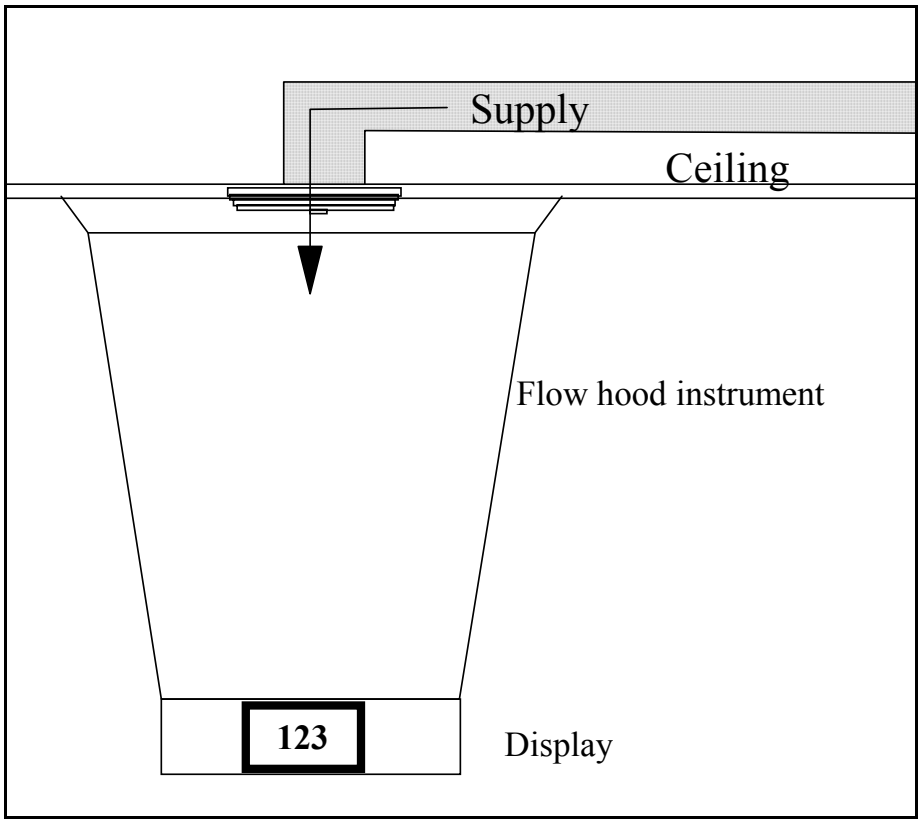


Fig. 1.27. Flow hood instrument.

1.4.11 Radon Entry Pathway Measurement

The classical radon entry mechanism is migration into the living area through cracks and holes at the soil/structural interface. In theory, if all entry pathways can be identified, then passive means (e.g., sealing the holes) can be used to reduce the radon levels in the living area. To identify these pathways, a radon entry pathway (REP) measurement is performed using a continuous radon monitor equipped with an intake pump and flow cell. To perform the measurement, a hose is inserted into or passed over the suspected entry pathway. Significant increases in measured concentration (e.g., a factor of 100) relative to the room indicate a potentially significant pathway. Examples of potential pathways to inspect are soil/structural interfaces such as the wall/floor interface, floor drains, perimeter or French drains, and sumps. Small stress cracks (e.g., <1/8 in. across) found on walls and floors typically are not significant pathways. Figure 1.28 illustrates a typical REP measurement apparatus.

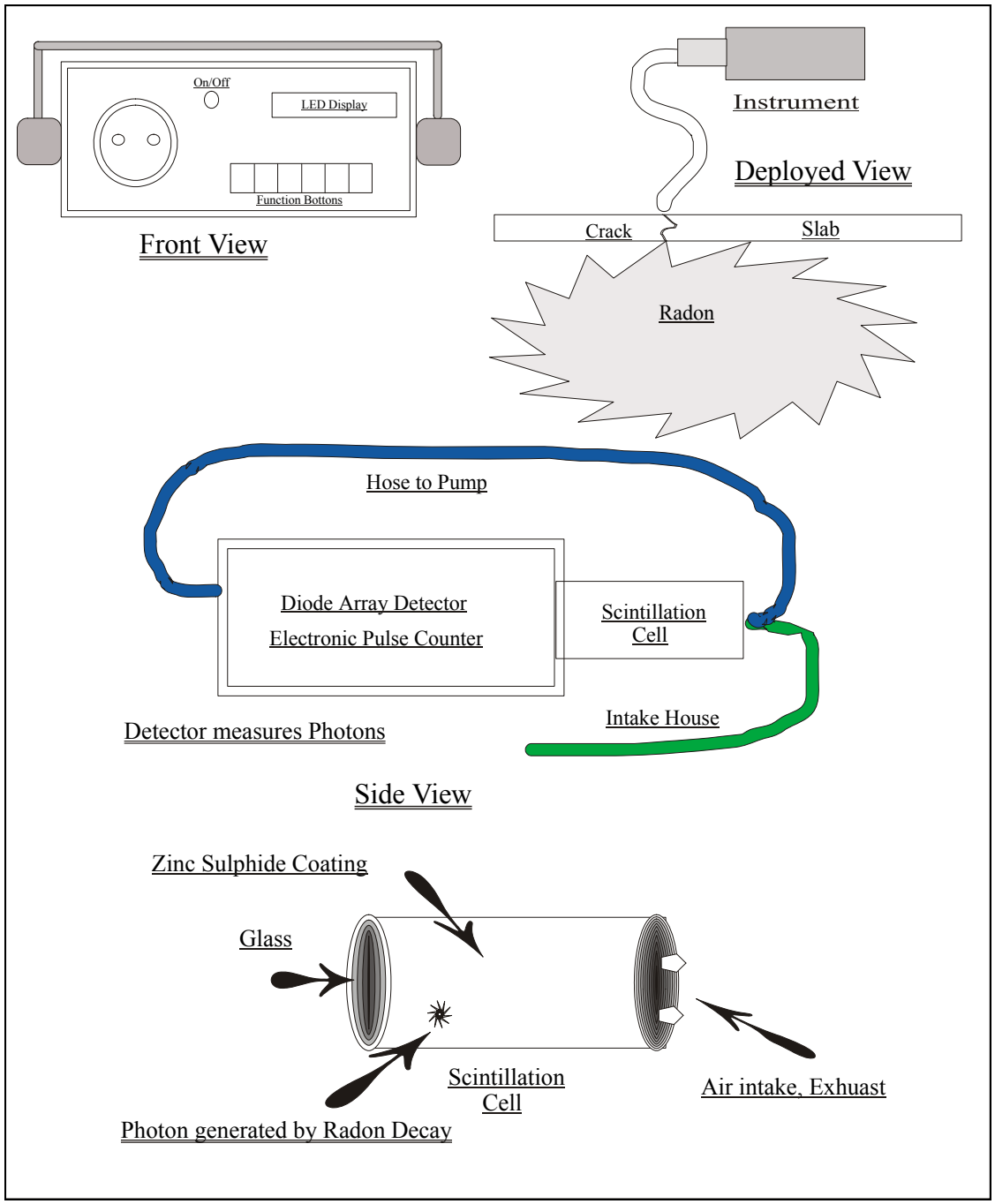


Fig. 1.28. Typical radon entry pathway apparatus.

1.4.12 Basic Subslab Depressurization System Designs

Subslab depressurization (SSD) mitigation uses a pipe inserted through the slab and connected to a fan (Fig. 1.29). Generally speaking, SSD systems are classified according to the location of the penetration point (e.g., internal or external) and the location of the fan. The three basic designs (with minor variations) are

1. Type 1: an externally mounted pipe/fan system with an exterior penetration (Fig. 1.29),
2. Type 2: an externally mounted pipe/fan system with an internal penetration (Fig. 1.30), and
3. Type 3: an interior pipe penetration with a roof- or attic-mounted fan (Fig. 1.31).

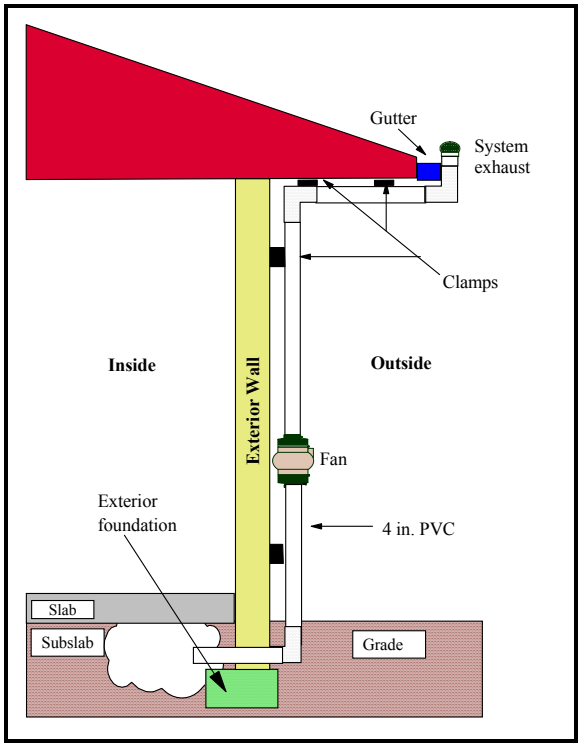


Fig. 1.29. Type 1 subslab depressurization system.

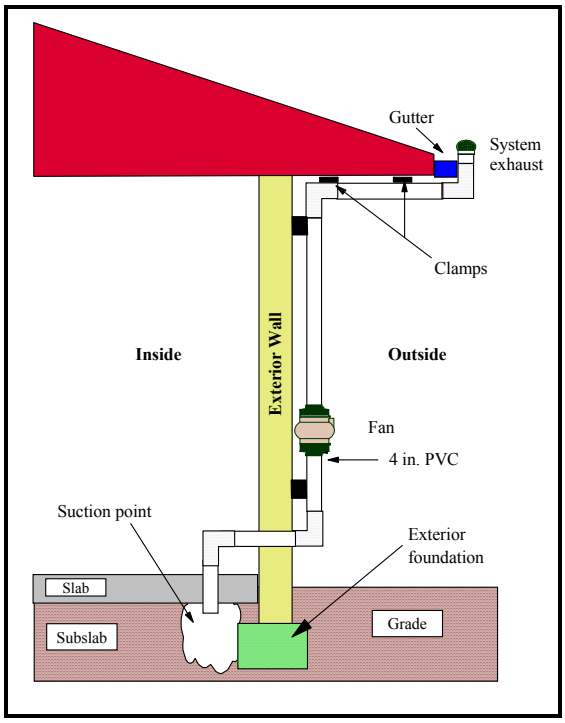


Fig. 1.30. Type 2 subslab depressurization system.

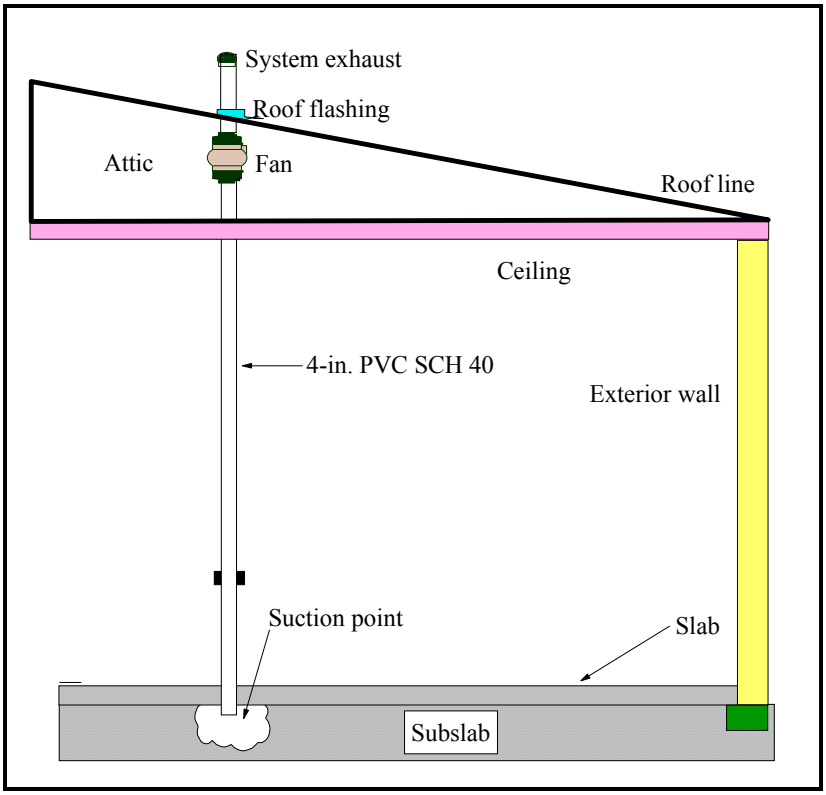


Fig. 1.31. Type 3 subslab depressurization system.

Another consideration in selecting an SSD design is planning for future O&M of the radon system. Although SSD systems do not require any specific routine maintenance, some of the system components will need to be replaced in the future because of failure or as part of a preventive maintenance schedule. In addition, to verify that the system is working, EPA recommends periodic checks of the system performance indicator in addition to inspecting the system every 2 years.

Although the time required for these checks and repairs is minimal (typically just a few minutes), gaining access to the interior of the building can be a time-consuming process. For example, studies conducted by ORNL within DoD housing sites have found that one-third to one-half of the time expended for Type 3 SSD repairs and inspections was used contacting the resident to arrange for access. Conversely, minimal resident interaction was required for Type 1 and 2 SSD systems. Although access to OMA buildings is much simpler to obtain than family housing, the time required for attic or roof access is approximately the same. Another consideration is nonresidential roofing. Unlike traditional residential asphalt shingle roofing, commercial buildings usually have complex roofing systems and are warranted or bonded by the contactor for a fixed number of years. Installing a pipe through this roof without the support or permission of the contractor would void the warranty for not only the area where the penetration occurred, but potentially the entire roof. With these considerations in mind, a Type 1 or Type 2 SSD system would be preferred.

With respect to SSD system performance indicators, EPA (*Radon Mitigation Standards,* EPA 402-R-93-078, 1994) requires that it be simple to read or interpret and be located where it is easily seen or heard by building occupants and protected from damage or destruction. The simplest and most common performance indicator, the manometer, deflects a volume of oil in a U-tube. Others rely on an electrical pressure sensor to trigger either a warning light or audible alarm.

1.4.13 Shell Pressurization System Design

Shell pressurization (SP), the oldest mitigation method, retards radon entry by mechanically introducing sufficient outdoor air to induce a positive pressure across the slab and into the soil (Fig. 1.32). However, because the installation and long-term O&M cost of an SP system is approximately twice that of an SSD system, SP mitigation is generally considered the last mitigation alternative. Typically, SP systems are used only when

1. the LFE is insufficient to depressurize the subslab,
2. ERV is impractical because of the volume of air needed,
3. the building is under significant negative pressure, or
4. the building's mechanical system has sufficient capacity to condition the outdoor makeup air.

SP systems consist of two basic types: Type 1 SP uses the existing mechanical system to provide the required volume of outdoor air (Fig. 1.19), and a Type 2 uses an independent mechanical system to condition the outdoor air prior to its entry into the structure (Fig. 1.32).

The deciding factors for the selection of a Type 1 or Type 2 SP system are the volume of outdoor air needed and the reserve load capacity of the existing mechanical system. To determine the best selection, diagnostics followed by detailed mechanical inspections are performed. Load calculations are then performed on the existing conditions and with the added conditioning load. If the added load exceeds 80% of the current capacity, then an appropriate-size Type 2 system will be needed.

More recently, the DoD has provided new requirements for ventilation systems equipped with fresh-air makeups (UFC 4-010-01, *DoD Minimum Antiterrorism Standards for Buildings*, October 2003, updated 22 January 2007). Specifically, all fresh-air makeups must have a low leakage damper and be located 10 ft above grade. In addition, the system must also have an emergency cut-off switch located on the interior of the building.

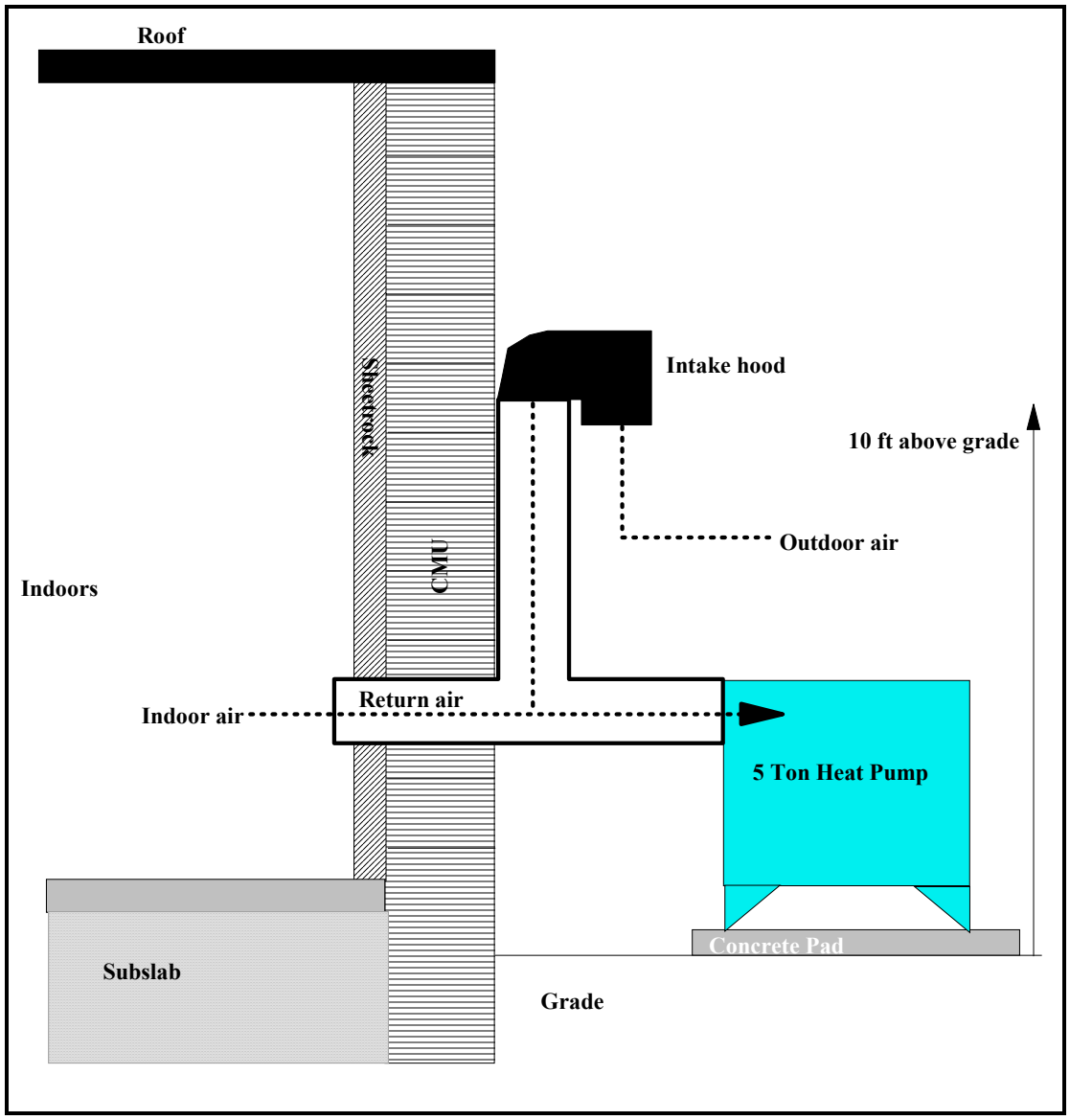


Fig. 1.32. Type 2 SP system.

1.4.14 Supplemental Air Makeup Systems Design

Supplemental air makeup (SAM) mitigation is used to correct elevated radon problems in single nonresidential rooms by providing additional ventilation. Although the systems are easy to install and maintain, the technique is not widely employed because of its limited application. Typically, for a SAM mitigation to be a viable option, the room in question must have radon levels <20 pCi/L, be <3500 ft^3 in volume, and have a low air-exchange rate (e.g., <0.2 ACH). In addition, the room must be located near a large room or common area in which 75 to 250 cfm of low radon containing conditioned air can be withdrawn without the significant risk of depressurization.

Although SAM mitigation systems are the least complex of all active mitigation systems (i.e., typically it only has a fan and two short pieces of ductwork), for it to work properly, significant pre-mitigation planning must be employed. To design a SAM mitigation system, one must first estimate or preferably measure the room's air-change rate then perform a series of calculations which include the room's volume and its current radon level (EPA 625/5-87/019, 1988). From these calculations, the minimum capacity and hence required size of the in-line ventilator can be ascertained. Then by using ASHRAE design standards, the proper duct size can then be estimated. Because SAM systems pull air from inside the building, the most recent DoD requirements (*DoD Minimum Antiterrorism Standards for Buildings,* UFC 4-010-01, October 2003, update 22 January 2207) are not applicable.

In addition to the design parameters, particular attention must also be paid to noise and occupant comfort. Because these systems are usually used in single or double offices, the noise generated by the discharge of the supply air may pose an inadvertent distraction to the occupant(s). Therefore, the supply diffuser, in addition to being aesthetically pleasing, must afford the least amount of noise. Another important consideration is the location of the discharge point. The discharge air velocity from a typical SAM system is comparable to that of a forced air system. So to the best extent possible, the discharge needs to be in a location that would not appreciably increase the air velocity in the primary work areas.

1.5 OVERVIEW OF RADON RESISTANT NEW CONSTRUCTION

Within the last 15 years, ASTM, DoD, and EPA have published standards and guidance documents to assist with incorporation of radon resistant features into new construction. Examples of available radon resistant new construction (RRNC) documents are listed here.

Residential

- *Building Radon Out: A Step-by-Step Guide on How to Build Radon-Resistant Homes* (EPA 402-K-01-002, April 2001).
- *Model Standards and Techniques for Control of Radon in New Residential Buildings* (EPA 402-R-94-009, March 1994).
- *Standard Practice for Radon Control Options for the Design and Construction of New Low-Rise Residential Buildings* (ASTM E1465-08a).

Nonresidential

- *Indoor Radon Prevention and Mitigation* (UFC 3-490-04A, May 2003).
- *Radon Prevention in the Design and Construction of Schools and Other Large Buildings* (EPA 625-R-92-016, June 1994).

As for the selection of the most appropriate standard or guideline to follow, each document has its own strengths and weakness. However, in most cases a blended approach (e.g., taking the most applicable parts of each) is best in drafting a

nonresidential RRNC design. For example, in deciding the extent of RRNC techniques needed, UFC 3-490-04A recommends that the type of facility be taken into account along with the potential for elevated radon based upon the highest radon result collected in close proximity to the new facility, whereas ASTM simply details options that could be incorporated into the design. Another consideration is the fact that certain nonresidential construction techniques go counter to the requirements of what is needed to incorporate radon resistant features. One example of this is where high ground floor loads are expected or the ground floor is part of a structural support member, the compaction of the subslab aggregate is required. Therefore, in this case a "to the best extent possible" approach for RRNC incorporation will have to be employed. The following sections provide an overview of some of the most common options available for RRNC integration.

1.5.1 Passive Sealing

A common theme in all RRNC approaches is the need to perform sealing in the floor/foundation system to prevent radon entry through openings in the slab (e.g., expansion and foundation joints, pipe penetrations etc.). Presumably if these are sealed, the radon flux into the building can be greatly reduced. However, more recently additional benefits such as reduction of moisture and insect intrusion into the building have also been identified. Last but not least is the energy savings if SSD mitigation is required in the future. Studies by DOE and EPA have shown that up to 75% of the exhaust air from an SSD system comes from the living area. Although the energy penalty associated with the loss of this small volume of air is small (typically 50–75 cfm costs about $50/year), the cumulative cost over the lifetime of the building can be significant. With respect the cost of sealing, typical estimates range from $0.10 to $0.25 per gross ft^2. Therefore, for a 10,000 ft^2 building, sealing would add an additional $1000 to $2500 to the construction cost. It is because of this low cost and the variety of resulting benefits that the authors of the various standards encourage this approach as a minimum for new construction.

1.5.2 Passive Stack

In addition to the sealing, ASTM and EPA also recommend what is called a passive stack approach. In addition passive sealing, they also recommend the installation of a 3 or 4 in. PVC vent pipe that runs from the aggregate bed [minimum 4 in. layer of clean coarse gravel (½–¾ in. mesh)] through the building and roof (Fig. 1.33). The idea being that the pipe would allow some radon to passively vent to the outside about the roof and not diffuse into the building. If this approach is used, they also recommend that an electrical junction box be placed in the attic or outside near the pipe in case a fan is needed later to activate the system. As to the number of vent pipes per building, EPA recommends at least one for every 2000 ft^2 of slab. With respect to cost, estimates range from $200 to $400 per vent pipe, which also includes the aforementioned electrical junction box. So for a 10,000 ft^2 building, installing five passive vent pipes would add an additional $1000

to $2000 to the construction cost. Unlike sealing, other than the possibility of passive radon control, there are no other apparent benefits to installing a passive vent pipe. However, if active mitigation is required, the cost of converting a passive vent pipe to an active SSD system is typically around 10% of the cost of installing a new system. In summary, for approximately the cost of installing one from scratch for an active SSD system, five passive vent stacks could be installed in new construction.

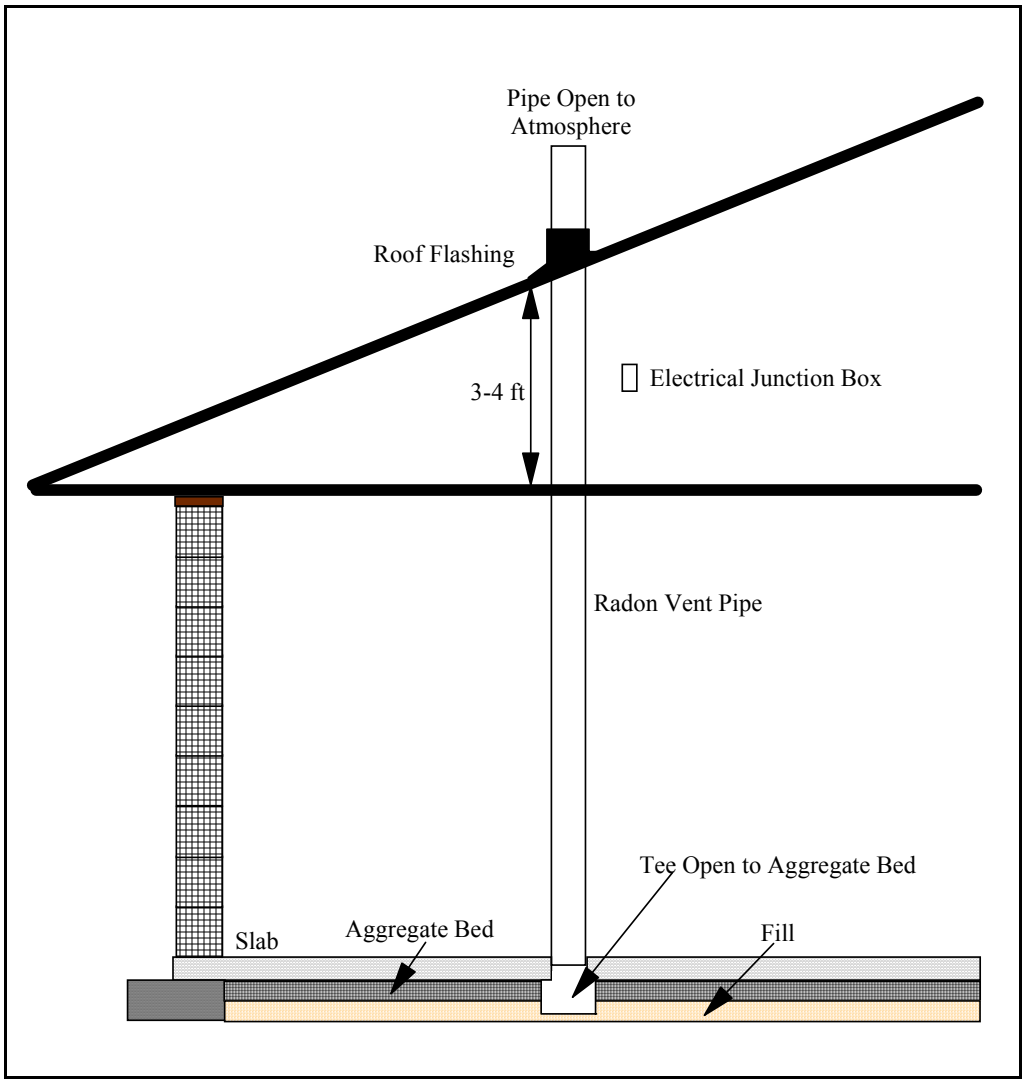


Fig. 1.33. Basic passive stack design.

1.5.3 Soil Gas Collection System

Over the past 10 years, there has been considerable increase in the number and type of soil gas collections systems available for incorporation in new construction. The oldest and perhaps simplest designs focused primarily on making the aggregate bed as permeable as possible. In this design, 6–8 in. of noncompacted, clean, ½–¾ in. mesh stone was used under the slab, grade beams, and interior footings. If later, radon mitigation was required, a subslab depressurization system was installed. The key advantage of this approach was the low cost for initial installation and the additional and predictable subslab coverage (typically 2000 ft^2 for an active system) offered by the added aggregate. In cases where the additional aggregate was not available or not practical, later designs made use of trenches filled with aggregate or proprietary strip mats.

To enhance subslab coverage for both passive and active mitigation systems, later approaches used, in addition to the enhanced aggregate bed, a network of perforated pipe under the slab. This network consists of a perforated 4 in. PVC pipe (commonly called septic field line or slotted PVC well casing) in the aggregate bed which bisects the length of the slab and, as needed, branches to penetrate interior footings or foundations (Fig. 1.34). In lieu of using PVC pipe, 4 in. polyethylene slotted corrugated drain pipe can be used, but care must be taken to ensure that the pipe is not crushed prior to pouring the slab. To successfully cover the perforated pipe, an additional 3–4 in. (½–¾ in. mesh) of aggregate (8 in. total) is applied in addition to a vapor barrier on top of the aggregate. In designing the soil gas collection system, it is imperative that the pipe extends into each and every compartment of the subslab. In addition, aggregate depth, size, and degree of compaction have a strong influence on the coverage. For example if 8 in. of noncompacted, ½–¾ in. mesh stone is used, the vacuum field will extend up to 50 ft from each side of the branch in a non-subdivided subslab compartment. However, if the same aggregate is highly compacted, the coverage can drop to <10 ft. If properly installed, one can typically expect field extensions of 5000 ft^2 or more for active mitigation systems.

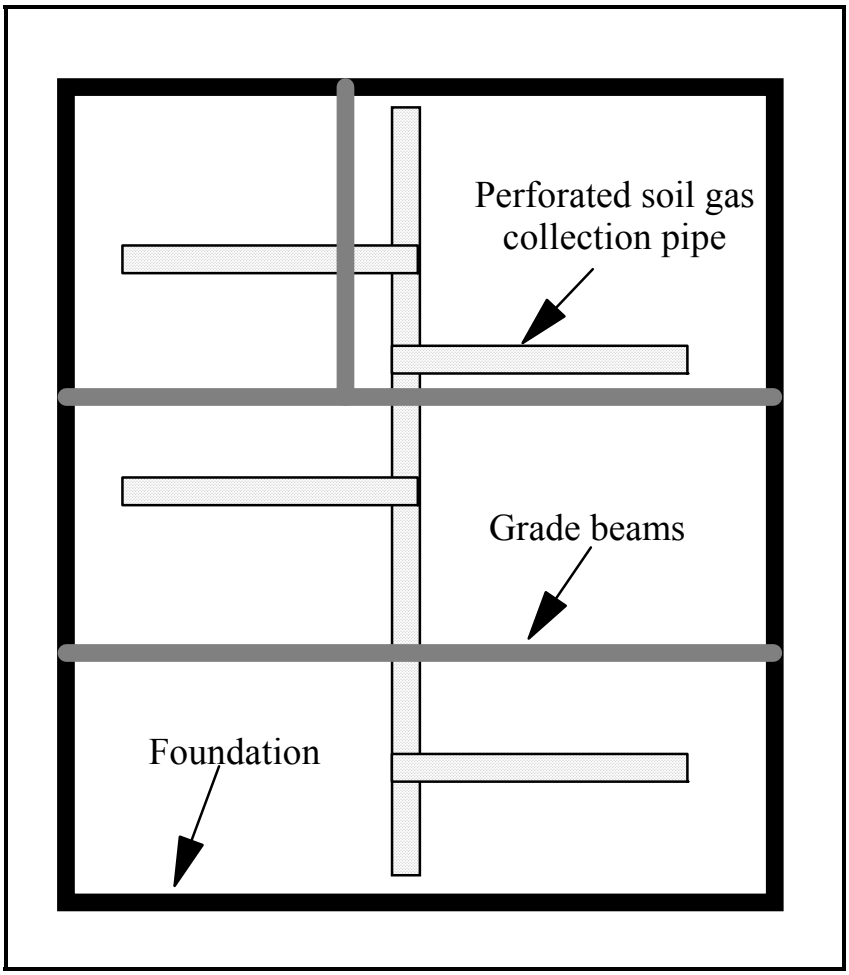


Fig. 1.34. Example of a soil gas collection system.

More recently, in 2008 ASTM conducted a review of all available soil gas system methods and consolidated them in *Standard Practice for Radon Control Options for the Design and Construction of New Low-Rise Residential Buildings (*ASTM E1465-08a). Briefly, in the standard, ASTM has categorized the most common soil gas collection systems into one of five general designs (Table 2, page 9) each with its own options (Table 4, page 10). Although this document was drafted for residential applications, the decision tree and specifications extrapolate readily to nonresidential applications.

1.5.3.1 Vent Pipe Options for Soil Gas Collection System

If a soil gas collection system is installed, the pipe network must be connected to either a passive stack vent or to a pipe that is stubbed out and capped either in the living area or attic or on the exterior of the building. The number of vent pipes, or more commonly referred to as risers, depends upon the aggregate depth, size, and degree of compaction. For example, if 8 in. of noncompacted, ½–¾ in. mesh stone is used, one riser would usually cover 3000–5000 ft^2 in a non-subdivided compartment. However, if the same

aggregate is highly compacted, the coverage can drop to <1000 ft^2. Because of the possibility of passive mitigation in noncompacted aggregate beds, EPA recommends that a passive stack be connected to the soil gas collection system with allowances for the installation of a fan if needed later.

Because not all building designs can accommodate a passive stack, another option is to extend a branch through the outside foundation to the outside of the building and install a capped riser (Fig. 1.35). If later testing determines that an active system is needed, the vent pipe and fan are installed.

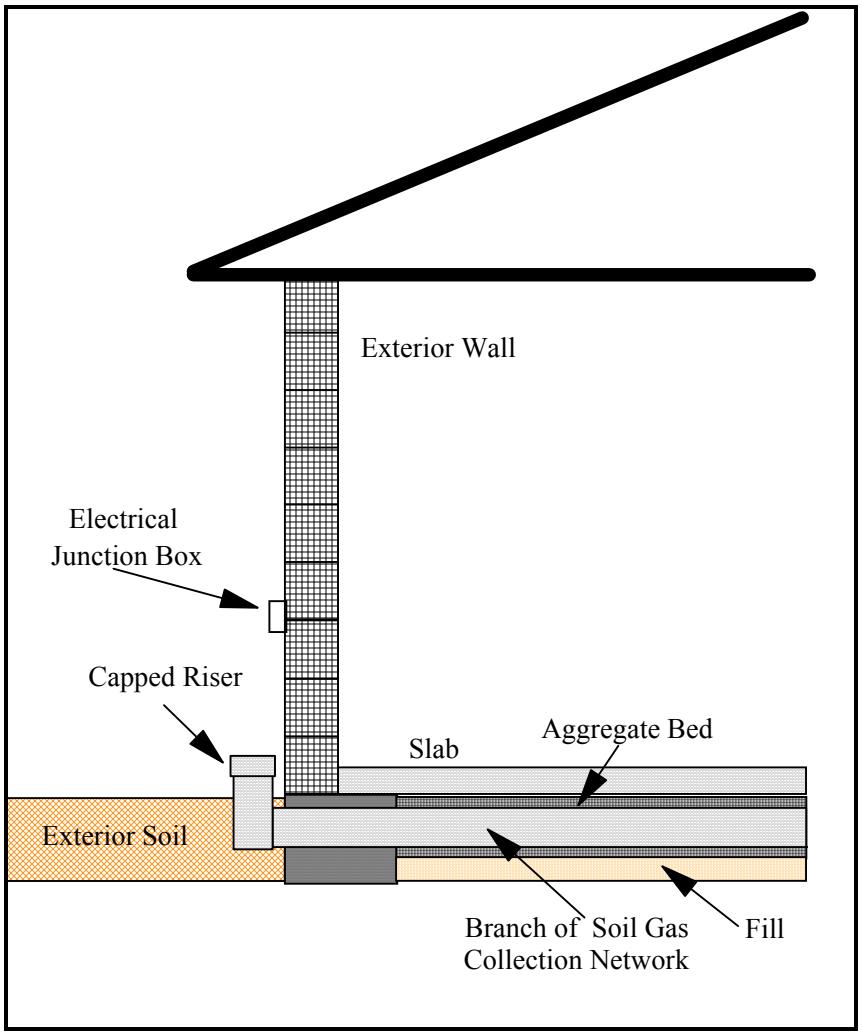


Fig. 1.35. Exterior riser on a soil gas collection network.

1.6 RADON SPECIFIC ISSUES AT FT CAMPBELL

1.6.1 The Geologic Radon Potential of Ft Campbell

In 1995, USGS published a report that provided a generalized assessment of the radon potential in Kentucky and Tennessee based on available USGS geological data and soil survey data collected by the Soil Conservation Service (*Geological Radon Potential of EPA Region 4*, USGS Open File Report 93-292-D). In addition to these data, the report took into account available radon data collected by EPA during the 1986–1987 national residential radon survey.

According to the USGS report, Ft Campbell, which spans Christian County, Kentucky, and Montgomery County, Tennessee, resides on the Mississippian Plateau which consists primarily of formations of marine shale, sandstone, and limestone. Although sandstone formations are not typically identified with high radon potential, the remaining two formations (marine shale and limestone) are known to have significant uranium and radium content. In addition, some of the limestone formations in this area contain karst features, which have been linked to seasonally enhanced radon levels (Wilson 1991).

However, geologic potential for radon is only part of the elevated radon question. Before radon can enter a building, it usually must past through a layer of soil. Simply stated, buildings with a thick underlining layer of low permeability soil have a lesser chance of having elevated radon than those located over shallow high permeability soils. According to the USGS report, Ft Campbell resides on the Pembroke-Cumberland Crider soil series, which is a well-grained clay soil with high permeability. Because this soil is derived from limestone, variable amounts of uranium and radium are found just below the top organic layer. In addition, because of the presence of karst features in the Mississippian Plateau formation, radon emanating from the soil matrix can diffuse into the solution cavities where it can potentially concentrate and migrate over significant distances.

Using this information and the data collected by EPA during the national residential radon survey, USGS concluded in 1995 that the two counties (Christian and Montgomery) would be an EPA Radon Zone 2. In brief, homes and buildings tested in these counties would have a moderate elevated radon potential with predicted average radon concentrations for the entire population between 2 and 4 pCi/L.

More recent studies at Ft Campbell conducted by the DOE have confirmed the presence of karst radon assisted transport into both residential and nonresidential buildings during the primary heating season (nominally November to March). These studies have found that, on average, indoor radon levels are approximately 2 to 3 times as high during the winter months when compared to the summer months. In addition, soil gas subslab pressure data collected during opposite seasons within a subset of these buildings

confirmed that the karst cavities were indeed venting during the heating season. This observation does not imply that the radon problem at Ft Campbell is only observed during the winter months. The studies also demonstrated that most of the buildings identified as having elevated radon in the winter months continue to be >4 pCi/L during the cooling season as well.

1.6.2 Karst Assisted Radon Transport at Ft Campbell

Indoor radon levels can vary significantly from day to day and season to season. To minimize the impact of the day-to-day variation, whenever feasible, long-term testing is used at Ft Campbell. However, the potential problem with season-to-season variation at Ft Campbell is a little more difficult to address. The EPA action level for radon, 4 pCi/L, is based upon an annual integrated average exposure. Therefore, in areas of the country where sizable seasonal variation occurs, care must be taken to reach a defensible testing conclusion. Recent studies by the DOE at Ft Campbell have determined that some buildings exhibit karst assisted radon transport (KART) during the heating season. In these buildings the seasonal studies have shown that measurements collected during similar seasons and under similar conditions usually agree within 25%. However, within the same buildings, a difference of 200% has also been observed when comparing winter vs summer elevated radon concentrations. This observation does not imply that elevated radon at Ft Campbell is a seasonal problem. In fact, most of the buildings identified as having elevated radon in the winter also had elevated radon in the summer. However, for a few buildings, follow-up testing during the summer months would have been potentially misleading (although the summer radon concentration was <4 pCi/L, the integrated annual concentration was >4 pCi/L). A close examination of all available seasonal radon data collected at Ft Campbell has determined that most buildings do not appear to exhibit KART. However, since it is impossible to predict in advance KART buildings, the prudent course of action is to conduct the testing in a manner that anticipates its presence.

The most apparent solution to the KART question would be to test all buildings for 1 year. However, studies at Ft Campbell have found that detector losses average around 0.5% to 1% per month. Therefore during a 1 year test, losses of 6 to 12% would be expected, necessitating a significant retest effort. To minimize the potential losses while still addressing the KART concern, a middle ground needs to be identified without the need to perform excessive opposite season testing. One option is to perform the EPA sequential averaging of opposite season short-term results method. In this method the testing conclusion is based on the simple arithmetic average of the two short-term measurements collected in opposite seasons. However, EPA concedes that following up a measurement >8 pCi/L would be pointless because even if the measurement was 0 pCi/L (a theoretical impossibility), the average of the two measurements would still be 4.0 pCi/L. Therefore, the precedent exists for the establishment of an analogous Ft Campbell KART threshold whereby an elevated reading would be considered sufficient to warrant corrective action. According to the National Weather Service, the mean temperature at Ft Campbell drops below ground temperature (the driving force of

radon in karst geology) for approximately five months of the year (Table 1.5). Hypothetically speaking, based upon the average winter/summer ratios (2 to 3) observed at Ft Campbell, any valid long-term measurement ≥6 pCi/L performed during those five months (November to March) would have an acceptable chance of integrating to a 4 pCi/L annual average (Table 1.6). For measurements <6 pCi/L, opposite season testing should be considered.

Table 1.5. Monthly mean temperatures at Clarksville, Tennessee

Month	Mean Temperature
Jan	35°F
Feb	40°F
Mar	49°F
Apr	58°F
May	66°F
Jun	75°F
Jul	79°F
Aug	77°F
Sep	71°F
Oct	59°F
Nov	48°F
Dec	39°F

Table 1.6. Example of winter/summer ratios test data

150 Day Concentration to Result in 4 pCi/L Annual (pCi/L)	Average Radon Concentration for Remainder of the Year (pCi/L)	Winter/Summer Ratio
9.0	0.5	18.0
8.3	1.0	8.3
7.6	1.5	5.1
6.9	2.0	3.4
6.2	2.5	2.5
5.4	3.0	1.8
4.7	3.5	1.3
4.0	4.0	1.0

2. REGULATION, POLICY AND GUIDELINES
Revision Date: October 22, 2009

2.1 REGULATORY OVERVIEW OF RADON

In recognition of the public health hazard presented by indoor radon, the U.S. Congress passed the *Indoor Radon Abatement Act of 1988* (IRAA), and the President signed it into law. IRAA, part of Title III of the *Toxic Substances Control Act of 1988,* declares the national goal to be "that the air within buildings in the United States should be as free of radon as the ambient air outside the buildings" (Public Law 100-551, TSCA Section 301 in Title III of the *Toxic Substances Control Act of 1988*). In addition, the law stipulates that the head of each federal agency that manages a building will design a study to assess the extent of radon contamination in buildings within its jurisdiction and submit that study to EPA. However, unlike the case for other indoor environmental hazards (e.g., lead-based paint, asbestos), IRAA did not require that any corrective action be taken. With respect to other federal laws, the Occupational Safety and Health Administration (OSHA) regulates radon only at privately owned and operated nuclear facilities. At the state level, many states (e.g. Illinois, Pennsylvania, and New Jersey) have strict laws requiring that homes be tested and that radon test results be disclosed to the prospective home buyer. In some states, radon must be reduced to acceptable levels prior to closing. In Tennessee and Kentucky, currently there are no legal requirements for testing, mitigation, or reporting.

2.1.1 Regulatory Overview of Radon in Water

The *Safe Drinking Water Act* as amended in 1996 directed EPA to make available a multimedia mitigation (MMM) program to address radon risks in indoor air and from drinking water. This option affords states the opportunity to develop enhanced state programs to address the health risks from radon in indoor air while individual water systems reduce radon levels in drinking water to 4000 pCi/L or lower. Currently, EPA is encouraging states to adopt this option because it is the most cost-effective way to achieve the greatest radon risk reduction. Within the U.S. Department of the Army (DA), responsibility for compliance with the *Safe Drinking Water Act* as amended in 1996 falls within the Environmental Office of the Public Works Business Center and consequently falls outside the scope of this document.

2.2 U.S. ARMY GUIDANCE AND REGULATIONS

2.2.1 The Army Radon Assessment and Mitigation Program

The *Indoor Radon Abatement Act of 1988* (IRAA) (Public Law 100-551, TSCA Section 309 in Title III of the *Toxic Substances Control Act of 1988*) requires all Federal agencies to conduct studies to determine the extent of radon contamination in their respective Federal buildings. In response, the DA established the Army Radon Reduction Program (ARRP) under Army Regulation (AR) 200-1 to comply with this regulation.

The ARRP is divided into three phases:

1. Phase I, Initial Assessment, involves performing measurements under closed building conditions so that a conservative assessment of the radon levels can be obtained. If low radon levels are detected, it is assumed that the annual radon concentrations are below the recommended remedial levels.
2. Phase II, Confirmation, involves follow-up measurements in buildings that had measurements higher than the recommended remedial action level during Phase I.
3. Phase III, Mitigation, involves taking corrective action in buildings that have confirmed high radon levels.

Based on a building's use and its degree of occupancy, ARRP prioritizes the order in which buildings are to be tested. Under this algorithm, all buildings at a DA site are classified into one of five priority codes, the lowest priority code having the highest degree of urgency. A description of the priority codes follows.

1. Priority 1 buildings are defined as living areas, such as day care centers, hospitals, schools, residential quarters, and billets.
2. Priority 2 buildings are 24 h operation areas, such as operation centers and research, development, test, and evaluation facilities.
3. Priority 3 buildings include 8 h or less operation areas, such as all other routinely occupied structures, offices, and shops.
4. Priority 4 buildings do not have any offices and may have open airways. Testing of these buildings is at the discretion of the DA facility.
5. Priority 5 buildings are structures scheduled for demolition. ARRP policy stipulates that buildings designated as Priority 5 buildings should not be tested.

The U.S. Army Environmental Hygiene Agency (USAEHA) Technical Guide 164 sets the Army's action levels for its buildings, and is based on EPA guidelines (Table 2.1). Table 2.2 lists the ARRP action guidelines.

Table 2.1. Radon exposure risk

Radon level (pCi/L)	Number of lung cancer deaths per year per 1000 people	Comparable risks
200	440–770	More than 60 times the lung cancer risks of nonsmokers
		Four packs/day smoker
100	270–630	
		20,000 chest X-rays per year
40	120–380	
		Two pack/day smoker
20	60–120	
		One pack/day smoker
10	30–120	
		Five times non-smoker risks
4	13–50	
		200 chest X-rays per year
2	7–30	
		Nonsmoker risk of lung cancer
1	3–13	
0.2	1–3	20 chest X-rays per year

Source: EPA, *A Citizen's Guide to Radon,* OPA-86-004, 1986.

Table 2.2. ARRP recommended radon mitigation schedules

Action Priority	Radon Levels (pCi/L)	Army Radon Reduction Program Policy
5	0 to ≤ 4	No further action is required.
4	> 4 to ≤ 8	Perform long-term radon test. If the measurement is confirmed, mitigate within five years.
3	> 8 to ≤ 20	Perform long-term radon test. If the measurement is confirmed, mitigate within one to four years.
2	> 20 to ≤ 200	Mitigate within six months.
1	> 200	Mitigate immediately. If mitigation will take longer than one month, occupants shall be relocated to another living or working environment.

2.2.2 U.S. Army Radon Policies

The original intent of the ARRP testing protocols (TG-164) was to assess Army facilities for elevated radon potential. In 1995, after an Army-wide programmatic review, the USAEHA decentralized the ARRP program and made the implementation of the program the responsibility of each Army facility. In 1997 the Army published *Environmental Protection and Enhancement* (AR 200-1, 21 February 1997, Chapter 9), which clarified the Army radon program's objectives and added the requirement for testing all renovated and newly constructed Army facilities in addition to disclosure of radon results to facility managers. In 1998 the Army published the *Commander's Guide to Environmental Management*, March 1998 (page 109), which provided objectives and additional instructions for base commanders with regard to radon. According to the guide, the objectives of the program are as follows:

1. Implement the Army radon program.
2. Implement the Army Radon Assessment Plan, designed to measure by priority the radon levels in schools, day care centers, hospitals, housing, offices, and other structures.
3. Identify structures with indoor radon levels greater than 4 pCi/L and implement mitigation actions to reduce levels to 4 pCi/L or less.
4. Implement the Army Radon Mitigation Plan, specifying deadlines for mitigation based on radon levels.

With respect to the Garrison Commander, the guide states the commander should:

1. Incorporate radon mitigation techniques in new construction.
2. Maintain a database of radon assessment and mitigation data.
3. Budget for the measurement of radon in structures and the mitigation of elevated levels.

In 2002 the Army released the *Environmental Protection and Enhancement* (DA PAM 200-1, 17 January 2002, Chapter 9), which provided additional clarification on records retention and guidance for radon testing and mitigation. Also in 2002, in recognition of the fact that the control of radon is an ongoing, never-ending process, the U.S. Army Environmental Center published the *Installation Environmental Program Management Guide* (SFIM-AEC-CO-TR-2002016, 2002), which transformed ARRP from a screening program to a radon management program.

In December 2007, the AR 200-1, 21 February 1997 was superseded by AR 200-1, 13 December 2007. In this latest AR 200-1 edition, the radon section was inexplicitly omitted. However, according to the U.S. Army Corps of Engineers (COE) radon point of contact (located at the COE Omaha Office), a Technical Bulletin for AR 200-1, 13 December 2007 to correct the omission is currently in draft. In the meantime, the previous guidance on radon will be followed.

2.3 FT CAMPBELL RADON REDUCTION PROGRAM POLICIES

At the inception of the Army Radon Reduction Program (ARRP) in 1988, the stated overall objective was to test all Army facilities worldwide using a sampling protocol that would ensure an overall 95% statistical confidence that no single Army facility would have elevated radon potential. Since that time the ARRP's focus has shifted from a worldwide screening program to more of an ongoing facility environmental program. To reflect these transitional changes in Army radon policy, the Ft Campbell Radon Reduction Program has established post specific policies to address all facets of radon (e.g., RRNC, testing, mitigation, and long-term operation and maintenance of radon mitigation systems). In developing the following post specific policies, EPA, state radon contacts, and subject matter experts were consulted.

2.3.1 Radon Management Plan

The primary purpose of the *U.S. Army Radon Management Plan 2009* is to provide role and responsibility guidance for the implementation of RRNC, radon testing, mitigation, and radon system maintenance activities within OMA buildings. Briefly, the primary responsibility for the implementation of the plan resides with the Radon Management Control Officer (RMCO) who heads a Radon Management Team (Fig. 2.1) comprised of personnel from different disciplines and organizations (e.g., Directorate of Contracting, Health Services, Public Affairs Office, etc.) at Ft Campbell.

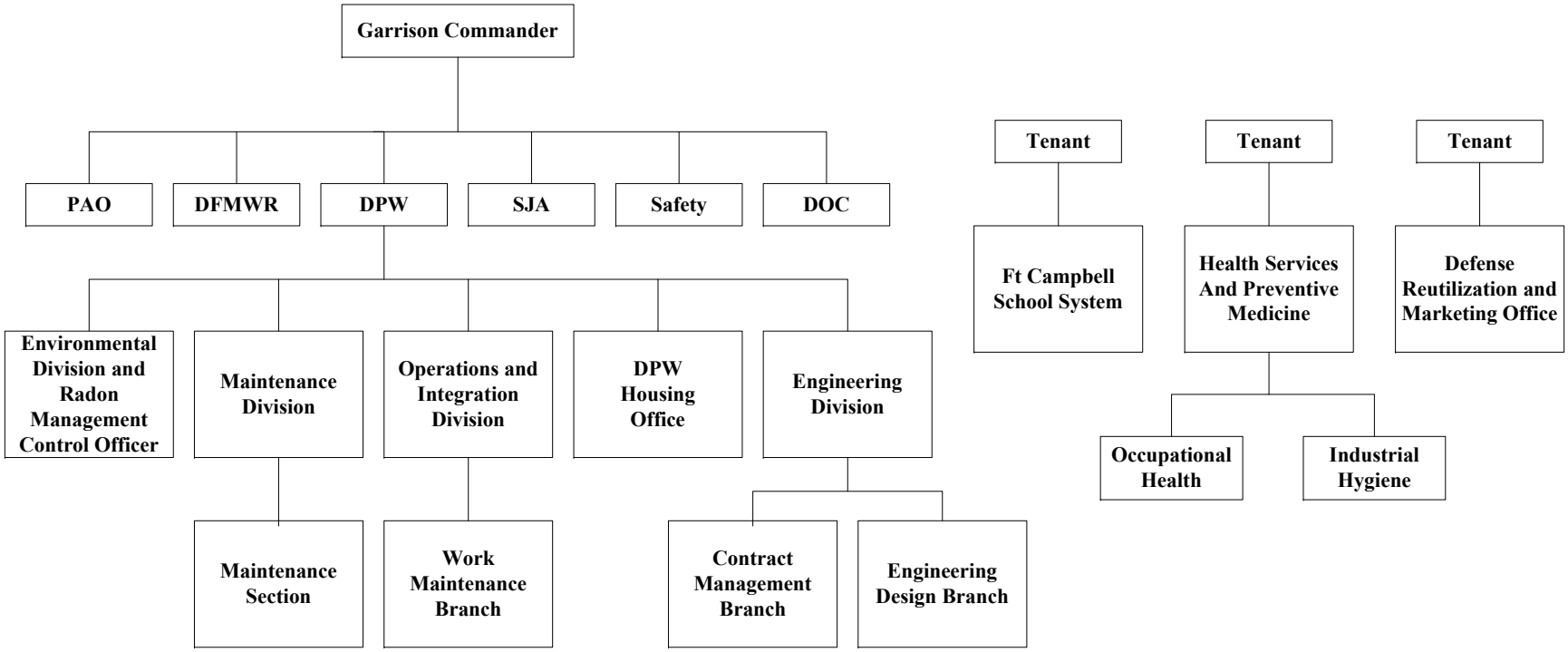


Fig. 2.1. Ft Campbell Radon Management Team organization chart.

2.3.2 Radon Testing Policy

It is the policy at Ft Campbell that **ALL** enclosed, ground contact, occupied rooms within OMA buildings (i.e., occupied for >4 h/day) be tested for radon. In addition, the policy requires that

1. a short-term radon test be performed prior to occupancy of all new buildings, followed by a long-term test after at least 1 year of occupancy;
2. renovated buildings be retested within 1 year of its completion;
3. all buildings and rooms without mitigation be retested every 5–7 years; and
4. mitigated rooms be retested every 2 years.

Exceptions to this testing policy are

- vacant buildings scheduled for demolition or divestiture within the next 2 years, and
- buildings scheduled for significant or whole renovation within the next 2 calendar years.

2.3.2.1 Rooms to Test

In selecting a room to test within a building, Ft Campbell radon testing policy requires that all routinely occupied (i.e., >4 h/day) or readily occupiable, enclosed, ground contact rooms should be tested for radon. Additional rooms for testing at the discretion of the Radon Management Control Officer may include ground-contact hallways, common areas, and other types of rooms that meet the minimum occupancy requirements. To the best extent possible the detectors should be placed in accordance with applicable portions of *Indoor Radon and Radon Decay Product Measurement Device Protocols* (EPA 402-R-92-004, July 1992) and *Protocols for Radon and Radon Decay Product Measurements in Homes* (EPA 402-R-92-003, May 1993).

2.3.2.2 Type of Radon Test

With respect to the type of radon testing, Ft Campbell radon testing policy requires that to the best extent possible, the initial radon test in a building should be long term (i.e., >90 days) and be a collocated duplicate measurement. For all other types of radon testing (e.g., renovation and follow-up retesting, postmitigation, and operation and maintenance testing), collocated, duplicate short-term testing (i.e., 2 to 90 days) is permitted. In addition, the testing device must measure and report radon gas directly and not be reliant either directly or indirectly on the particulate concentration.

2.3.2.3 Type of Radon Detectors

For radon testing in OMA buildings at Ft Campbell, four types of detectors are approved for radon measurements: alpha-track, charcoal, electret, and continuous radon monitors. In addition, all detectors and continuous monitors used for radon testing must

- be EPA, National Environmental Health Association (NEHA), or National Radon Safety Board (NRSB) approved;
- be used in accordance with the manufacturer's, EPA, NEHA, and NRSB published specifications; and
- have data collection that meets minimum ARRP and Ft Campbell data quality objectives.

2.3.2.3.1 *Rationale for Radon Testing Policy*

According to USGS and EPA, the Ft Campbell Military Reservation is located in an area with moderate radon potential (EPA Radon Zone 2). Past radon studies in OMA buildings have found these predictions to be true for all areas of the military reservation. In addition, because of the presence of karst geology under most of the military reservation, there is a potential for seasonal variation in the concentration of indoor radon.

2.3.2.3.2 *Rationale for the Exclusion of Radon Progeny Measurements*

Although EPA, NEHA, and NRSB protocols allow for the measurement and reporting of radon results in either picocuries per liter or working level (WL), uncertainties in particulate concentrations (a key assumption in WL measurements) within OMA buildings make using WL measurements difficult. Although it is acknowledged that considerable risk comes from radon progeny attached to particles, there is still a great deal of uncertainty associated with the lung cancer risk from unattached progeny. However, what is known and acknowledged by EPA is that if the radon gas concentration is low, the risk is low.

2.3.3 Confirmation Policy

Consistent with current EPA recommendations for follow-up testing, Ft Campbell requires that all rooms with a single reading (e.g., one detector) ≥4 pCi/L be confirmed by a collocated duplicate follow-up measurement (short term or long term) before the initiation of corrective action. However, an elevated measurement can be considered confirmed (i.e., no further testing is needed) if

- the elevated measurement was performed using collocated duplicates and the relative percent difference (RPD, Equation 2.1) is <36%,

- other rooms in the building have elevated radon, or
- test data in the room collected within the last 5–7 years was elevated.

$$\text{Relative percent difference} = \frac{(\text{Highest pCi/L} - \text{Lowest pCi/L}) \times 100\%}{\text{Mean}}$$

Equation 2.1. Relative percent difference.

In all other cases, a collocated duplicate follow-up measurement will have to be performed. After the collocated duplicate follow-up measurement, the elevated measurement will be considered confirmed if

- the average of the follow-up measurement is ≥4 pCi/L, or
- the average of the follow-up measurement is ±50% of the elevated measurement.

In cases of disagreement, an additional measurement using either a short term or long term (preferred) should be performed during similar test conditions as the elevated measurement. If the second follow-up measurement agrees with the initial radon test, then the elevated result is kept. If the second follow-up agrees with the first follow-up measurement, then a new conclusion is reached based on the most recent measurement.

2.3.4 Corrective Action Policy

Consistent with EPA and ARRP guidelines, all occupied rooms (i.e., >4 h/day) with a confirmed radon concentration ≥4 pCi/L shall be mitigated. With respect to timeline, all mitigation should be performed as soon as practical or within the timeframe listed in Table 2.3.

Table 2.3. Ft Campbell radon action levels

Radon Level (pCi/L)	Timeline for Corrective Action
<4	No action required
≥4 to ≤8	Mitigate within 5 years
>8 to ≤20	Mitigate within 1 to 4 years
>20 to ≤200	Mitigate within 6 months
>200	Mitigate immediately. If mitigation will take longer than one month, occupants shall be relocated to another working environment.

2.3.5 Radon Mitigation Policy

The only mitigation techniques allowed within the Ft Campbell area of cognizance are those which prevent radon gas from entering the building or those which dilute the gas by

use of supplemental ventilation (see EPA/625/5-88/024 August 1988, and EPA/625/R-93/011 October 1993 for a complete list of mitigation techniques). Mitigation methods using high-efficiency particulate air (HEPA) filtration or progeny removal are not allowed.

2.3.5.1 Rationale for Not Allowing HEPA Mitigation

Although it is acknowledged that a HEPA filter can remove significant particulate matter from the air and reduce the radon progeny from the ambient atmosphere in those areas being filtered. However, because the radon gas concentration is unaffected by the HEPA filter, the progeny are continually replaced by subsequent radioactive decay of the radon gas. Further, filtration of the air changes the distribution of the sizes of the particles in the air to lower sizes. Radon progeny attached to particles of decreased size present in the air may become more effective in delivering dose to the lung, thus the reduction in progeny filtration may not provide equal health risk reduction (P. Jalbert, E. Fisher, U.S. EPA correspondence to Douglas County School Board, Minden, Nevada, March 6, 2008).

In summary, while HEPA or other high efficiency filtration can be used to remove particulates and reduce radon progeny in the air, it does not affect the radon gas concentration and, therefore, radon progeny will continue to be produced in the ambient air. The resulting shift in particle size distribution in the air will deliver an unknown dose from radon progeny to the lung. Further, radon gas measurements will be unaffected by filtering, and the assessment of the effect of filtration involves multiple measurements of radon progeny concentrations and particle size distributions throughout the building. Therefore, at this time and consistent with EPA recommendations, Ft Campbell does not support the use of air filtration as a means of mitigating the health effects of radon.

2.3.6 Radon Mitigation Scheduling

Although it is the policy of Ft Campbell to mitigate all buildings as soon as possible or within the Army/EPA recommended guidelines, available funding, and mission schedule will have an impact on the mitigation schedule. In cases where selections need to be made, the following ARRP mitigation priority list shall be used:

- Priority 1: Living areas, day care centers, hospitals, schools, residential quarters, and billets.
- Priority 2: Buildings that are staffed 24 h/day such as operation centers and research, development, test, and evaluation facilities.
- Priority 3: Buildings that are staffed 8 h/day such as operation areas, offices, and shops.
- Priority 4: Buildings that are staffed >4 h/day but <8 h/day.
- Priority 5: Buildings that are currently occupied, but that are scheduled for demolition.

The Radon Management Control Officer (RMCO) is responsible for maintaining an active list of buildings requiring mitigation and determining mitigation priorities.

2.3.7 Operation and Maintenance of Radon Mitigation System Policy

Consistent with EPA guidelines, all radon mitigation systems shall be maintained. This includes, but is not limited to, performing any required maintenance, periodic inspections, and retesting the mitigated rooms every 2 years.

2.3.8 Radon Resistant New Construction Policy

For all new OMA building construction at Ft Campbell, the DA and the *Ft. Campbell Engineering Design Guide*, June 2007 require the incorporation of radon resistant features in all new construction. Therefore as a minimum, all construction should meet the requirements listed in *Indoor Radon Prevention and Mitigation* (UFC 3-490-04A, May 2003).

2.3.9 Public Awareness Policy

Ft Campbell policy is that all verified information be offered to the specific stakeholder(s) in a traceable fashion as soon as it becomes available. Examples of stakeholders are

- occupants of OMA buildings,
- command authorities,
- Department of Defense Dependent Schools (DODDS) personnel, and
- Ft Campbell medical support staff.

Release of general information or individual radon results to other potentially interested parties such as state, local, and federal officials, educational and research institutions, and news organizations must be cleared by the Public Affairs Office prior to release.

2.3.10 Quality Assurance and Quality Control Policy

For all radon surveys and mitigation at Ft Campbell, sufficient Quality Assurance and Quality Control (QA/QC) must be employed to ensure that the data quality objectives for the project are met or exceeded.

2.3.10.1 Radon Testing Quality Assurance and Quality Control Policy

The overall Ft Campbell QA/QC requirements for radon measurement are that

- Reported data must have established ranges within a 95% confidence interval.
- Reported data must be able to be referenced to a defensible standard.
- Known measurement errors must be tracked, corrected, and reported.
- All data must meet minimum EPA, NEHA, and NRSB requirements for radon measurements.
- Contractors performing the testing shall be certified by NEHA or NRSB and have documented experience.

2.3.10.2 Radon Mitigation Quality Assurance and Quality Control Policy

The Ft Campbell QA/QC policy for radon mitigation is as follows:

- The installed mitigation system shall consistently maintain the radon levels <4 pCi/L when operating.
- Only mitigation methods that either (1) prevent radon gas from entering the building or (2) dilute the gas by use of supplemental ventilation can be used within OMA buildings (EPA/625/5-88/024 August 1988, and EPA/625/R-93/011 October 1993).
- All active soil depressurization (ASD) mitigation systems shall be in accordance with ASTM E2121-08 and UFGS-31-21-13 (April 2006).
- All mitigation systems will be equipped with a performance indicator and contact information to report system failure.

2.3.11 Testing and Mitigation Health and Safety Policy

Prior to the initiation of testing or mitigation at Ft Campbell, the subcontractor shall submit for review and comment to the Radon Management Control Officer (RMCO) project health and safety plan (HASP). At a minimum, the submitted HASP shall meet the requirements listed in *Radon Mitigation Standards* (EPA 402-R-93-078, 1994) and address potential hazards to the workers and building occupants and the proposed measures to control them.

3. METHODS, PROCEDURES AND SPECIFICATIONS
Revision Date: October 22, 2009

3.1 RADON TESTING AT FT CAMPBELL

3.1.1 Ft Campbell Radon Testing Protocol Overview

At the inception of the Army Radon Reduction Program in 1988, the stated overall objective was to test all Army facilities worldwide using a sampling protocol that would ensure an overall 95% statistical confidence that no single Army facility would have elevated radon potential. Since that time the focus has shifted from a facility screening program to more of an ongoing facility maintenance program in which the primary focus is the individual building. Because most radon testing in the United States is performed in single-family housing, the EPA has focused considerable effort in the development of residential testing protocols. The underlying premise in these protocols is that the resident is genuinely motivated either by health concerns or the desire to sell a house and will do what is required to achieve a defensible testing conclusion. Consequently, the ability to perform a successful short-term radon measurement under the prescribed closed building conditions presumably is simplified. With respect to nonresidential buildings, the only available EPA guidance document, *Radon Measurement in Schools* (EPA 402-R-92-014, July 1993) does not adequately address the reality of testing a large population of buildings using its multiple test strategy. Consequently, the Ft Campbell Radon Reduction Program has had to develop its own sampling strategy for OMA Buildings. In compiling the nonresidential sampling strategy, in addition to consulting with EPA, state radon contacts and subject matter experts, applicable portions of *The Department of the Army Radon Program* (USAEHA, Technical Guide 164, September 1989) and the following EPA documents were used:

- *A Citizen's Guide to Radon* (EPA 402-K-07-009, revised May 2007);
- *Home Buyer's and Seller's Guide to Radon* (EPA 402-K-06-093, November 2006);
- *Radon Measurement in Schools Revised Edition* (EPA 402-R-92-014, July 1993);
- *Technical Support Document for the 1992 Citizen's Guide to Radon* (EPA 400-R-92-011, May 1992); and
- *Indoor Radon and Radon Decay Product Measurement Device Protocols* (EPA 402-R-92-004, July 1992).

Briefly, this protocol requires the testing of all routinely occupied (i.e., >4 h/day), enclosed, ground contact rooms in addition to rooms that are currently vacant but suitable for occupancy. Additional rooms for testing at the discretion of the Radon Management and Control Officer may include ground-contact hallways, common areas, and other types of rooms that meet the minimum occupancy requirements.

Circa 2002, USAEHA declared the testing portion of TG-164 obsolete and recommended that all future testing of OMA buildings be conducted as applicable with the then current *Radon Measurement in Schools (Revised Edition)* (EPA 402-R-92-014, July 1993). However, in anticipation of the testing protocol change beginning in 2000, Ft Campbell implemented testing all routinely occupied ground contact rooms for previously untested buildings. With respect to buildings tested using the outdated TG-164 testing protocol in prior years (1989–1998), a goal was set to retest these buildings within the next 5 to 10 years.

Beginning in 2006, the EPA's Federal Interagency Committee on Indoor Air Quality (CIAQ) began providing additional guidance to federal agencies on radon testing and mitigation. For nonresidential buildings the committee has made the following recommendations:

- Test every occupied room.
- Retest every 5 to 7 years at a radon priority site.
- In buildings with radon reduction systems, perform O&M testing and inspections every 2 years.

Based on the information and guidelines provided by EPA, radon testing in OMA buildings at Ft Campbell was divided into two categories, buildings with and without mitigation. For buildings without radon mitigation, radon testing in all occupied or readily occupiable ground contact rooms is performed every 5–7 years (Fig. 3.1). For buildings with mitigation, the rooms identified as having elevated radon are retested every 2 years (Fig. 3.2).

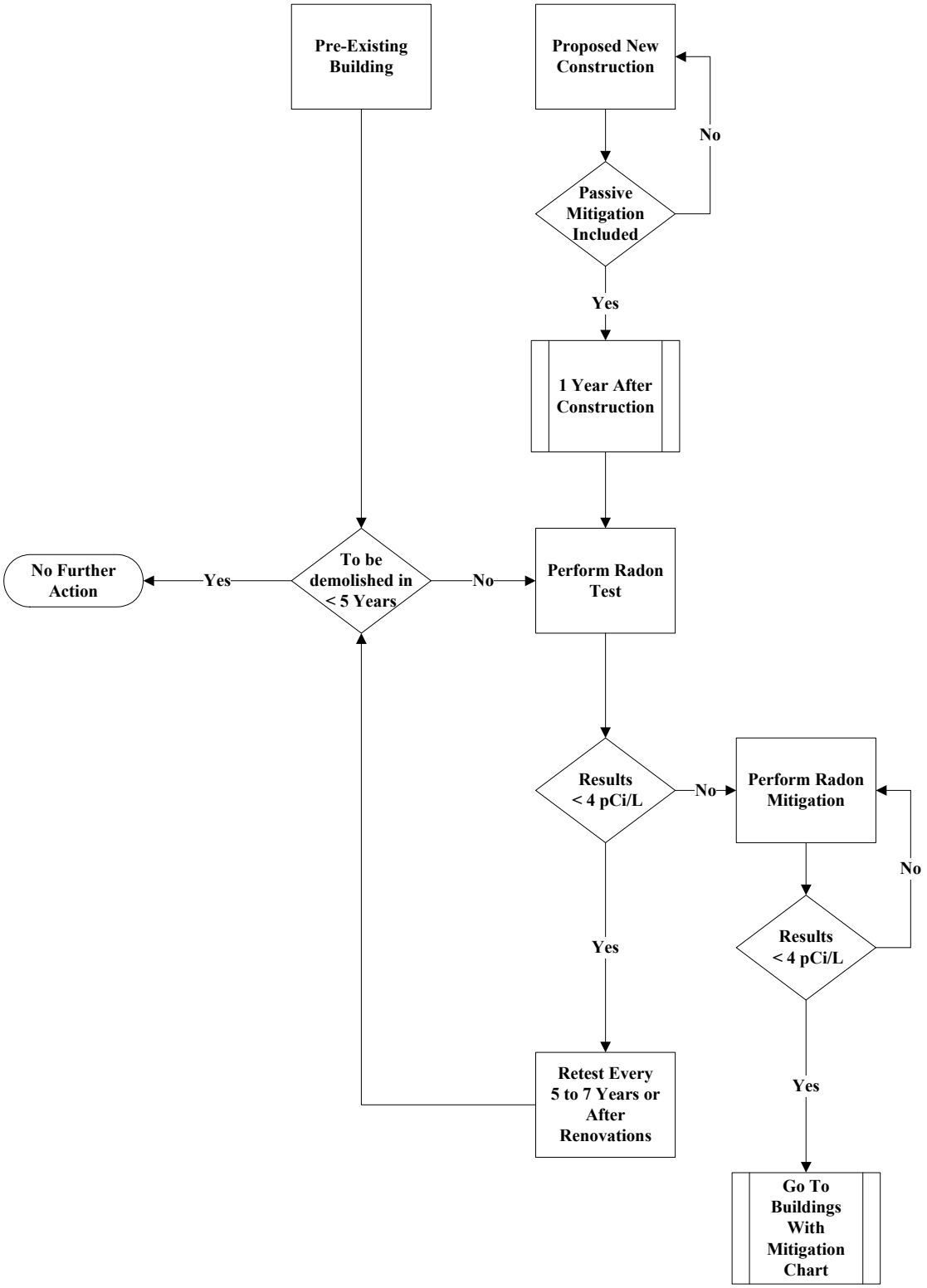


Fig. 3.1. Building without radon mitigation testing cycle.

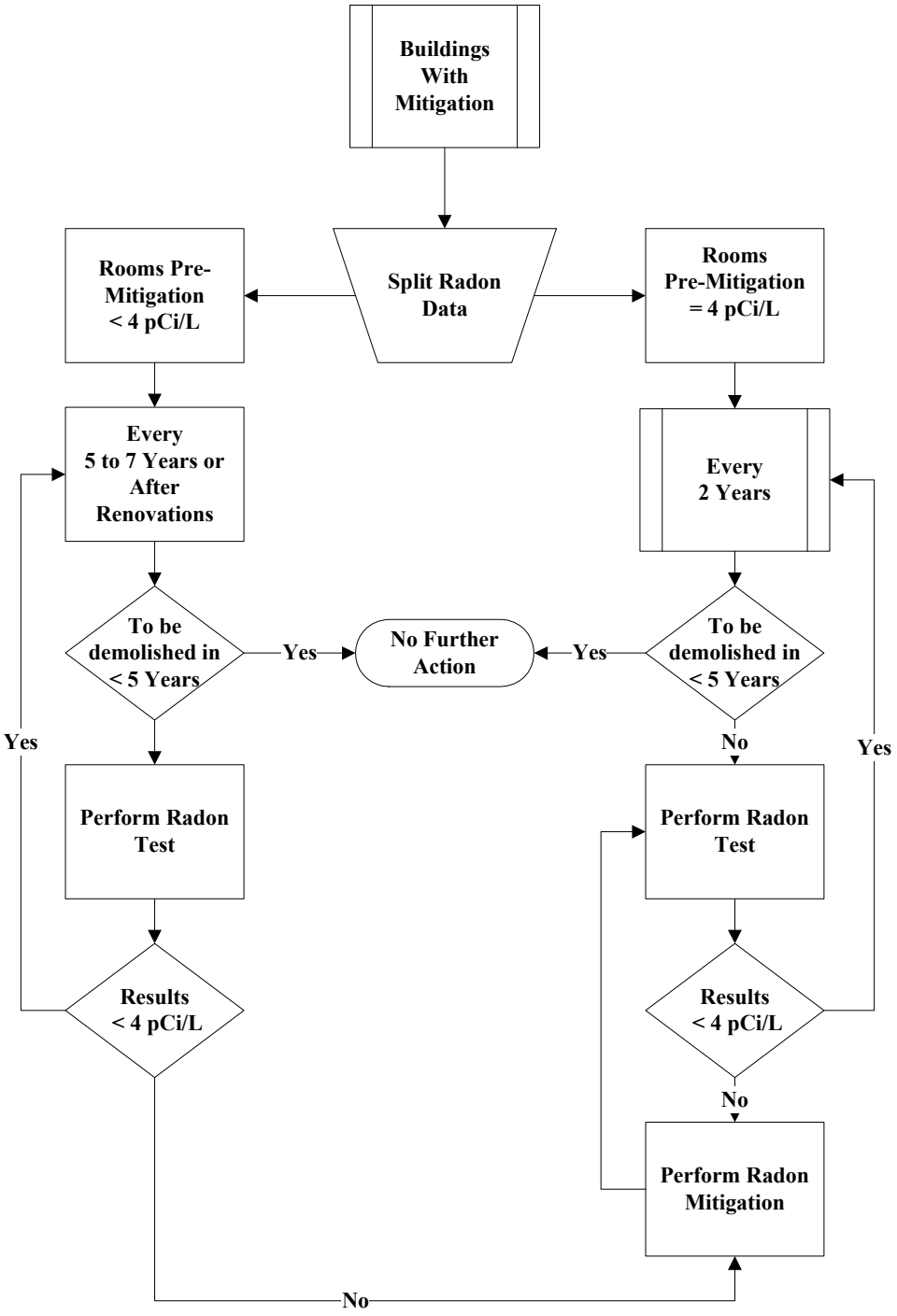


Fig. 3.2. Building with mitigation testing cycle.

3.1.2 Radon Detector Selection

The selection of the most appropriate radon detector for a particular application is dependent on many factors, such as the type of radon test, the cost of the device, and the logistics of getting the detector analyzed. For testing in OMA buildings at Ft Campbell, three types of detectors are approved for short-term measurements (charcoal, electret, and CRM) and two types of detectors for long-term measurements (ATD and electrets). It is important to note that Ft Campbell policy does not specify a particular detector manufacturer but does require that the following technical specifications be met:

- The detectors and analysis laboratory must be EPA, NEHA, or NRSB approved.
- The CRM must be EPA, NEHA, or NRSB listed.
- The detectors or CRM must be used in accordance with the manufacturer's, EPA, NEHA, and NRSB published specifications.
- The data collected must meet minimum Ft Campbell data quality objectives.

Although EPA, NEHA, and NRSB protocols allow for the reporting of radon results in either picocuries per liter or working level months (WLM), uncertainties in particulate concentrations (a key assumption in WLM measurements) within OMA Buildings make using WLM difficult. Therefore, only testing methods that measure radon gas concentration directly in picocuries per liter are permitted.

3.1.3 Radon Testing Services Qualifications

For all field placement and retrieval activities, the radon team must be under the supervision of an on-site Field Supervisor. Qualifications of the Field Supervisor follow.

- Training: Radon testing training certified by EPA, NEHA, or NRSB
- Experience: 3 years of documentable radon testing experience
- Certification: Current NEHA or NRSB certification

Personnel other than the on-site Field Supervisor who are placing and retrieving radon detectors are called Field Technicians. Qualifications for the Field Technician follow.

- Training: Radon testing training certified by EPA, NEHA, or NRSB
- Experience: 1 year of documentable radon testing experience
- Certification: Current NEHA or NRSB certification

Personnel who perform data analysis, validation, and certification of the radon testing results are called Radon Testing Analysts. Qualifications for the Radon Testing Analyst follow.

- Training: Radon testing training certified by EPA, NEHA, or NRSB
- Experience: 5 years of documentable radon testing experience
- Certification: Current NEHA or NRSB certification

3.1.3.1 Radon Testing Using In-House Personnel

Under EPA guidelines for implementation of the IRAA, government employees may perform the radon testing at their facility without accreditation. Therefore, for small testing projects and routine O&M testing, radon testing may employ Ft Campbell staff as a cost savings measure. However, the remaining requirements for the testing (EPA, NEHA, or NRSB listed devices and laboratories shall be used, testing locations, documentation, etc.) remain unchanged.

3.1.4 Testing Duration at Ft Campbell

EPA classifies radon testing into one of two categories: long-term and short-term measurements. Although EPA considers both categories of measurements as acceptable, long-term results are more representative of the integrated annual average radon concentration. Because of the karst geology at Ft Campbell, long-term measurements performed during November to March would be the preferred testing mythology and time period for baseline testing. However, all other types of testing (e.g., confirmation, supplemental, postmitigation, and post-renovation testing) can be short-term measurements (i.e., 2 to <90 days).

3.1.5 Testing Rooms and Locations

Ft Campbell testing policy requires that all routinely occupied (i.e., >4 h/day), enclosed, ground contact rooms should be tested for radon. Also included are rooms that are currently vacant but suitable for occupancy. Additional rooms for testing at the discretion of the radon project manager may include ground-contact hallways, common areas, and other types of rooms that meet the minimum occupancy requirements. For rooms up to 50,000 ft^2, a sampling interval of one testing location per 2000 ft^2 should be used up to a maximum of ten testing locations. For rooms ≥50,000 ft^2, the sampling should be performed at an interval of one testing location per 5000 ft^2, up to 50 testing locations.

After the rooms for radon testing have been selected, to the best extent possible, the detectors should be placed in accordance with applicable portions of *Indoor Radon and Radon Decay Product Measurement Device Protocols* (EPA 402-R-92-004, July 1992) and *Protocols for Radon and Radon Decay Product Measurements in Homes* (EPA 402-R-92-003, May 1993). Specifically,

- Select a testing location that reduces the probability that the device will be disturbed.
- Do not place the devices within 3 ft of drafts caused by heating, air-conditioning, or other ventilation systems.
- Do not place or hang the detectors on light or fire sprinkler fixtures.
- Do not put the detectors inside drawers or cabinets.
- Place the devices between 2 and 8 ft from the floor, 4 in. from other objects, at least 3 ft from exterior doors and windows, and 1 ft from an outside wall.
- Place collocated duplicate detectors (i.e., two detectors per test location), within 4 to 6 in. of each other.

After the detectors are placed, a sticker bearing the following information should be attached either to the detectors or adjacent to them on the wall:

DO NOT DISTURB
RADON TESTING IN PROGRESS
CALL: (contact phone number)

At the time of detector placement, a handout containing information about radon, the testing device, etc. should be left with the occupant.

3.1.6 Detector Losses

For planning purposes, in radon nonresidential surveys, one can usually anticipate losses of about 0.5% to 1% per month of the total number of rooms tested. Therefore, during a 6 month, 1000 room survey, one would expect to retest 30 to 60 rooms. As for reasons why these losses occur, studies have identified the following three major reasons:

1. The occupant threw the detector away for various reasons (15%).
2. Uniformed painters and clean-up crews threw the detector away (75%).
3. The detector fell (10%) and was disposed of.

To counter these reasons,

1. Warning stickers with a local number to call for additional information are affixed to the detectors, and information handouts are provided during detector placement.
2. Contractors and base personnel working in OMA buildings are informed that radon testing is in progress and not to disturb the testing devices.
3. Detectors are placed in out-of-the-way locations to ensure that they will not be bumped during the test period, and occupants are instructed during placement to reattach the detectors if they accidently fall.

Retesting of these rooms can be performed using either long-term (preferred) or short-term measurement devices. However, short-term testing can be performed only if the test

can be performed during nominal closed building conditions. With respect to the schedule for retesting, it is recommended that all rooms without radon results be retested within 1 calendar year of the retrieval date. The noted exception is for buildings in which one or more rooms had radon results ≥4 pCi/L. In this case, testing should be completed as soon as possible so that mitigation planning and implementation could proceed in a timely manner.

3.1.6.1 Rationale for Testing Rooms with Lost Detectors

The room to room radon distribution within nonresidential buildings usually does not follow a statistical distribution. Therefore, the ability to predict with a high degree of confidence if one or more untested rooms within a building have elevated radon is limited. Because the objective of the testing is to ensure that no routinely occupied space has elevated radon, testing of all these spaces would be required.

3.1.7 Radon Measurement Test Types

Because the nominal lifetime of a building is 30 to 40 years, it is possible to have 20 or more radon testing data sets. Even with the best of records, over time it is possible that the reason or rationale for a particular set of measurement could be lost or misinterpreted. The long-term health risk posed by exposure to radon exacerbates this problem by raising the possibility of the need to perform future dose reconstruction. To assist current and future users of the data set with determining a particular building's testing history or status for stakeholders or other interested parties, the reason for the radon test is recorded for each measurement by the use of a single two-letter codes (Table 3.1).

Table 3.1. Testing codes

Type of Radon Measurement	Testing Code	Description of the Test
Screening	SG	Testing was performed using ARRP protocol
Supplemental screening	SS	Additional testing was performed in the building using ARRP protocol
Screening confirmation	SC	Confirmation measurement performed on an elevated screening radon result
Assessment	AS	Testing was performed using the Ft Campbell testing protocol
Supplemental assessment	SA	Additional testing was performed using the Ft Campbell testing protocol
Assessment confirmation	AC	Confirmation measurement performed on an elevated assessment radon result
Follow-up test	FT	A requested retest of the room by a stakeholder
Renovation retest	RR	A retest of the room after renovation
Postmitigation	PM	Radon test after mitigation
Operation and maintenance	OM	A mitigation performance test

3.1.8 Testing Documentation

After the radon detectors have been placed, specific information needs to be recorded on a data sheet. At a minimum, the following information should be collected:

- placement technician,
- building number,
- building name,
- detector numbers,
- types of radon detectors (ATD, electret, CRM, etc.),
- type of radon test (Table 3.1),
- date placed,
- room placed,
- location placed in the room, and
- comments.

In addition to the above information, rooms that require radon testing but for a valid reason could not be accessed during detector placement should be recorded and the reason documented.

During detector retrieval, in addition to verifying the information recorded during detector placement, the following addition information needs to be collected:

- date retrieved,
- any evidence of tampering, and
- any evidence of renovation or modifications to the building that could have an impact on the radon level.

If the detectors are missing, the loss should be noted on the retrieval form and, if possible, a reason documented.

After the detectors have been retrieved, they should be returned to the manufacturer for analysis and reporting. Because different devices have different field holding times (the time between detector retrieval and analysis), manufacturer recommendations shall be strictly adhered to at all times.

3.1.9 Additional Testing Requirements

All passive radon testing at Ft Campbell shall be

1. made under normal living or working conditions,
2. performed using 100% collocated, duplicate measurements,
3. in accordance with EPA and Ft Campbell testing procedures;
4. performed using the Quality Control Plan, and
5. repeated if the data does not meet the data quality objectives.

Additional requirements for radon tests of <4 days duration are that the test shall be performed under closed building conditions (i.e., all windows and exterior doors should be closed except for normal entrances and exits) and the building shall be closed 12 h prior to the initiation of the radon measurement.

3.1.10 Radon Measurement Reporting Requirements

For all radon testing conducted, a report shall be generated and submitted to the PWBC Environmental Radon Program Manager or a designee and shall contain at a minimum the following information:

Contractor Information

- contractor name,
- address and phone number,
- contract number, and
- NEHA or NRSB testing certification number.

Device Information

- manufacturer's name, address, and phone number;
- device type and model number; and
- manufacturer's NEHA and/or NRSB certification number.

The following information should be submitted by building and room tested:

- report date,
- building name,
- sample room and location,
- type of detector,
- type test (short-term or long-term),
- detector identification number,
- duplicate identification number,
- date placed and retrieved,
- measured radon concentration in pCi/L,
- duplicate radon concentration in pCi/L,
- average radon concentration in pCi/L,
- occupied rooms that could not be tested, and
- testing exceptions and losses and comments

For each building tested, a summary listing should include the following:

- number of measurements completed,
- number of detectors lost,
- list of rooms in which testing was unsuccessful,
- number of rooms 0 to <4 pCi/L,
- number of rooms 4 to <8 pCi/L,
- number of rooms 8 to <20 pCi/L,
- number of rooms 20 to <200 pCi/L,
- number of rooms ≥200 pCi/L or greater,
- highest measurement in picocuries per liter,
- rooms requiring radon mitigation, and
- recommendations for future actions.

Depending on the size, complexity, and needs of the project, additional deliverables (e.g., electronic format, maps, and local geological conditions) may also be requested.

3.1.11 Release of Radon Data

Simply stated, the Ft Campbell policy is to allow full disclosure of radon results to current, past, and future residents and occupants of family housing and OMA buildings. For housing, the primary responsibility for radon information dissemination resides with

Actus Lend Lease. However, if requested by the Director of Housing, Environmental will assist with providing radon information and results.

For current and past occupants of OMA buildings, radon results are provided to the building manager once they have become finalized. However, data summaries and results will be provided to current and past occupants if requested in writing.

As a minimum, the radon information packet should contain

- the date,
- the building number,
- brief description of what radon is,
- when the radon test was performed,
- the radon result,
- applicable action, and
- a local contact for additional information about radon.

For buildings with multiple data sets, the most recent radon results should be provided; however, reference should be made in the packet that additional test data may be available if requested. A record of this correspondence should be kept on file.

For past occupants, radon results can be provided in the above letter format provided that

1. the request is made in writing to the Environmental Director and
2. the requestors occupancy can be verified.

3.1.12 Records Management

All radon testing and mitigation data forms shall be kept in active files for a period of 10 years. After which time, they should be scanned into Adobe Portable Document Format (PDF) or similar electronic format for indefinite long-term storage. All individual test results shall be stored electronically in a data base file to facilitate data retrieval for occupant requests.

3.1.13 Testing Quality Assurance and Quality Control

The objective of radon measurement QA is to ensure that data are scientifically sound and of known precision and accuracy. To determine these values, QC is performed using blanks, duplicates, and controlled exposures (spikes). In addition, contractors who are performing radon measurements should establish and maintain QA programs. In these QA programs, procedures for attaining the defined QA objectives and a system for recording and monitoring should be established. In performing the validation and analysis of a data set (a data set being defined as a group of measurements performed at the same time using the same devices), all exceptions must be noted, reported, and the

impact of these deficiencies noted in the data report. In addition, the quality control measurements shall be permanently linked with the data set to afford independent analysis in the future.

At Ft Campbell the QC requirements for all radon testing are

- Blanks: Blanks should be at or below the manufactures published lower level of detection (LLD).
- Duplicates: Collocated detectors in which both measurements are >4 pCi/L should have a relative percent difference (RPD) of <36% (see Eq. 3.1). For collocated detectors <4 pCi/L, an RPD of <67% is considered acceptable.
- Spikes: Spike results should be within ±25% of the known value.

$$\text{Relative percent difference} = \frac{(\text{Highest pCi/L} - \text{Lowest pCi/L}) \times 100\%}{\text{Mean}}$$

Equation 3.1. Relative percent difference.

3.1.14 Passive Measurement Data Set Validation

Before a data set can be reported, it must first be validated to ensure that it meets specific QA requirements. Failure to meet any of the minimum QA requirements will require specific reporting actions and, depending on the severity of the failure, possible retesting. The following sections detail the requirements, analysis procedures, and corrective actions to be taken if needed. At Ft Campbell, the level of QC for passive detectors (ATDs, charcoal canisters, and electrets) is dependent upon the number of locations (e.g., rooms) being tested at a given time. The minimum levels of QC follow.

- <10 locations
  - one blank detector and
  - 100% collocated duplicates.
- 10 to <33 locations
  - three blank detectors;
  - 100% collocated duplicates; and
  - three spike detectors at 4 times the number of days of the projected exposure (e.g., for a 120 day exposure, the spike should be 480 pCi/L-days).
- ≥33 locations
  - blank detectors: 3% of the total number of locations tested, or up to 30 blanks, whichever quantity is less;
  - 100% collocated duplicates; and
  - spike detectors: 5% of the total number of locations tested or up to 50 spikes, whichever quantity is less; spike concentration should be 4 times the number of days of the projected exposure (e.g., for a 120 day exposure, the spike should be 480 pCi/L-days).

For blank ATD detectors, an acceptable blank measurement would be any reported measurement ≤60 pCi/L-day (1 pCi/L-day is the dose a detector receives if it is exposed to 1 pCi/L for 1 day). For charcoal canisters, an acceptable blank measurement would be any reported measurement ≤1 pCi/L-day. For electret-based detectors, an acceptable blank measurement would be any measurement ±3 V from the original measurement.

With respect to analysis of spike results, Ft Campbell requirements are that the mean spike result (the average of all spike results at a given concentration) be ±25% of the known concentration (Equation 3.2).

$$\textbf{Individual relative error} = \frac{\textbf{(Average pCi/L)} \times 100\%}{\textbf{(Known pCi/L)}}$$

Equation 3.2. Individual relative error.

In all cases where one or more of the above QC requirements are not met, the contactor shall first inform the laboratory of the problem(s). If the laboratory can correct the problem, then the corrected results for the data set shall be resubmitted by the laboratory. However, if the laboratory is unwilling or unable to correct the QC problem(s), then the contractor shall perform an in depth analysis on the impact of the QC failure on the radon measurements. At a minimum the impact analysis shall address the overall measurement uncertainty at 4 pCi/L, and the likelihood of false positive and/or negative measurements. Using these measurement uncertainties, a review of the individual field measurements should be performed and all measurements in which the conclusion (e.g., the need to perform mitigation is in doubt) is in question identified. For these individual measurements, retesting would be required. With respect to the individual measurements that fall outside the range of interest, the errors should be documented, and retesting would be at the discretion of the Ft Campbell Radon Project Manager.

All radon testing currently performed at Ft Campbell using passive radon detectors is performed using 100% collocated duplicates. To determine if a data set meets overall precision requirements, the RPD for each measurement is calculated (Equation 3.1) and then the results are sorted into two ranges based upon the average radon concentration of the measurement (<4 pCi/L and ≥4 pCi/L).

The arithmetic average of the RPDs of each range is then calculated, and a data set (a data set being a group of radon measurements performed at approximately the same time using identical detectors, the same quality control, etc.) is considered to have acceptable precision if both of the following requirements are met:

- an average RPD of <67% is achieved for all radon results <4 pCi/L, and
- an average RPD of <36% is achieved for all radon results ≥4 pCi/L.

However, if one or both of the RPD precision requirements are not met, then further analysis is required using the following steps:

Average Radon Measurements <4 pCi/L with RPD ≥67%

- Using the Student T test or other appropriate statistical method, eliminate all statistical outliers and recalculate the average RPD.
    - If the average RPD without the statistical outliers is <67%, then the abbreviated data set is considered to have acceptable precision in the lower range.
        - For the statistical outliers excluded from the RPD analysis, retesting is recommended for results with an arithmetic average ≥2 pCi/L, and not recommended for statistical outliers with an arithmetic average <2 pCi/L.
- If after the exclusion of the statistical outliers the average RPD is >67%, then the RPD should be recalculated excluding all outliers and measurements in which both radon results are <2 pCi/L.
    - If the average RPD is <67%, then the abbreviated data set is considered to have acceptable precision in the lower range.
        - For the results excluded from the RPD analysis, retesting is recommended for those with an arithmetic average ≥2 pCi/L, and not recommended for those with an arithmetic average <2 pCi/L.

If both methods using the abbreviated data set fail to achieve an <67% RPD using the abbreviated data sets, then the testing should be repeated.

Average Radon Measurements ≥4 pCi/L with RPD ≥36%

- Using the Student T test or other appropriate statistical method, eliminate all statistical outliers and recalculate the average RPD.
    - If the average RPD without the statistical outliers is <36%, then the abbreviated data set is considered to have an acceptable precision in the upper range.
        - For the statistical outliers excluded from the RPD analysis, retesting is recommended for results with an arithmetic average ≥4 pCi/L to <20 pCi/L, and not recommended for statistical outliers where both measurements are ≥20 pCi/L.
- If after the exclusion of the statistical outliers the average RPD is >36%, then the RPD should be recalculated excluding all outliers and measurements in which both radon results are ≥10 pCi/L.
    - If the average RPD is <36%, then the abbreviated data set is considered to have an acceptable precision in the upper range.
        - For the results excluded from the RPD analysis, retesting is recommended for those in which both results are <10 pCi/L, and not recommended for those in which both results are ≥10 pCi/L.

If both methods using the abbreviated data set fail to achieve an <36% RPD using the abbreviated data sets, then the testing should be repeated.

3.1.15 Continuous Radon Monitor QC

At a minimum, all CRMs used at Ft Campbell must have a ±10% resolution at 2 pCi/L and be able to record the levels hourly. The device used in the field must have a current manufacturer's calibration certificate and shall be maintained in accordance with their specifications. For every 10th radon measurement performed, a duplicate measurement performed with another CRM or an approved electret or charcoal canister shall be performed. The acceptance criterion for the CRM is that the result be within ±25% of the collocated duplicate measurement.

If this condition is not met, then the test should be repeated using either collocated duplicate passive detectors or with collocated duplicate CRMs. If the CRM is found to be in error, then all rooms previously tested by the CRM since the last performance check should be retested.

3.1.16 Analysis of Elevated Radon Results

The objective of this section is to reach a defensible testing conclusion for each room tested using a validated data set following standardize procedures. Because EPA and Army guidelines require that any measurement ≥4 pCi/L be confirmed prior to corrective action being taken, the measurements need to be segregated by room into two types of measurements, those performed individually and those performed using collocated duplicates.

For rooms tested with a single measurement, results ≥4 pCi/L are considered confirmed if one or more of the following is true:

- One or more rooms in the building are ≥4 pCi/L.
- Prior testing in the room has been ≥4 pCi/L.
- The average of nonsequential duplicates in the room is ≥4 pCi/L.

For all other rooms, the ≥4 pCi/L measurement will need to be confirmed by independent measurement using either long or short-term devices prior to taking corrective action.

For measurements performed using collocated duplicates, results in which the arithmetic average is ≥4 pCi/L are individually reviewed to determine if confirmation is required. The measurement is considered confirmed if one or more of the following is true:

- The RPD is <36%.
- One or more rooms in the building are confirmed ≥4 pCi/L.
- Prior testing in the room has been ≥4 pCi/L.
- The average of nonsequential duplicates in the room is ≥4 pCi/L.

For the remaining cases, the ≥4 pCi/L measurement will need to be confirmed by independent measurement using either long or short-term devices prior to taking corrective action.

3.1.17 Analysis of Follow-up and Confirmation Measurements

As was mentioned above, the objective of the testing is to reach a defensible testing conclusion. In cases where valid elevated radon has been detected but not confirmed, an additional set of measurements (long- or short-term) will be required. Ideally, to confirm a long-term measurement, another long-term measurement would be performed during the same season. Unfortunately, time and/or financial considerations may require a follow-up test using a shorter measurement interval in a different season. Extrapolating from EPA guidance and lessons learned at Ft Campbell, a few general rules to assist in interpreting independently measured long-term tests and short-term data have been developed. The following is a summary of the confirmation algorithm:

1. If both the short-term and long-term measurements are ≥4 pCi/L, then the long-term result is considered confirmed (e.g., initial long-term = 4.0 pCi/L and average short-term confirmation = 30 pCi/L).

2. If the short-term measurement result is <4 pCi/L but >50% of the long-term result, then the long-term result is confirmed (e.g., initial long-term = 4.0 pCi/L and short-term confirmation = 2.0 pCi/L).

In cases of disagreement either a short-term or long-term (preferred) confirmation measurement should be performed during similar long-term test conditions. If the second follow-up measurement is >4 pCi/L, then the initial conclusion is kept (e.g., elevated radon is present). If the second follow-up agrees with the first follow-up measurement, then a new conclusion is reached based on the most recent short-term measurements. In addition, consideration should be given to any changes (usage, structural, or mechanical) that may have occurred since the initial long-term test was performed. The occurrence of any one of these events can cause significant increases or decreases in the radon levels.

3.1.17.1 Analysis of Postmitigation and O&M Test Data

For postmitigation testing, EPA only requires that the measurement be performed using an approved device/method and be conducted within 30 days of the mitigation installation (EPA 402-R-93-078, 1994). A successful mitigation is evident if the measurement is <4 pCi/L. For O&M testing, a similar guidance is provided with the exception that the test be performed every 2 years after mitigation. However, at Ft Campbell, KART is most prevalent during the heating season (November to March). Therefore, any postmitigation measurement or O&M test performed outside this window would potentially be in question. To address this concern, to the best extent possible, postmitigation and O&M testing at Ft Campbell should be performed during the primary

heating season. However, because of schedule and potential funding issues, performing postmitigation and O&M testing only during the November to March timeframe may not always be practical. Therefore, the following systematic process is used to determine if retesting during the heating season would be recommended.

The first step is to compare the premitigation radon result to the <4 pCi/L postmitigation or O&M result. Based on the KART studies at Ft Campbell, radon levels are enhanced by about a factor of 2 to 3 during the heating season. For example, if KART were present, a 10 pCi/L heating season measurement would be projected to fall between 3.3 to 5.0 pCi/L during the rest of the year. Therefore, a postmitigation or O&M result <3.3 pCi/L would give an indication that mitigation might have occurred. The threshold for an acceptable radon result should be ≤50% of the lower KART range (i.e., 1.7 pCi/L). It is important to note that for rooms between 4 to 6 pCi/L, this type of analysis would not be recommended because of the uncertainties of measuring radon at concentrations <1 pCi/L. Table 3.2 lists the 50% lower KART threshold concentrations.

If the non-heating season test results are at or above the 50% lower range but still <4 pCi/L, another approach is to look at the mitigation type, its design, and its performance characteristics. For example, buildings mitigated with shell pressurization, energy recovery ventilation, and supplemental air makeup can be tested at time of the year because these methods are not defeated by increased radon soil gas pressure. However, methods using the most common mitigation category, ASD, can be defeated by KART. Within this category of mitigation, the lateral field extension under the slab or membrane of the room(s) of interest must be measured and examined. In cases where the lateral field extension is >10 Pa, the odds of year-round mitigation would be considered very high. Thus retesting should be considered as a low priority. However, in the remaining cases, retesting during the primary heating season should be considered.

Table 3.2. Upper and lower KART ranges

Premitigation Radon (pCi/L)	Lower KART Range (pCi/L)	Upper KART Range (pCi/L)	50% Lower Range (pCi/L)
12.0	4.0	6.0	2.0
11.0	3.7	5.5	1.8
10.0	3.3	5.0	1.7
9.0	3.0	4.5	1.5
8.0	2.7	4.0	1.3
7.0	2.3	3.5	1.2
6.0	2.0	3.0	1.0
5.0	1.7	2.5	0.8
4.0	1.3	2.0	0.7

3.2 RADON MITIGATION SPECIFICATIONS AND REQUIREMENTS

EPA divides radon mitigation into two basic categories: passive and active. Passive mitigation is defined as a nonmechanical means of radon abatement or control by the use of sealing cracks, balancing an existing mechanical system, installing a passive stack vent pipe during construction, or increasing the natural ventilation rate of the building substructure (i.e., crawl space). On the other hand, active mitigation entails the use of mechanical means, such as a fan or blower, to either dilute or control its entry into the living area. Examples of active mitigation include, but are not limited to, shell pressurization (SP), energy recovery ventilation (ERV), subslab depressurization (SSD) and supplemental air makeup (SAM).

Because of the diversity in style and construction of OMA buildings, a single mitigation approach for all buildings at Ft Campbell is not possible. Therefore, building-specific mitigation diagnostics (measurements that assist in the selection of a mitigation system) should be conducted to ensure that a proper mitigation system selection is made. As for mitigation method selection criteria, in general the costs (installation and O&M), probability of success, and direct impact on the buildings occupants are always considered. Other considerations might also include

- energy consumption,
- security concerns,
- aesthetics,
- noise generation,
- loss of indoor functional space,
- proposed and pending renovations,
- projected remaining lifetime of the building, and
- understanding of the occupants' concerns.

As a general rule, because of their long-term cost effectiveness, passive, SSD, and SAM mitigation should always be considered first. If these methods are not viable, then other mitigation methods (e.g., ERV, SP) should be considered. However, under no circumstances, because of uncertainties in risk reduction, should HEPA systems or other methods that alter the radon decay product equilibrium be used.

Upon completion of a mitigation system installation, postmitigation radon testing shall be performed by the mitigation contractor to ensure that radon levels are <4 pCi/L. All postmitigation testing shall be short term and in accordance with Ft Campbell testing policies, guidelines, procedures and EPA 402-R-92-004 (July 1992). Postmitigation testing shall be performed no sooner than 24 h and no later than 30 days after system activation or, in the case of passive mitigation, completion. Within 30 days of the reporting of the postmitigation test results and at the discretion of the RMCO, an independent, postmitigation test may be performed to verify that radon mitigation has

indeed occurred. The extent and frequency of this follow-up postmitigation test are at the sole discretion of the RMCO.

3.2.1 Passive Mitigation Specifications and QA

For use in existing construction, passive mitigation is divided into two categories: sealing and mechanical balance and repair. Although simple in concept (e.g., no moving parts), passive mitigation can sometimes in the long term be difficult to inspect and ascertain current system performance. With respect to O&M, EPA applies the same inspection and testing criteria as with active systems (e.g., periodic inspection, retest every 2 years, etc.).

In passive sealing, various sealants are applied to cracks, crevasses, expansion joints, and other potential radon soil gas entry points in a effort to reduce or ideally eliminate its entry entirely. Passive sealing should only be attempted as a mitigation means if the repair would potentially last for >20 years. Therefore, the selection of the most appropriate sealant is critical. According to the American Adhesive and Sealant Council, the choice of a sealant should be based on the type and size of the opening, the opening's substrate, the environment in which it would be used, and the potential for deterioration, just to name a few. For most sealants on the market, specification and instruction sheets provided by the manufacturer are a good source of this particular type of information. In addition, the Material Safety Data Sheet (MSDS) should also be consulted to see if any precautions need to be taken during installation and post-application curing. Because of these considerations, any project where passive sealing is proposed as the primary mitigation means should be reviewed by the RMCO.

With respect to post-installation QA, passive sealing is very much application specific and thus does not fit easily into a standard checklist. Therefore, a customized QA checklist will have to be developed for each post-installation inspection and for future O&M checks. Questions that should always be included on the post-installation checklist are:

- Was the use of this particular sealant appropriate for this application?
- Was the sealant applied per manufacturer's instructions?

In mechanical balance and repair, the building's mechanical systems (e.g., supply and exhaust) are modified or restored back to the original design specifications. This includes, but is not limited to, the replacement of makeup air and exhaust components, adjustments to supply and return air, adjustments to the fresh-air and exhaust dampers, and modifications to duct components that are in ground contact (e.g., subslab return or supply ducts). As with passive sealing, this technique is very much application specific and does not easily fit into a standardized QA checklist. Therefore, a customized form will have to be developed for the post-installation check and future O&M inspections. Questions that should always be included on the post-installation check list are:

- Did the adjustment, modification, or repair keep the building's temperature and humidity within the design specifications?
- Did the adjustment, modification, or repair have any significant impact on the occupants' comfort?

Within 30 days of the passive mitigation installation, the RMCO should perform independent inspections on the passive mitigation installation to verify that the system meets the design requirements and was installed properly.

3.2.2 Shell Pressurization Specifications and QA

SP, although the oldest and best understood of all radon mitigation methods, should be considered as the mitigation method of last resort. To be brief, SP mitigation when compared to other forms of radon mitigation has higher maintenance and energy costs and, depending upon the type of SP system installed, higher installation costs. SP systems consist of two basic types differentiated by how the required volume of outdoor air is supplied.

A Type 1 SP system uses either an existing or installed fresh-air damper to supply the fresh air. In this design, the air is conditioned by the building's existing mechanical system prior to discharge into the building. Therefore, prior to installation the building's current mechanical system would need to be evaluated, and load calculations performed to determine if it could condition the added volume of air (e.g., heat, cool, and dehumidify). If the existing mechanical system lacks the capacity for conditioning the required makeup air, then a Type 2 SP system (an independent mechanical system to condition the outdoor air prior to its entry into the structure) will be required. As before, load calculations will have to be performed to ensure that the unit will adequately condition the supply air year round.

Specifications for SP mitigation systems are building and application specific, meaning that the design for one building will not be readily interchangeable with another. Many considerations go into the design of an SP system to ensure that the current mechanical system(s) can handle the added conditioning load and that the possible increase in humidity would not place the building within the range for inducing mold growth (≥ 60% RH). Therefore, if SP installation is selected as the mitigation method, the design will need to be reviewed and approved by a qualified mechanical engineer prior to mitigation installation. From this final design, a QA checklist can be generated for possible inspection. Examples of typical features and conditions to check after installation are:

1. The quarters, room(s), or building is between (+) 4 to 8 Pa relative to the outdoors.
2. Installed filters are MERV 8 or greater rating (ASHRAE 52.2-2007) and are accessible.
3. The relative humidity in the room(s) or building is ≤60% or whatever the building's requirements are.

4. Wall penetrations to the exterior are sealed.
5. To the best extent possible, the system should meet fresh-air intake requirements of *DoD Minimum Antiterrorism Standards for Buildings* (UFC 4-010-01, October 2003, updated 22 January 2007).

Within 30 days of the mitigation installation, the RMCO should perform independent inspections on the SP system to verify that the system meets the design requirements and was installed properly. In addition, pressure, temperature, and humidity measurements should be made in the supply air and in the rooms or building to verify that the tolerances listed in the design were met. The frequency of the future random checks is at the sole discretion of the RMCO.

3.2.3 Energy Recovery Ventilation Specifications and QA

ERV is a post-entry mitigation technique that reduces the indoor radon concentration by increasing the air exchange in the building or room(s). An ERV unit typically consists of two fans, one exhausting a known volume of indoor air and the second bringing in an equal volume. During operation, the two air streams (in separate compartments of the unit) pass over an inter-compartmental heat exchanger (for energy recovery) and a desiccant wheel (for humidity control). Although heat recovery is high for most units (ranging from 60 to 80%), the units are not well suited for use as a dehumidifier in particular climates with hot, humid summers. Consequently, as part of the mitigation design, the existing building's mechanical system needs to be evaluated to determine if it can handle the added cooling and heating load and the increase in humidity. If that capability is in question, optional features (available on most commercial units) for conditioning the incoming outdoor air should be included.

As for design specifications, all ERV systems for use at Ft Campbell must have been evaluated using either ASHRAE Standard 84-2008 or AHRI Standard 1060-2005.

The proposed ERV unit should have a rated capacity of at least 10% above the required CFM to allow for some performance degradation between air filter change outs. Also, the supply air should be at least 5% greater than the exhaust air to prevent possible room depressurization. In addition, on average the unit should recover at least 70% of the conditioned temperatures year round (as determined by either ASHRAE Standard 84-2008 or AHRI Standard 1060-2005). The unit should also be equipped with a bug screen and MERV 8 filters (ASHRAE 52.2-2007). In addition, the operation of the unit should not cause room(s), or building to exceed 60% RH or whatever the building's requirements are for any extended period of time. Also, to the best extent possible, the system should meet fresh-air intake requirements *of DoD Minimum Antiterrorism Standards for Buildings* (UFC 4-010-01, October 2003, updated 22 January 2007).

Within 30 days of the ERV installation, the RMCO should perform independent inspections on the mitigation installation to verify that the system met the proposed contract design requirements and was installed properly. In addition, temperature and

humidity measurements should be made in the supply air and in the room(s) or building to verify that the tolerances listed in the design were met.

3.2.4 Supplemental Air Makeup Specifications and QA

SAM is used to correct elevated radon problems in a single nonresidential room by providing additional forced-air ventilation. Although relatively easy install and maintain (a typical SAM system consists of a blower, ductwork, and a switch), the technique is not widely employed because of its limited application. For example, the criteria for the room to be mitigated by SAM are that it must

- have radon levels <20 pCi/L,
- be no larger than 3,500 ft^3,
- have an air change rate <0.2 air changes per hour, and
- be located near a large room or common area in which the desired volume of low-radon-containing conditioned air can be withdrawn without the significant risk of depressurization.

In addition to the above criteria, particular attention must also be paid to noise and occupant comfort. Because these systems are usually used in single or double offices, the noise generated by the discharge of the supply air may pose an inadvertent distraction to the occupant(s). Therefore, the supply diffuser in addition to being aesthetically pleasing, must also afford the least amount of noise. Another important consideration is the location of the discharge point. The discharge air velocity from a typical SAM system is comparable to that of a forced air system. So to the best extent possible, the discharge needs to be in a location that would not appreciably increase the air velocity in the primary work area.

Within 30 days of the SAM installation, the RMCO should perform independent inspections on the mitigation installation to verify that the system meets the proposed contract design requirements and was installed properly.

3.2.5 Subslab Depressurization Specifications and QA

For SSD mitigation systems, minimum specifications are that the systems meet

- *Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings*, ASTM E2121-08.
- *Radon Mitigation,* UFGS-31-21-13, April 2006.

In addition to the above requirements, the following are also required at Ft Campbell:

1. All electrical work shall meet or exceed the most current National Electrical Code and shall use solid 12 AWG wire.
2. The electrical circuit for the radon fan shall be clearly labeled in the breaker panel.
3. All mitigation fans shall be hard-wired unless in an attic, where corded fans (<6 ft) will be allowed.
4. A wet location–rated electrical switch shall be located within 6 ft of the fan unless it is an attic installation where corded fans are permitted.
5. All vent pipe and fittings shall be white 4 in. PVC Schedule 40.
6. All metal components of the system (e.g., fasteners, pipe straps, channel, etc.) shall be stainless steel or be corrosion resistant.
7. All fans shall be rated for exterior use and be designated by the manufacturer for use as a radon mitigation fan.
8. All vent stacks shall be covered with a vent cap.
9. All systems shall have a performance indicator located within 6 ft of the primary slab penetration point. Instructions on how to read the indicator and a contact phone number shall be posted adjacent to the indicator.
10. Where applicable, all radon fans shall be covered by a fan cover attached to a fan cover base plate.
11. All exterior clamps and fasters shall be stainless steel, galvanized, or corrosion resistant.

Contractor-requested exceptions to these standards shall be submitted to the RMCO in writing for consideration at least 2 weeks prior to the mitigation installation.

Within 30 days of the mitigation installation project, the RMCO or designee should perform an independent inspection on a random selection of the radon system to verify that the system meets the proposed design specifications. The frequency of the random checks and the number of systems to verify are at the sole discretion of the RMCO. An example data form for SSD inspection is included in Appendix A.

3.2.6 Radon Mitigation Subcontractor Qualifications

For all field mitigation diagnostics and installation activities, the radon team must be under the direct supervision of an on-site Field Supervisor. Qualifications of the Field Supervisor follow.

- Training: Radon mitigation training certified by EPA, NEHA, or NRSB
- Experience: 3 years of documentable radon mitigation experience
- Certification: Current NEHA or NRSB certification

Personnel other than the on-site Field Supervisor who are involved in mitigation diagnostics or installation are called Field Technicians. Qualifications for the Field Technician follow.

- Training: Radon mitigation training certified by EPA, NEHA, or NRSB
- Experience: 1 year of documentable radon mitigation experience
- Certification: Current NEHA or NRSB certification

Personnel who perform mitigation design are called Radon Mitigation Analysts. Qualifications for the Radon Mitigation Analyst follow.

- Training: Radon mitigation training certified by EPA, NEHA, or NRSB
- Experience: 5 years of documentable radon mitigation experience
- Certification: Current NEHA or NRSB certification

3.3 RADON RESISTANT NEW CONSTRUCTION REQUIREMENTS

Because of the presence of elevated radon at Ft Campbell, all new construction is required to incorporate RRNC features in accordance with the *Ft. Campbell Engineering Design Guide* (June 2007). Briefly, the design requires

- that if possible, the aggregate bed under the slab not be compacted,
- the installation of one riser for every 3000–5000 ft^2 of slab (see also ASTM E1465-08a),
- the extension of the vent pipe through the roof,
- provisions for 3–4 ft of clearance in the attic to allow for easy access to install and maintain the fan, and
- that the electrical outlet be located within 6 ft of the radon vent riser in the attic.

In addition to the requirements listed in the *Ft. Campbell Engineering Design Guide*, the passive sealing portions of Unified Facilities Criteria (UFC) 3-490-04A (May 2003) and the subslab gas collector specifications from ASTM E1465-08a should be incorporated as well.

3.3.1 RRNC Design Overview

For all new construction at Ft Campbell, at a minimum sealing of all gaps/joints and slab penetrations should be performed. However, the installation of other RRNC features and components will depend upon the design of the building. It is recommended that to the best extent possible, one of the following three RRNC methods be incorporated into the building design:

- Method 1 uses a preinstalled vent pipe to route radon from under the slab to above the roof. This method is commonly referred to as passive stack.
- Method 2 uses a subslab soil gas collection piping network that is connected to a vent pipe that penetrates the roof. This technique is commonly referred to as mitigation ready passive stack.
- Method 3 uses an identical subslab soil gas collection piping network but the vent piping is stubbed out and capped either in the living area or attic or on the exterior of the building. This technique is commonly referred to as mitigation ready.

3.3.1.1 Seal Slabs Specifications

Seal all gaps/joints and all floor slab penetrations in accordance with ASTM E1465-08a, UFC 3-490-04A, and UFC 3-190-01FA to prevent air leakage into the building. Gaps can be filled with polyethylene backer rod or comparable filler material as required and sealed with polyurethane caulk or other elastomeric sealant. Caulks and sealants shall be applied according to manufacturer's instructions. Ensure that all penetrations to the building exterior are weather-tight. Coordinate all work with the Contracting Officer.

3.3.1.2 Method 1: Passive Stack (Option)

Operational Principle

This design utilizes a radon-resistant technique to potentially retard radon entry into the building by passively redirecting the radon soil gas from under the slab to a vent pipe.

Specifications

Just prior to the pouring of the slab, at an interval of one pipe for every 2000 ft^2 of slab, a 4 in. Schedule 40 PVC vent pipe equipped with a Tee is inserted into a noncompacted aggregate bed [minimum 4 in. layer of clean coarse gravel (½–¾ in. mesh)]. After the concrete has been poured, the gap around the pipe should be sealed with polyurethane caulk or other elastomeric sealant. The vent pipe is then routed vertically through the building and through the roof in a manner that would not interfere with the daily operations and functions of the building occupants. The exhaust end of the pipe is left uncapped, and the vent stack pipe discharge location shall be as specified in ASTM E1465-08a.

Within 6 ft of the location of a proposed fan (fan cannot be mounted in or directly under living space), an electrical outlet on a dedicated circuit shall be installed. If needed, multiple fans can be wired to the same dedicated circuit. All components of radon system piping shall drain their condensed water vapor and collected rain completely to the ground beneath the slab. If the intent is to mount the proposed fan in the attic, then a minimum of 3–4 ft of vertical clearance will be required to allow for easy access to install and maintain the fan. To the best extent possible, the visibility of the system should be

kept to a minimum, and all operating components should be accessible for maintenance and repair.

3.3.1.3 Method 2: Mitigation Ready Passive Stack (Option)

Operational Principle

This design utilizes a radon-resistant technique to potentially retard radon entry into the building by passively redirecting the radon soil gas through a network of underground pipes to a vent pipe.

Specifications

A network of Schedule 40 perforated PVC pipes (Type 1 soil gas collector) will be buried in the gas-permeable layer of crushed stone [minimum 8 in. layer of clean coarse gravel (½–¾ in. mesh)] and manifolded to effect coverage under all rooms. Tee assembly shall be positioned so that the suction point pipe that attaches to it penetrates the slab in an unobtrusive place and where the suction point can be attached to the vent stack (one riser for every 3000–5000 ft^2 of slab). Perforated, corrugated drain tile can be substituted for the Schedule 40 PVC provided it is inspected for deformations (e.g., crushed) and repaired just prior to pouring the slab. The radon system's vent piping (4 in. Schedule 40, corrugated drain tile cannot be substituted) shall be routed so as not to interfere with the daily operations and functions of the building occupants. The exhaust end of the pipe is left uncapped, and the vent stack pipe discharge location shall be as specified in ASTM E1465-08a.

Within 6 ft of the location of a proposed fan (fan cannot be mounted in or directly under living space), an electrical outlet on a dedicated circuit shall be installed. If needed, multiple fans can be wired to the same dedicated circuit. If the intent is to mount the proposed fan in the attic, then a minimum of 3–4 ft of vertical clearance will be required to allow for easy access to install and maintain the fan. All components of radon system piping shall drain their condensed water vapor and collected rain completely to the ground beneath the slab. To the best extent possible, the visibility of the system should be kept to a minimum and all operating components should be accessible for maintenance and repair.

3.3.1.4 Method 3: Mitigation Ready (Option)

Operational Principle

This design utilizes a mitigation ready approach to ensure that if elevated radon is found, mitigation can be successfully performed at a lower cost.

Specifications

A network of Schedule 40 perforated PVC pipes (Type 1 soil gas collector) will be buried in the gas-permeable layer of crushed stone [minimum 8 in. layer of clean coarse gravel (½–¾ in mesh)] and manifolded to effect coverage under all rooms. In the design, allowances should be made for one riser of either type (see below) for every 3000–5000 ft^2 of slab. Perforated, corrugated drain tile can be substituted for the Schedule 40 PVC soil gas collection network provided it is inspected for deformations (e.g., crushed) and repaired just prior to pouring the slab.

For interior risers, a Tee assembly shall be positioned so that the suction point pipe that attaches to the soil gas collection network penetrates the slab in an unobtrusive place and where the suction point can be attached to the vent stack. The capped riser should extend at minimum 6 in. above the floor (proposed route of the optional vent pipe should be included in the building plans) and should be located in an area that is readily accessible (e.g., the capped end of the riser cannot be enclosed inside a wall).

For exterior mounted risers, a branch of the soil gas collection network should extend through the foundation using 4 in. Schedule 40 pipe and have a 90 degree elbow attached. From the top of the elbow, a minimum of a 6 in. section of 4 in. Schedule 40 pipe shall be attached and a cap installed on the end. The riser should be located in an area that is readily accessible, and the building plans should contain the proposed route of the optional vent pipe. In addition, the location of the riser and optional vent pipe should not interfere with the daily operations and functions of the building occupants.

Within 6 ft of the location (either type of riser) of a proposed fan (fan cannot be mounted in or directly under living space), an electrical outlet on a dedicated circuit shall be installed. If needed, multiple fans can be wired to the same dedicated circuit. If the intent is to mount the proposed fan in the attic, then a minimum of 3–4 ft of vertical clearance will be required to allow for easy access to install and maintain the fan. All components of radon system piping shall drain their condensed water vapor and collected rain completely to the ground beneath the slab. To the best extent possible, the visibility of the system should be kept to a minimum, and all operating components should be accessible for maintenance and repair.

3.3.1.5 Design Specification for Radon Fan Assembly

For all passive stack and mitigation ready options, designs and specification shall be provided for the installation of the radon fan. In addition, the proposed fan shall be installed in a vertical section of the vent stack pipe and in a vertical orientation to prevent condensed water and precipitation from accumulating in the fan. As a minimum, the design shall contain the

- proposed fan location and type of fan,
- proposed electrical hook-up and wiring specification,
- the location and type of the system performance indicator, and

- any additional hardware needed for fan activation.

3.3.1.6 Labeling of System

Labeling of system components as specified in ASTM E1465-08a shall be performed for all passive stack and mitigation ready options.

3.3.1.7 Radon Testing

Upon building completion, an initial radon gas test shall be performed as specified in accordance with the Ft Campbell testing protocol. The building should be tested under closed building conditions (e.g., all windows and doors should be closed). In addition, all mechanical equipment (normally, exhaust blowers and central air-conditioning system typically operating) that will be operating during normal human occupancy should be operating at least 24 h prior to performing an initial radon test.

3.3.1.8 Activation of Radon Mitigation System (Option)

If the initial radon test results are ≥4.0 pCi/L, then the mitigation fan and any remaining vent pipe should be installed per design, and activated by a certified radon mitigator under the supervision of the responsible system designer. Upon completion of fan installation and activation, postmitigation testing shall be performed no sooner than 24 h after fan activation to ensure that radon levels in occupiable spaces are <4.0 pCi/L. All these should be performed under closed building conditions (i.e., all windows and doors should be closed). In addition, all mechanical equipment (normally, exhaust blowers and central air conditioning system typically operating) that will be operating during normal human occupancy should be operating at least 24 h prior to performing an initial radon test. If elevated radon is still present, the Contract Officer should be consulted for further instruction.

3.3.2 Radon Resistant New Construction Designer Subcontractor Qualifications

For all RRNC designs, the designer shall have as a minimum:

- Training: Radon mitigation training certified by EPA, NEHA, or NRSB
- Experience: 5 years of documentable radon mitigation experience
- Certification: Current NEHA or NRSB certification

Personnel responsible for the installation, oversight, or activation of the RRNC system shall have as a minimum:

- Training: Radon mitigation training certified by EPA, NEHA, or NRSB

- Experience: 1 year of documentable radon mitigation experience
- Certification: Current NEHA or NRSB certification

3.4 O&M OF RADON MITIGATION SYSTEMS

To maintain effective long-term radon control, radon systems will require periodic maintenance and retesting. Therefore, EPA recommends (EPA 402-R-93-078, 1994) that in addition to periodic performance checks, every 2 years a detailed system inspection be performed followed by radon testing of the mitigated rooms. The following sections outline recommended O&M by type.

3.4.1 O&M of Passive Mitigation Systems

With respect to O&M, passive sealing is very much application specific and thus does not fit easily into a standard checklist. Therefore, a customized O&M checklist will have to be developed. For passive mitigation involving mechanical balance and repair, the building's mechanical system (e.g., supply and exhaust) is modified or restored to the original design specifications. This includes, but is not limited to, the replacement of makeup air and exhaust components, adjustments to supply and return air, adjustments to the fresh-air and exhaust dampers, and modifications to duct components that are in ground contact (e.g., subslab return or supply ducts). Therefore, the O&M checklist should include those items. In addition, in cases where the repair or adjustments involved bring in more fresh air, the building's temperature and humidity should be included as well. In cases where sealing was involved, all joints should be inspected to verify that the caulk is still adhering to the substrate.

3.4.2 O&M of Shell Pressurization Systems

An SP system retards radon entry by mechanically introducing sufficient outdoor air to induce a positive pressure across the slab (typically 4 to 6 Pa) and into the soil. By applying pressure across the building shell, the natural flow of radon from the soil into the living area is reversed. Therefore, the air flows from the living area into the subslab, preventing radon entry. The downside of an SP system is that all windows and doors must be kept closed to maintain mitigation. Small openings, such as leaving an entry door ajar or leaving a window cracked, will result in the radon levels reverting to their unmitigated levels. Also, as door and window seals deteriorate over time, additional fresh air must be drawn to maintain mitigation.

With respect to routine maintenance of an air intake SP system, the following maintenance is recommended on a quarterly basis or as required by the manufacturer:

1. Clean or replace as needed the air intake grill air filter.

2. Clean in-house return air filter.
3. After cleaning both filters, verify that shell pressure (indoor to outside) is between 4 to 6 Pa with the aid of a digital micromanometer.

Table 3.3 lists troubleshooting techniques for air-intake SP mitigation systems if, in the future, mitigation failure occurs or the unit can no longer be pressurized to 4 Pa.

Table 3.3. Troubleshooting SP mitigation systems

Problem	Possible Solutions
Unit is <4 Pa shell pressure (indoor to outside)	1. Verify that the mechanical blower is running continuously and properly. 2. Inspect intake grill for blockage. 3. Clean intake grill air filter. 4. Adjust air intake damper to increase outdoor airflow. 5. Inspect the mechanical collar for leakage. Repair leak as needed. 6. Inspect shell for any significant leaks around windows and exterior doors. As appropriate, replace door seals or caulk any cracks around windows and doors.
Unit is >6 Pa pressure (indoor to outside)	1. Adjust air intake damper to decrease outdoor airflow. 2. Clean central mechanical return air filter. 3. Inspect mechanical collar for leakage. Repair leak as needed.
Unit is >4 pCi/L	1. Verify that the blower is running continuously and properly. 2. Check shell pressure with digital micromanometer. 3. Verify that residents are not leaving windows and doors open for extended periods of time.
Unit is >4 pCi/L and shell pressure is between 4 and 6 Pa	1. Repeat differential pressure (DP) diagnostic for all major air exhaust systems. Discuss with residents the frequency of usage of the exhaust systems. Increase airflow accordingly to compensate for largest and/or most frequently used air exhaust system.

3.4.3 O&M of Energy Recovery Ventilation Mitigation Systems

ERV systems are commercially available package systems that reduce radon levels by increasing the natural ventilation rate in the building or room(s). Because of differences in design, installation and materials, no two manufacturers' O&M requirements are exactly the same. Therefore, it is important to review the owner's manual and draft a system-specific O&M plan. Common O&M elements to address are

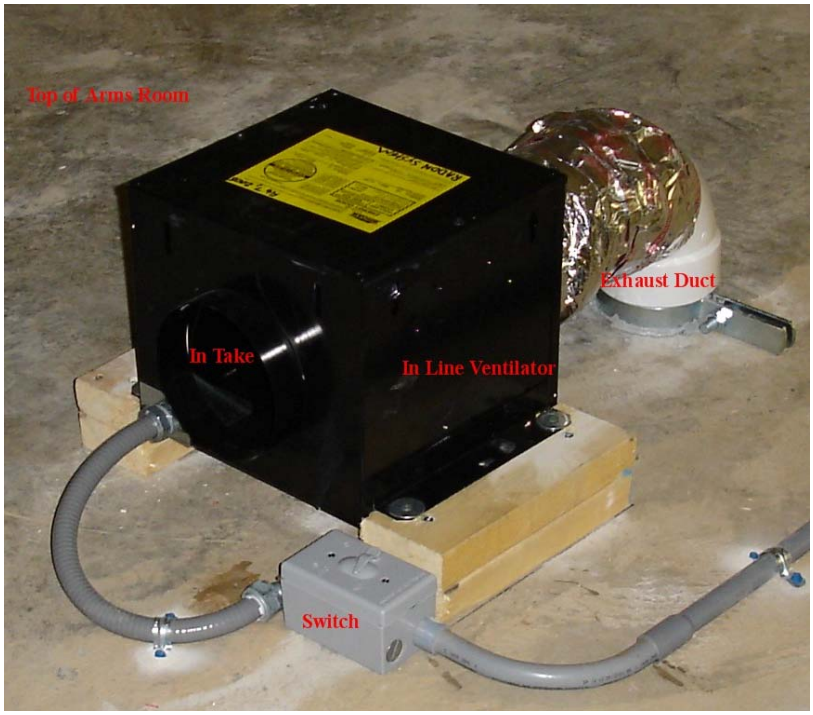
1. the frequency of changing the air filters and drive belts,
2. lubrication of the drive and blow motors,
3. maintenance of the desiccant wheel, and
4. the recommended frequency to check the pressure balance of the system.

It is important to note the following: for ERVs, O&M is not just a good idea; it is mandatory. For example, by not changing the system filters, the unit may become depressurized (ERV is exhausting more air than it is bringing in), resulting in an increase in the unit's radon levels. In addition, on some models of ERVs, lack of maintenance of the desiccant wheel could result in a sudden uncontrollable increase in humidity of the supply air. This condition could result in catastrophic condensation release followed by the onset of mold.

3.4.4 O&M of Supplemental Air Makeup Mitigation Systems

In general, SAM systems are easy to operate and maintain. The system consists of two basic parts: the electric fan (Broan SP200 or a FanTech FR150) and the duct, neither of which require any scheduled maintenance. However, periodically the intake (Pictures 3.1 and 3.2) should be inspected and cleaned in addition to confirming that the unit is exhausting (e.g., smoke test, strip of paper). To determine if a SAM is working, an illuminated light box (Picture 3.1) has been installed. Fan operation is indicated by the green LED light (Picture 3.3).

Every 2 years, it is recommended that the exhaust rate of the blower be checked using a pitot tube, face velocity probe, or other suitable measuring device to confirm a minimum of 150 cfm of makeup air or as specified by installer. If the air volume is found to be less, the blower should be replaced.



Picture 3.1. SAM components with Broan fan.

Picture 3.2. SAM components with FanTech fan.

Picture 3.3. SAM performance indicator.

3.4.4.1 SAM Fan Replacement

The only working part of the SAM mitigation system is the electric fan and it will eventually wear out and need replacement. The following procedure applies only to the system installed by ORNL, and it is recommended that an electrician or competent person perform the fan replacement.

1. Turn off the power switch.
2. Implement any requirements for lockout/tagout.
3. Unscrew and remove the electrical cover on the fan.
4. Loosen the wire nuts and disconnect wires.
5. Unscrew and remove the lock nut.
6. Remove the 12 AWG wire and liquid-tight connector from the fan.
7. Loosen the hose clamps around the 6 in. flex duct, and remove the duct from the fan.
8. Remove screws from sheet metal duct, and remove duct from fan.
9. Unscrew the fan from the wood supports.
10. Replace new fan to wood support.
11. Reconnect 6 in. flex duct and sheet metal duct.
12. Pull the 12 AWG wire back into the electrical compartment of the fan and slide liquid-tight connector back into position and secure it with a lock nut.
13. Reconnect wire to the fan, following instructions that came with the new fan.
14. Secure the fan's electrical compartment cover.
15. Turn on the power switch.

3.4.5 O&M of Subslab Depressurization Mitigation Systems

SSD mitigation uses a pipe that is inserted through the slab and connected to a fan (Fig. 3.3). When the fan is activated, the area beneath the slab (subslab) is depressurized. The resulting depressurization prevents radon entry into the living area by redirecting the subslab radon into the pipe for discharge into the atmosphere, where it is harmlessly diluted. Generally speaking, an SSD system consists of two major components: the exhaust pipe and the mitigation fan. Of these two components, only the fan will need to be replaced during the remaining lifetime of the building. To determine if the fan is working properly, it is recommended that the occupant perform a monthly visual inspection of the U-tube. If the oil level reads between 0.3 and 4.0 on the scale, then the fan is operating properly (Fig. 3.4). If the oil level is reading 0, then the occupant should

contact the phone number on the decal. A decal placed next to the U-tube provides detailed instructions and contact phone numbers. The only required maintenance of the U-tube is the infrequent addition of oil. If oil is needed, common cooking oil (e.g., Mazola® oil or the equivalent) may be used. Petroleum-based oils or fluids should not be used because of the potential for poisoning small children. Before oil is added to the U-tube, the fan should be turned off either at the exterior switch or by tripping the circuit breaker labeled "radon mitigation system" in the unit's main breaker panel. Using an eyedropper or plastic drinking straw, oil can then be added a drop at a time until the level equals 0. Pictures 3.4 and 3.5 show typical U tube installations. The illuminated light box (Picture 3.6) relies on an electrical pressure sensor to trigger one of two LED lights (red indicating fan is off, and green indicating fan is on). Maintenance for an illuminated light box is limited to infrequent replacement of the 10-year LED bulbs and pressure sensor.

Depending upon the orientation of the building and the type of system installed, the U-tube can be mounted on the exterior of the building inside a manometer box (Picture 3.4) or mounted on the pipe near the floor penetration (Picture 3.5). An illuminated light box (Picture 3.6), on the other hand, can be located near the system or at a convenient location some distance from the system for remote viewing. In the private sector, routine maintenance of the mitigation system is the responsibility of the individual homeowner or building owner, and maintenance is usually performed by qualified personnel after system failure. Evaluation of the SSD systems installed at other military facilities identified several critical parts and components that should be checked on a regular interval. This maintenance is recommended to prevent water leakage into the unit and loss of exterior components during high winds. With these considerations in mind, it is recommended that each component and part listed in Table 3.4 be inspected in accordance with the proposed schedule. To assist with the identification of the components, a "typical" SSD system has been broken into three assemblies (pipe, fan, and roof flashing) and is illustrated in Figs. 3.5, 3.6, and 3.7).

With respect to trouble-shooting an SSD mitigation system, problems generally are caused by failure of the mitigation fan or the loss of vacuum under the slab. Table 3.5 summarizes the most common problems and proposed corrective actions for SSD mitigation systems.

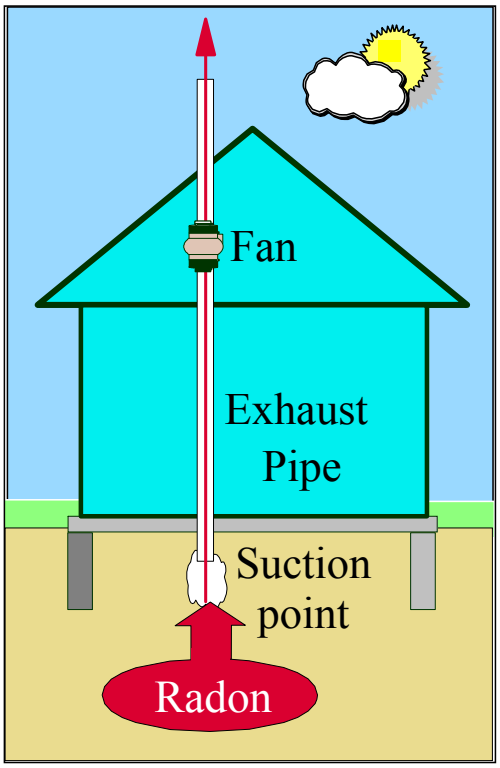


Fig. 3.3. Basic components of an SSD mitigation system.

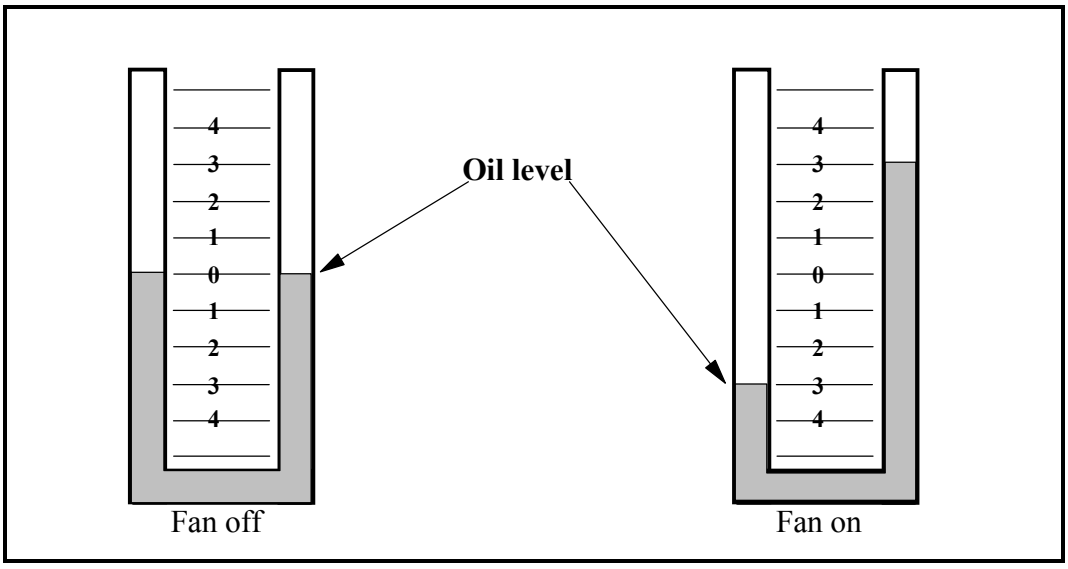


Fig. 3.4. Typical U-tube.

Picture 3.4. Typical external U-tube box.

Picture 3.5. Interior-mounted U-tube.

Picture 3.6. Typical illuminated light box.

Table 3.4. SSD components requiring routine inspection

Component	Check For	Corrective Action	Recommended Frequency of Inspection
U-tube (Fig. 3.4)			
U-tube	Fan operation	Call Trouble Desk if fan is not operational	Monthly by occupant
U-tube	Oil level	Add oil	2 years
Pipe assembly (Fig. 3.5)			
Pipe/slab seal	Leakage	Apply additional polyurethane caulk	2 years
Interior wall/pipe seal	Leakage	Apply additional polyurethane caulk	2 years
Exterior wall/pipe seal	Leakage	Apply additional polyurethane caulk	2 years
Clamp nut	Tightness	Tighten nut	2 years
Pipe-mounted fan assembly (Fig. 3.6)			
Rubber boot	Cracked or sagging, fan seated level	Replace boot	2 years
Fan operation	Excessive noise, vibration, or not operating	Replace fan	2 years
Rubber boot/pipe seal	Leakage	Replace boot	2 years
Flex conduit electrical condition	Cracking of conduit and deterioration of liquid-tight connectors	Replace conduit and liquid-tight connectors	2 years
Switch and switch and switch cover gasket	Functional switch and seal of box gasket	Replace switch and gasket	2 years
Conduit C clamp	Tightness and corrosion	Tighten or replace C clamp	2 years
Hose clamp	Tightness	Tighten	2 years
Roof flashing (Fig. 3.7)			
Flashing	Water leaks and cracking	Replace flashing	2 years

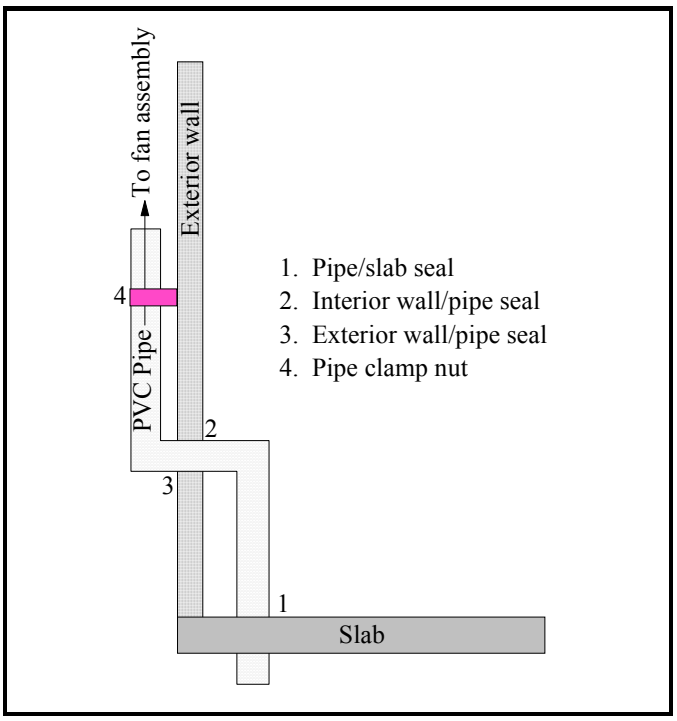


Fig. 3.5. Components to inspect in an SSD system pipe assembly.

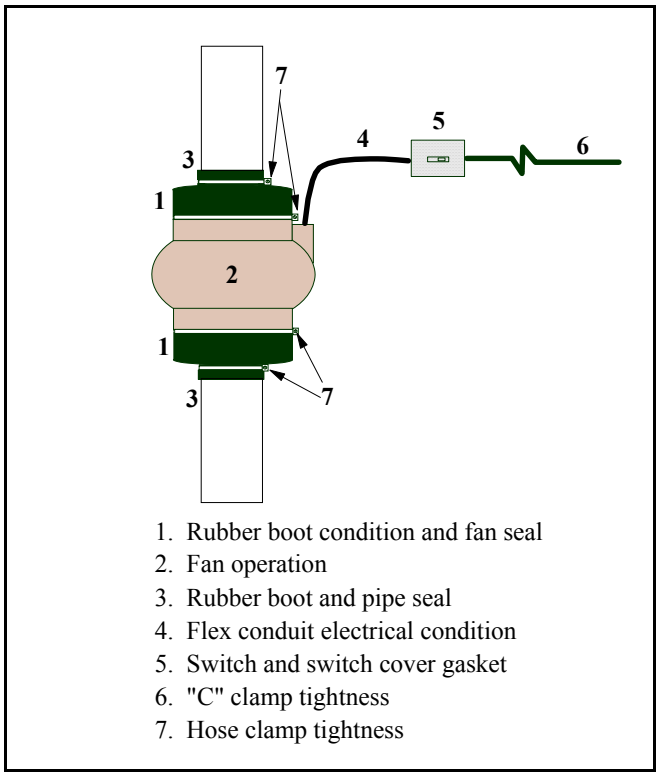


Fig. 3.6. Components to inspect in an SSD system pipe-mounted fan assembly.

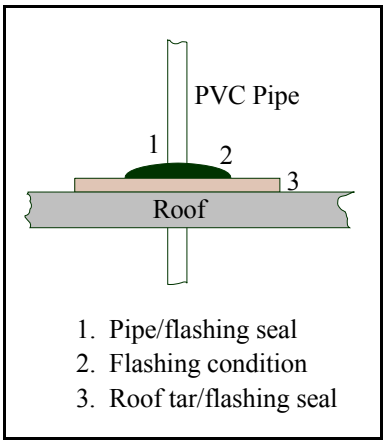


Fig. 3.7. Components to inspect in an SSD system roof flashing assembly.

Table 3.5. Common problems associated with SSD mitigation systems

Problem	Possible solution
Fan is not operating	1. Verify that the switch is on and the circuit breaker has not tripped 2. Check electrical connections from the switch box to the fan 3. Replace mitigation fan
Pipe has a noticeable vibration sound	1. Make sure that the fan is level 2. Verify that the base of the fan is not in contact with the pipe. If boot is sagging, replace boot 3. Replace fan
Fan is vibrating	1. Make sure that the fan is level 2. Replace fan
Fan is operating, but U-tube reads <1.5	1. Verify that additional oil is not needed in the U-tube 2. Inspect the U-tube and verify that it is connected to the pipe and that the tubing has not been crimped 3. Verify that no obstructions are present in the system exhaust 4. Inspect the boot/fan seals for air leaks 5. Check floor/pipe seals for air leakage 6. Inspect PVC pipe for holes 7. Replace mitigation fan

Table 3.5 (cont.)

Problem	Possible solution
Fan appears to be operating within normal parameters, but unit is no longer <4 pCi/L	1. Verify that U-tube has sufficient oil 2. Verify that no obstructions are present in the system exhaust 3. Inspect the boot/fan seals for air leaks 4. Check floor/pipe seals for air leakage 5. Inspect PVC pipe for holes 6. Repeat radon test 7. Replace fan 8. Review repair and renovation history of unit since the system was last verified to be functioning properly. Have renovations occurred that may have reduced the air change rate? Has a new air exhaust system been added? If the answer is yes to either question, a supplemental suction point may be required 9. Perform lateral field extension measurements to determine if vacuum gradient has changed. Install new suction point in area without vacuum
System has audible whistling sound while operating	1. Inspect pipe for holes 2. Inspect PVC joints for leakage 3. Inspect pipe/slab seal for leakage
During heavy rains, water leaks around pipe	1. Inspect wall/pipe seal for leakage 2. Inspect pipe/floor seal for leakage 3. Inspect flashing assembly for cracks or holes

Appendix A contains an example of a data form used for O&M inspection.

3.4.5.1 SSD Fan Replacement

As was mentioned earlier, the mitigation fan and the boots will eventually wear out and need to be replaced. The long-term question is whether it would be more economical to replace the fans and boots on an as-needed basis or to replace all the fans and boots at fixed intervals. If the fans and boots were allowed to deteriorate, separate maintenance calls would be required. Life-cycle analysis using information provided by the manufacturers has determined the optimum replacement interval is about 6 years. Therefore, it is recommended that the Ft Campbell maintenance program funds for a boot and fan replacement program every 6 years. With respect to mitigation fans, it is important to note that the FanTech 220 and Radon Away RP 265 have identical performance and are interchangeable. The following procedure applies only to replacement of the fans of the SSD systems installed by ORNL. It is recommended that an electrician or a competent person perform the fan replacement.

1. Turn off the power switch.
2. Implement any requirements for lockout/tagout.
3. Remove fan cover, if applicable.
4. Unscrew and remove the electrical cover on the fan.
5. Loosen the wire nuts and disconnect wires.
6. Unscrew and remove the lock nut.
7. Remove the 12 AWG wire and liquid-tight connector from fan.
8. Loosen the four hose clamp screws around the pipe and fan on both boots.
9. Slide the boots onto the pipe.
10. Remove the fan.
11. Replace the boots if needed.
12. Hold the fan in position and slide the boots over the fan.
13. Secure the four hose clamps around the pipe and fan.
14. Pull the 12 AWG wires into the electrical compartment of the fan and slide the gas-tight connector into position.
15. Secure the liquid-tight connector with the lock nut.
16. Reattach the wire to the fan, following the instructions that came with the replacement fan.
17. Secure the fan's electrical compartment cover.
18. Replace fan cover, if applicable.
19. Turn on the power switch.

3.4.6 Qualifications of O&M Subcontractor

3.4.6.1 Subcontractor Qualifications for O&M Testing

For all field placement and retrieval activities, the radon team must be under the supervision of an on-site Field Supervisor. Qualifications of the Field Supervisor follow.

- Training: Radon testing training certified by EPA, NEHA or NRSB
- Experience: 3 years of documentable radon testing experience
- Certification: Current NEHA or NRSB certification

Personnel other than the on-site Field Supervisor who are placing and retrieving radon detectors are called Field Technicians. Qualifications for the Field Technician follow.

- Training: Radon testing training certified by EPA, NEHA or NRSB
- Experience: 1 year of documentable radon testing experience
- Certification: Current NEHA or NRSB certification

Personnel who perform data analysis, validation, and certification of the radon testing results are called Radon Testing Analysts. Qualifications for the Radon Testing Analyst follow.

- Training: Radon testing training certified by EPA, NEHA, or NRSB
- Experience: 5 years of documentable radon testing experience
- Certification: Current NEHA or NRSB certification

3.4.6.2 Subcontractor Qualifications for O&M Inspection

For all O&M activities, the radon team must be under the direct supervision of an on-site Field Supervisor. Qualifications of the Field Supervisor follow.

- Training: Radon mitigation training certified by EPA, NEHA, or NRSB
- Experience: 5 years of documentable radon mitigation experience
- Certification: Current NEHA or NRSB certification

Personnel other than the on-site Field Supervisor who are involved in mitigation diagnostics or installation are called Field Technicians. Qualifications for the Field Technician follow.

- Training: Radon mitigation training certified by EPA, NEHA, or NRSB
- Experience: 1 year of documentable radon mitigation experience
- Certification: Current NEHA or NRSB certification

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APPENDIX A: EXAMPLE DATA FORMS

New Subslab Depressurization System Inspection Form (Pg 1 of 2)

Building Number: _____ **Building Name: _____**

Date: _____ **Inspectors: _____**

General System Description

System Number: Number Suction Points:	Suction Point Locations	Room(s) system fixes
Fan Make and Model	Fan Location Interior_____ Exterior_____ Attic_____ Roof_____	System Design Ext. (Type 1) ___ Int. w egress (Type 2) ___ Int. w/o egress (Type 3) ___
Performance Indicator Type	Performance Indicator Location	Performance Indicator Reading
Breaker/Panel Number	Switch Location	Electrical Tap Location
Comments		

Drawings/Notes

New Subslab Depressurization System Inspection Form (Pg 2 of 2)

Component	Specification	Findings	Comments
Vent Pipe	4 in, PVC, SCH 40, White	**Pass Fail**	
	Fittings and connections appear to be air tight, properly joined/sealed	**Pass Fail**	
	10 ft above grade, at least 12 in. above eave/roof and at least 10 ft from any opening to conditioned space	**Pass Fail**	
	Vent exhaust cap present	**Pass Fail**	
	Fire collar/damper present if fire rated wall is penetrated	**Pass Fail** **Not Applicable**	
	Sealing around vent pipe penetrations through slab, wall and floor is intact	**Pass Fail**	
	Pipe is strapped at least every 6 ft on horizontal runs and every 8 ft on vertical runs	**Pass Fail**	
	All exterior fasteners are stainless steel, galvanized, or corrosion resistant	**Pass Fail**	
Performance Indicator	A performance indicator is present, visible, operating and accessible.	**Pass Fail**	
	Pressure tubing is sealed and intact	**Pass Fail**	
	Instructions on how to use the indicator are present and a contact phone number is provided	**Pass Fail**	
Mitigation Fan	Mounted in a vertical section of pipe and level	**Pass Fail**	
	Fan is **not** located in or below conditioned space	**True False**	
	Vacuum within manufacturers performance range	**Pass Fail**	
	Fan not vibrating	**Pass Fail**	
Does System Meet EPA/ASTM/FTC Standards	Any negative findings above circle No	**Yes No**	
Additional Comments			

O&M Subslab Depressurization System Inspection Form

Building Number: _____ **Building Name: _____**

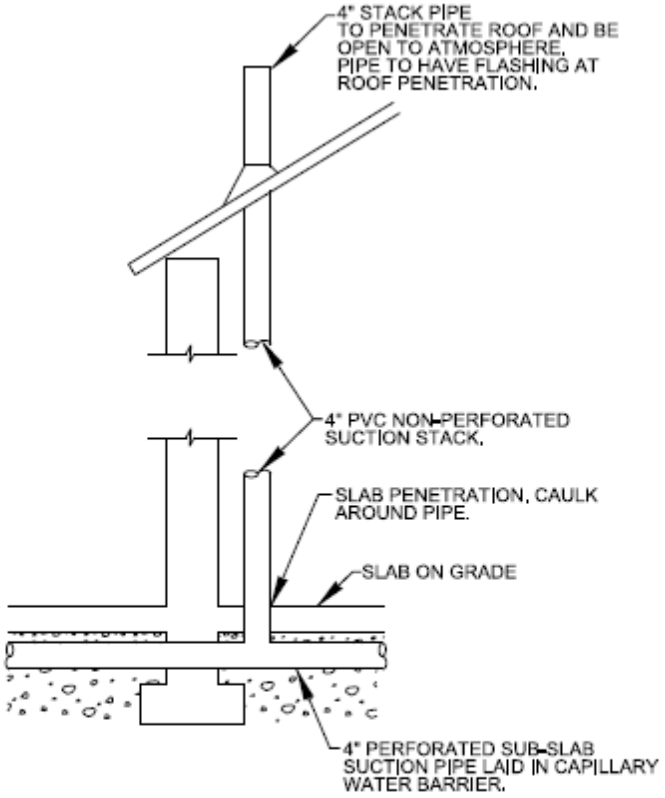
Date: _____ **Inspectors: _____**

System Number: _____ **Fan Make/Model: _____**

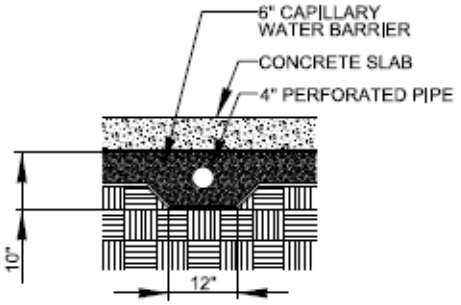
Item	P	F	NA	Comments	Corrected
Fan Cover					
Cover Screws					
Fan Operation				Replacement Fan: _____	
Fan Boots					
Fan Mounting					
System Decals					
Vacuum Indicator				Reading: _____	
Vacuum Tubing					
Pipe					
Pipe/Wall/Slab Seals					
Pipe Clamps					
Clamp Anchors					
Roof Cap					
Flex					
Flex Connectors					
Switch Operation					
Conduit					
Conduit Clamps					
Electrical Tap Seal					
Roof Seal					

Comments:

STANDARD FORT CAMPBELL RADON PIPE DETAILS



A1 SUCTION STACK PIPE DETAIL
SCALE: NONE

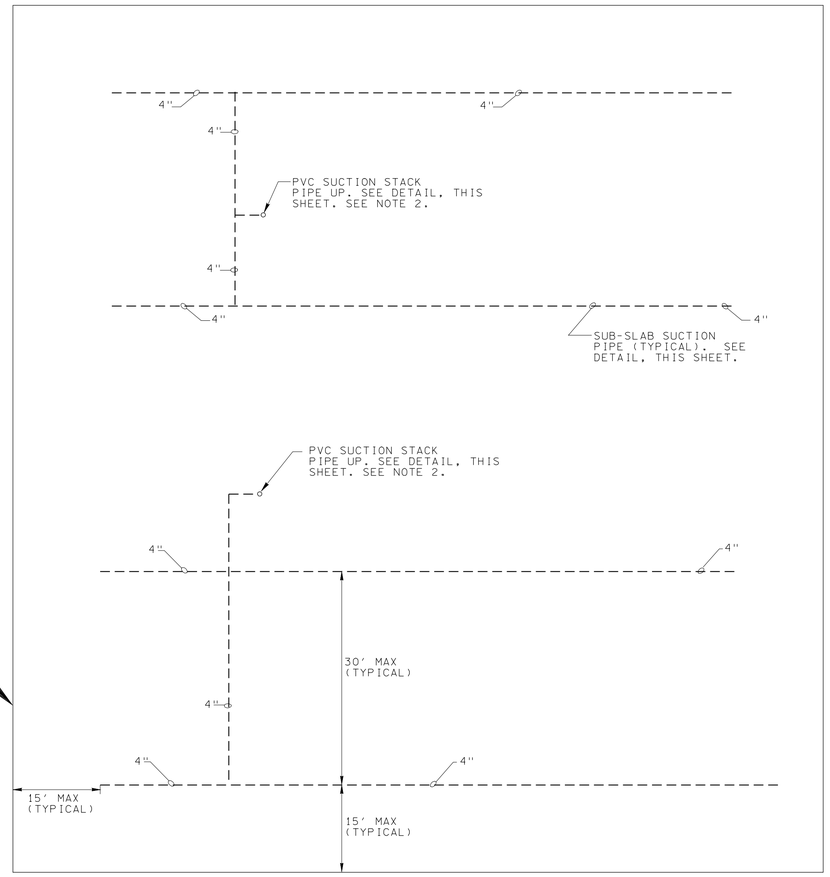


A6 SUB-SLAB SUCTION PIPE DETAIL
SCALE: NONE

DESIGN NOTES:

1. THE BUILDING PERIMETER SHALL BE SHOWN FOR ILLUSTRATIVE PURPOSES. PIPING LAYOUT SHALL BE PROVED TO SHOW TYPICIAL PIPING DETAILS.
2. SUCTION STACKS SHALL BE SIZED BASED ON AREA SERVED. 4" STACK CAN SERVE UP TO 5000 SF AREA.
3. A 120 BOLT RECEPTACLE SHALL BE PROVIDED NEAR THE SUCTION PIP TO PROVIDE POWER FOR ANY NESSARY EXHAUST FAN(S) IN THE FUTURE.

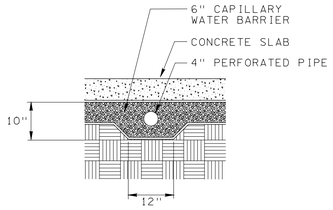
*** SAFETY PAYS ***



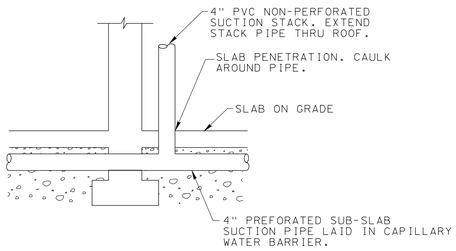
SAMPLE RADON PIPING PLAN
SCALE: NONE

NOTES:

1. BUILDING PERIMETER IS SHOWN FOR ILLUSTRATIVE PURPOSES ONLY. PIPING LAYOUT IS SHOWN TO PROVIDE TYPICAL PIPING DETAILS.
2. SUCTION STACKS SHALL BE SIZED BASED ON AREA SERVED. 4" STACK CAN SERVE UP TO 5000 SF AREA. 6" STACK CAN SERVE UP TO 12500 SF AREA



SUB-SLAB SUCTION PIPE DETAIL
SCALE: NONE



SUCTION STACK PIPE DETAIL
SCALE: NONE

US Army Corps of Engineers
Louisville District

Revisions			
Symbol	Description	Date	Appr.

Date: FEBRUARY 2008
Scale: AS SHOWN
Drawing code:

Designed by: KERRY PRATHER
Drawn by: KERRY PRATHER
Checked by: KEVIN PRATHER
Project Engineer/Architect: Date:

RADON PIPING DETAILS

FT. CAMPBELL KY.

Sheet reference number: P-1

Sheet 23 of 52

*** SUPPORT VALUE ENGINEERING - IT PAYS ***

PLOT DATE: 12-FEB-2008 10:42
FILENAME: C:\Documents and Settings\h2eddrah\Desktop\Radon Piping Details

W912QR-05-C-0013

APPENDIX GG

INTERIOR SIGNAGE

Chapter 11

INTERIOR SIGNS

Section 11A--Introduction

11.1. General Information. Interior signs should complement interior architecture and color schemes if at all possible. Since buildings vary a great deal, interior signs will also vary. The standards discussed here apply to buildings that do not have custom designed interior signs and are also intended to serve as a guide for the design of all interior signs. This chapter gives the standards for interior signs, including information on size, appearance, message, permitted graphics and layout.

11.2. Color. Standard brown or any dark color appropriate to the interior environment of the specific building may be used.

11.3. Design Parameters. All interior signs should be designed so that they require the minimum possible maintenance. The sign system should be flexible enough to adapt to frequent personnel changes and office relocations. The system shown here is designed to guide visitors through a building from the entrance point to the correct floor, the correct area of a floor, the correct office and (if appropriate) the correct desk.

11.4. Standards. All interior signs should follow these standards for system organization, sign types, and sizes. Variations in types of hardware and colors are permitted. These signs are designed to be compatible with the signs shown in the GSA Manual on the Design of Sign/Symbol Systems for Federal Facilities.

11.5. Mounting. Mounting options will vary with each system. For facilities or functional areas that require frequent removal and replacement of interior signs, consider the use of hook and loop fasteners, such as Velcro . A hook and loop attachment system allows for easy sign removal and replacement when frequent sign changes are required, does not require skilled labor and minimizes damage to wall surfaces.

11.6. Sources. There are many commercial sign systems available. There are usually national and local manufacturers of interior signs in most metropolitan areas. There are also many sign-making machines available.

11.6.1. References. Refer to the most recent version of the National Fire Protection Association (NFPA) NFPA 101 Life Safety Code and the NFPA Life Safety Code Handbook for the design and placement of all signs relating to means of egress and other life safety issues. Refer to Chapter 3 for the design and placement of all signs relating to the Americans with Disabilities Act.

Section 11B--Interior Sign Types

11.7. Main Categories. Like exterior signs, interior signs are standardized by function. The four

main sign categories are Information, Direction, Identification and Regulation.

11.8. Other Information. Bulletin boards display materials that relate to information, regulation, and motivation and are covered at the end of this chapter. The size, recommended design and layout for each type of sign are provided on the following pages. Information on typography and graphics can be found in Chapter 2. See Chapter 12 for information on sign structure and details.

11.9. Building Directory Sign Types AA1 and AA1a.

11.9.1. Usage, Location and Visibility. Types AA1 and AA1a building directories are used for major buildings. They are located in the main entrance lobby and should be clearly visible to visitors as they enter the building. For purposes of the ADAAG, these are considered to be temporary signs and need not comply.

11.9.2. Components of Type AA1. The Type AA1 building directory has two components. The permanent header panel gives the name of the building or the major organization, and may also show the unit organization emblem. The directory section is a changeable letter board with molded plastic letters that have tabs to align the letters in the slots of the letter board. It lists the name of each tenant in the building.

11.9.3. Components of Type AA1a. The Type AA1a building directory is similar to the Type AA1 directory, with the addition of a schematic building floor plan to assist in visitor orientation.

11.9.4. Building Directory Sign type AA1 Layout.

11.9.4.1. Colors. Colors should coordinate with the building interior design scheme.

11.9.4.2. Dimensions. 900 mm x 1 800 mm (3’- 0” x 6’- 0”).

11.9.4.3. Typography.

- Heading: upper and lower case Helvetica medium, 50 mm (2") capital letter height, flush left.
- Secondary Heading: upper and lower case Helvetica regular, 50 mm (2") capital letter height, flush left.
- The heading area will accommodate two lines with a maximum line length of 30 tiles or characters per line.
- Text: upper and lower case Helvetica medium, 12 mm (½ ”) capital letter height, flush left.
- The text area will accommodate three columns of 19 lines each, with a maximum line length of 45 tiles or characters per line.

11.9.4.4. Emblem: Authorized organizational emblem, 100 mm x 100 mm (4" x 4"), upper left corner.

Figure 11.1. Interior Sign Types.

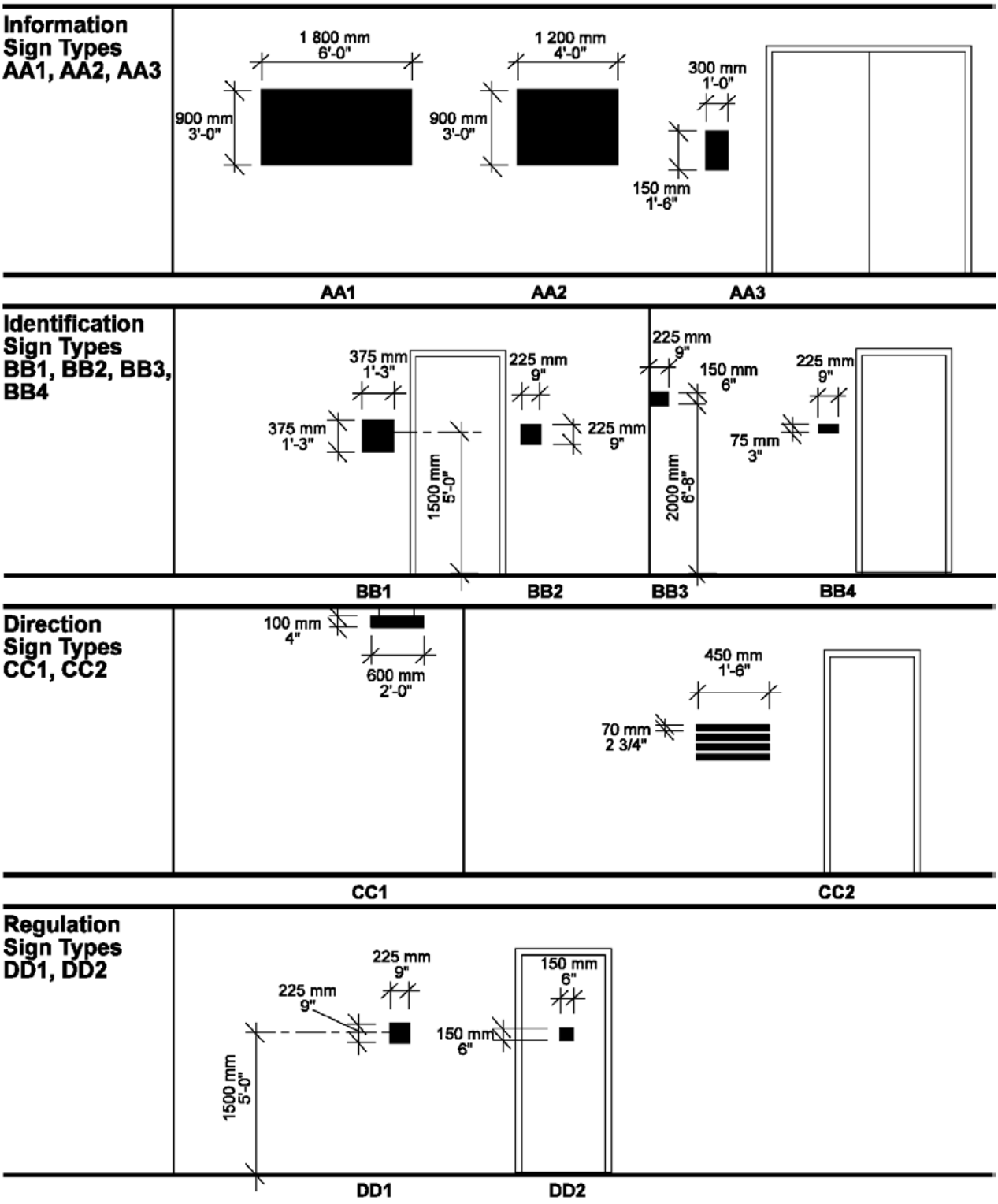


Figure 11.2. Placement of Building Directory Signs Types AA1 and AA1a.

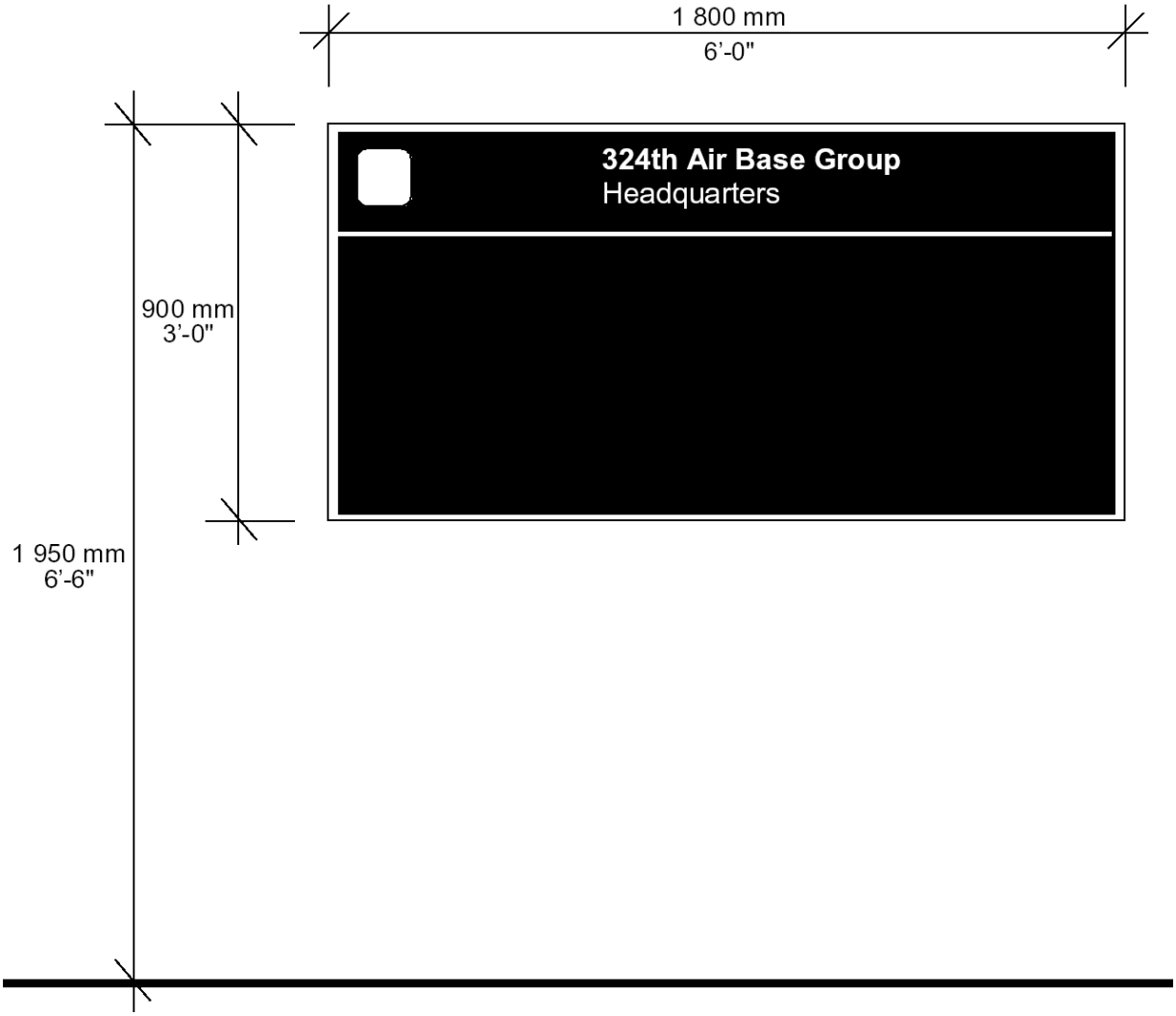
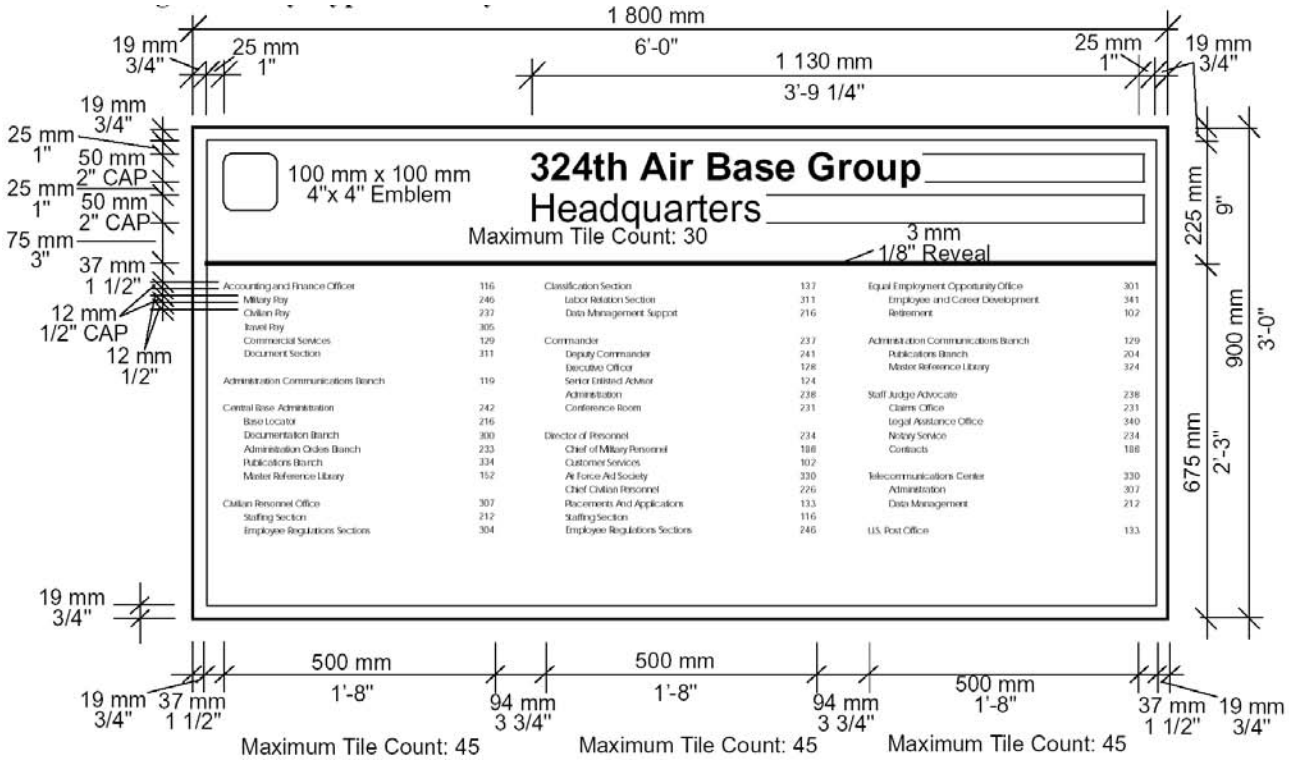


Figure 11.3. Building Directory Type AA1 Layout.



11.9.5. Building Directory Sign Type AA1a Layout.

11.9.5.1. Colors. Colors should coordinate with the building interior design scheme.

11.9.5.2. Dimensions. Height is 900 mm (3’- 0”). Width may vary from 1 800 mm (6’ -0”) to 2 700 mm (9’-0”).

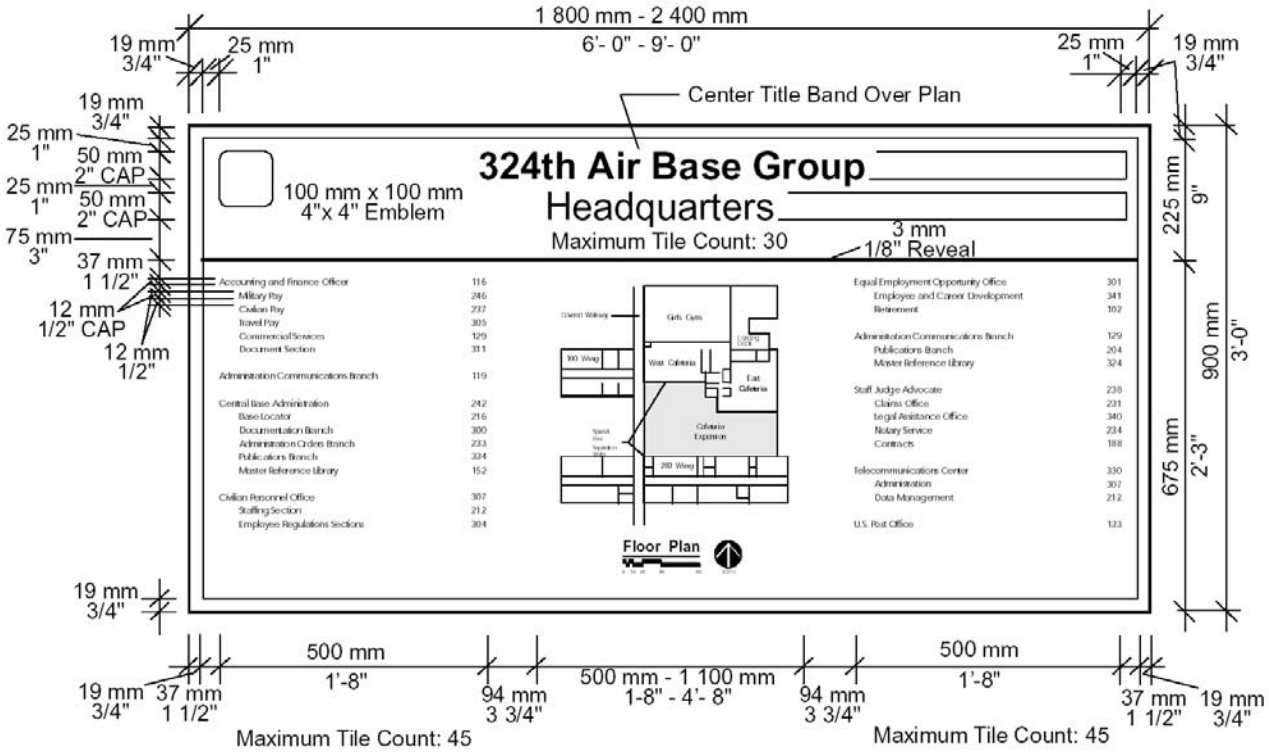
11.9.5.3. Typography.

- Heading: upper and lower case Helvetica medium, 50 mm (2”) capital letter height, centered over building floor plan.
- Secondary Heading: upper and lower case Helvetica regular, 50 mm (2") capital letter height, centered over building floor plan.
- The heading area will accommodate two lines with a maximum line length of 30 tiles or characters per line.
- Text: upper and lower case Helvetica medium, 12 mm ½” capital letter height, flush left.
- The text area will accommodate three columns of 19 lines each, with a maximum line length of 45 tiles or characters per line.

11.9.5.4. Emblem. Authorized organizational emblem, 100 mm x 100 mm (4" x 4"), upper left corner.

11.9.5.5. Building Floor Plan. Aligned and centered with directory text. This should be a professional quality schematic graphic.

Figure 11.4. Building Directory Sign Type AA1a Layout.



11.10. Building Directory Sign Type AA2 and Floor Directory Sign Type AA3.

11.10.1 Usage, Location and Visibility of AA2. The Type AA2 building directory is similar to the Type AA1 directory but lists fewer tenants. It should be located in the main entrance lobby and should be clearly visible to visitors as they enter the building. For purposes of the ADAAG, these are considered to be temporary signs and need not comply.

11.10.2. Locations and Visibility of AA3. The Type AA3 floor directory should be located in the elevator lobby of each floor, clearly visible to traffic entering the lobby from elevators or corridors. If the floor is not serviced by elevators, the floor directory should be located in the major stairway landings. For purposes of the ADAAG, these are considered to be temporary signs and need not comply.

11.11. Building Directory Sign Type AA2 Layout.

11.11.1. General Information. The Type AA2 building directory consists of a permanent header panel showing the name of the building or the major organization and a changeable directory that lists each tenant. An organizational emblem is not used on the header panel of the Type AA2 directory. The directory section is a board with changeable copy inserts or tiles.

Changeable letter boards with molded plastic changeable letters are a less favored option.

11.11.2. Colors. Colors should coordinate with the building interior design scheme.

11.11.3. Dimensions. 900 mm x 1 200 mm (3’- 0” x 4’- 0”)

11.11.4. Typography.

- Heading: upper and lower case Helvetica medium, 50 mm (2") capital letter height, flush left.
- Secondary Heading: upper and lower case Helvetica regular, 50 mm (2") capital letter height, flush left.
- The heading area will accommodate two lines with a maximum line length of 30 tiles or characters per line.
- Text: upper and lower case Helvetica medium, 12 mm (1/2”) capital letter height, flush left.
- The text area will accommodate two columns of 19 lines each, with a maximum line length of 45 tiles or characters per line.

Figure 11.5. Placement of Building Directory Sign Type AA2 and Floor Directory Sign Type AA3.

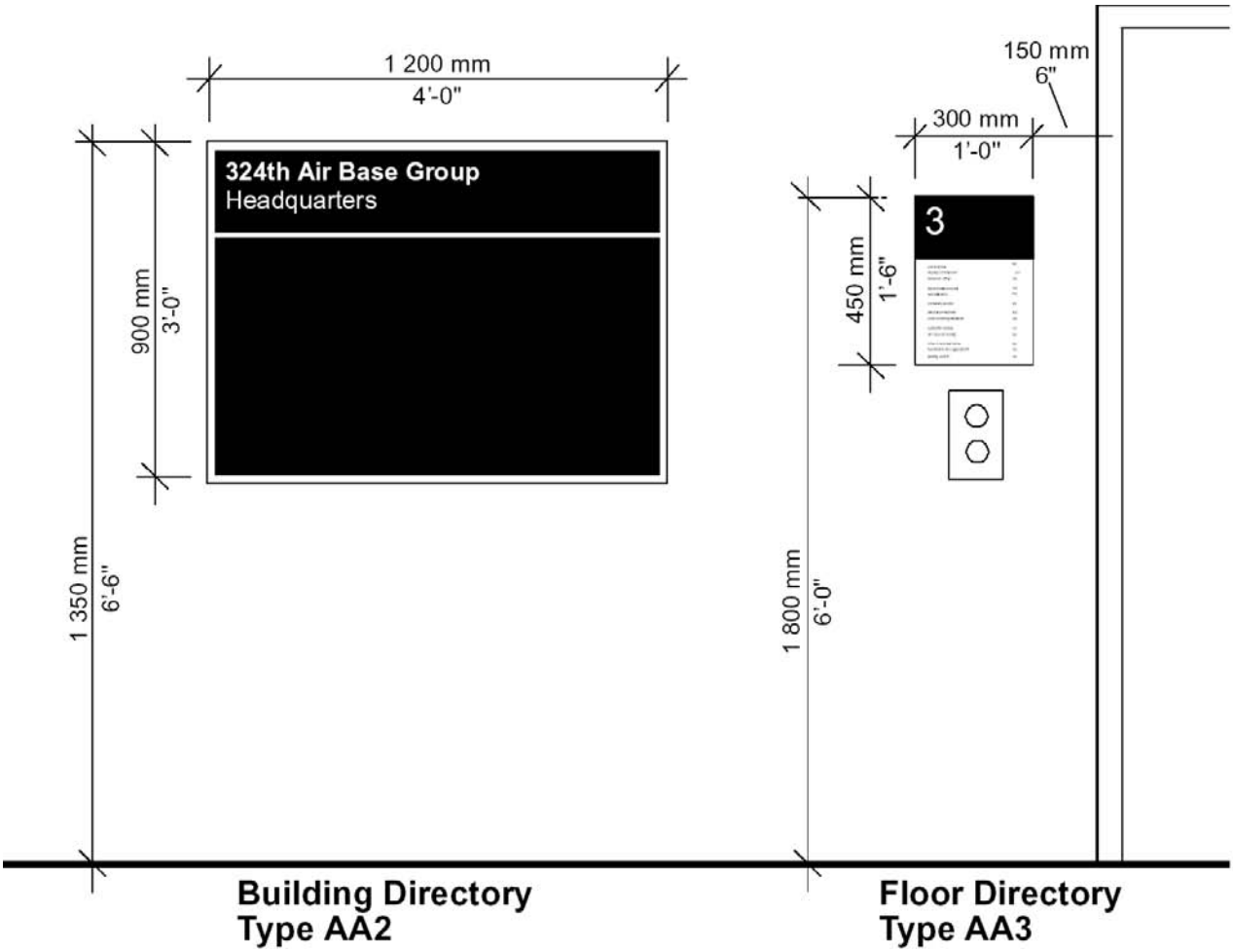
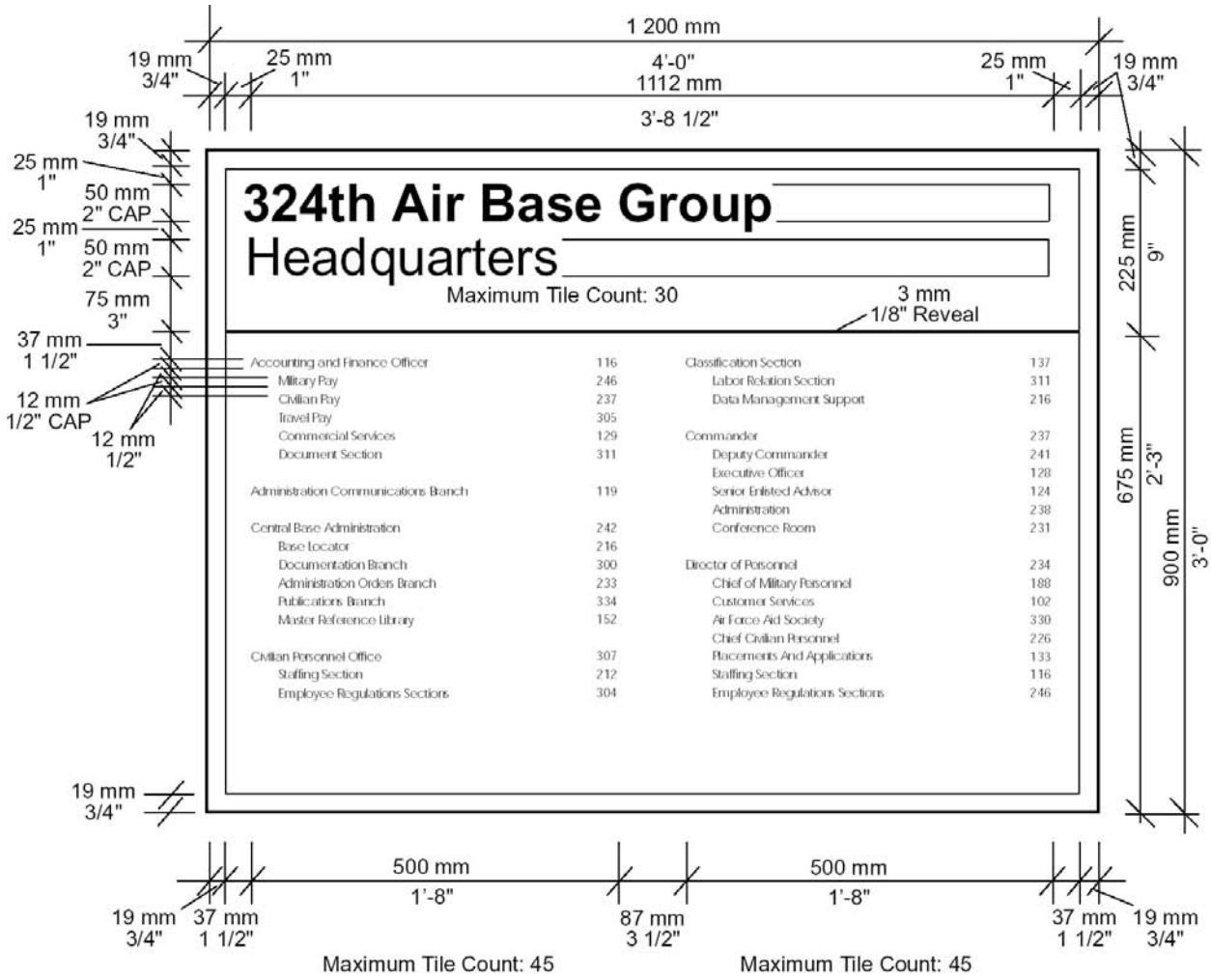


Figure 11.6. Building Directory Sign Type AA2 Layout.



11.12. Floor Directory Sign Type AA3 Layout.

11.12.1. General Information. The Type AA3 floor directory consists of a permanent header panel with the floor number, plus an insert panel that lists each tenant on the floor. The insert panel is a clear sleeve which will accept a paper or plastic insert listing the names of the tenants. A laser printed card stock sheet may be used as an insert, as shown in Figure 11.7.

11.12.2. Colors. Colors should coordinate with the building interior design scheme.

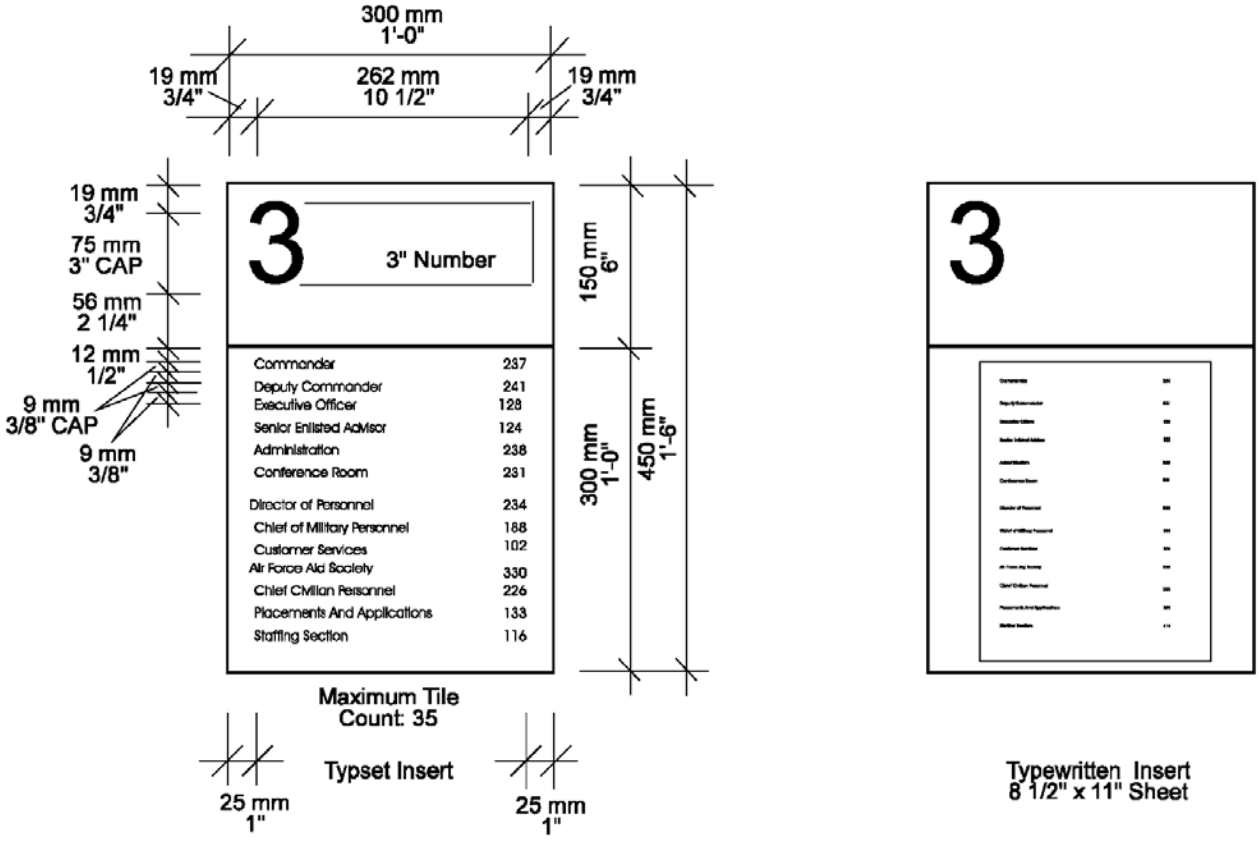
11.12.3. Dimensions. 450 mm x 300 mm (1’- 6” x 1’- 0”).

11.12.4. Typography.

- Floor number: Helvetica medium, 75 mm (3") number, flush left.
- Insert, headings: upper and lower case Helvetica medium, 9 mm (3/8") capital letter height, flush left.

- Insert, text: upper and lower case Helvetica regular, 9 mm (3/8") capital letter height, flush left.
- The insert message area will accommodate 15 lines with a maximum length of 35 tiles or characters per line.

Figure 11.7. Floor Directory Sign Type AA3 Layouts.



11.13. Office Identification Signs Types BB1, BB2, BB3 and BB4.

11.13.1. Usage. There are four types of office identification signs. The Type BB1 sign is used to identify a major office or area in a building (such as a wing or annex). The Type BB2 and Type BB3 signs are used for all other designated offices. The room number sign, Type BB4, is used to identify a secondary office entrance or a room with no designated function. 11.13.2. Description. The Type BB2 sign is a wall mounted sign, and is preferred to the Type BB3 projecting sign because it is easier to fabricate and maintain, but both types may be used. Each sign consists of a permanent header panel with the room number, wing, or annex designation plus an insert panel which identifies the occupant. The insert panel is a clear sleeve which will accept a paper or plastic insert with the name of the occupant. The Type BB4 sign consists of a header panel only, with no insert panel. It should be positioned at the same height from the floor as the Type BB2 sign. (See Figure 11.8)

11.13.3. Office Identification Sign Type BB1 Layout.

11.13.3.1. Colors. Colors should coordinate with the building interior design scheme

11.13.3.2. Dimensions. 375 mm x 375 mm (1'-3" x 1'-3").

11.13.3.3. Typography.

- Heading: upper case Helvetica medium 37 mm (1 ½ ") capital letter height, flush left.
- The heading area will accommodate two lines with a maximum of 10 tiles or characters per line and accompanying Grade Two Braille.
- Tenant name: upper and lower case Helvetica medium, 19 mm (3/4 ") capital letter height, flush left.
- Secondary information: upper and lower case Helvetica regular, 19 mm (3/4") capital letter height, flush left.
- The insert area will accommodate four lines with a maximum of 24 tiles or characters per line.

11.13.4. Office Identification Signs Type BB2, BB3 and BB4 Layouts.

11.13.4.1. Colors. Colors should coordinate with the building interior design scheme.

11.13.4.2. Dimensions. BB2 - 225 mm x 225 mm (9" x 9"), BB3 - 150 mm x 300 mm (6" x 12"),
BB4 - 75 mm x 225 mm (3" x 9").

11.13.4.3. Typography.

- Room number BB2, BB4: Helvetica medium, 37 mm (1 ½ ") numbers, flush left and accompanying Grade Two Braille.
- Room number BB3: Helvetica medium 75 mm (3") numbers, flush left.
- Tenant name: upper and lower case Helvetica medium, 12 mm (½ ") capital letter height, flush left.
- Secondary information: upper and lower case Helvetica regular, 12 mm (½ ") capital letter height, flush left.
- The insert area for the Type BB2 sign will accommodate four lines with a maximum of 21 tiles or characters per line.
- The insert area for the Type BB3 sign will accommodate one line with a maximum of 21 tiles or characters per line.

11.14. Office Identification Signs Type BB5, BB6 and BB7.

11.14.1. Usage, Placement and Description of BB5. The office partition identification sign Type BB5 is used to identify offices in open office areas. Place sign on the corner of the partition closest to traffic circulation. The sign consists of a permanent header panel showing the office workstation number and an insert panel which identifies the occupant. The insert panel has a clear sleeve which accepts a paper or plastic insert with the name of the occupant.

11.14.2. Usage and Placement of BB6. Use the Type BB6 desk plaque to identify individuals. If the base is removed, it may also be mounted on the office partition instead of the Type BB5 sign.

11.14.3. Usage of BB7. The service identification sign, Type BB7, is used to identify restrooms, telephones, and other services. The symbols for these services are shown in Figures 2.29, 2.30 and 2.31.

11.14.4. Sign Type BB5 - Office Partition Identification Sign.

11.14.4.1. Colors. Colors should coordinate with the building interior design scheme

11.14.4.2. Dimensions 150 mm x 150 mm (6" x 6").

11.14.4.3. Typography.

- Office identification: upper case Helvetica medium letters and numbers, 25 mm (1") high, flush left.
- Tenant Name: typewritten on a 75 mm x 150 mm (3" x 6") card, flush left, as shown in Figure 11.12.

Figure 11.8. Office Identification Signs Types BB1, BB2 and BB3.

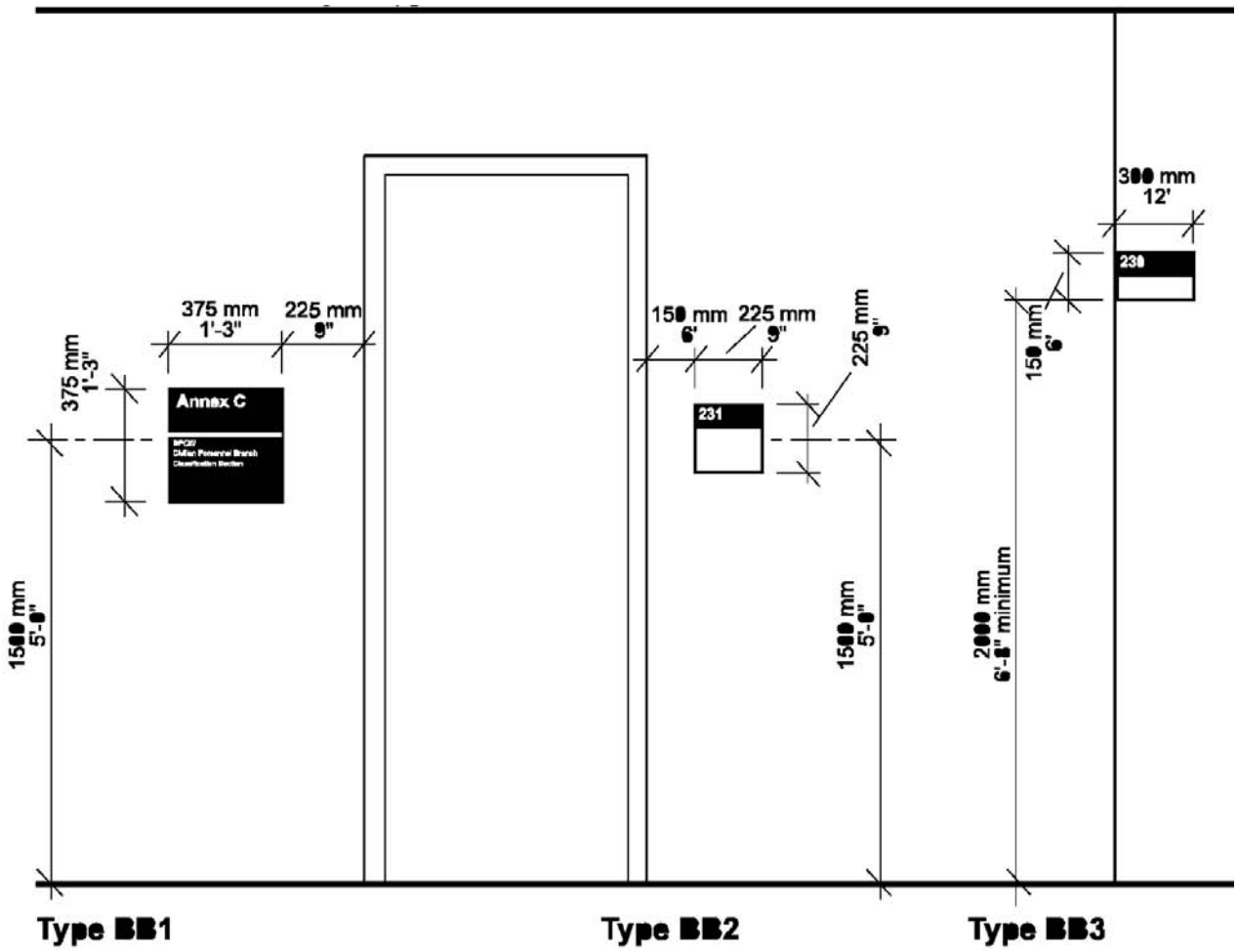


Figure 11.9. Office Identification Sign Type BB1 Layout.

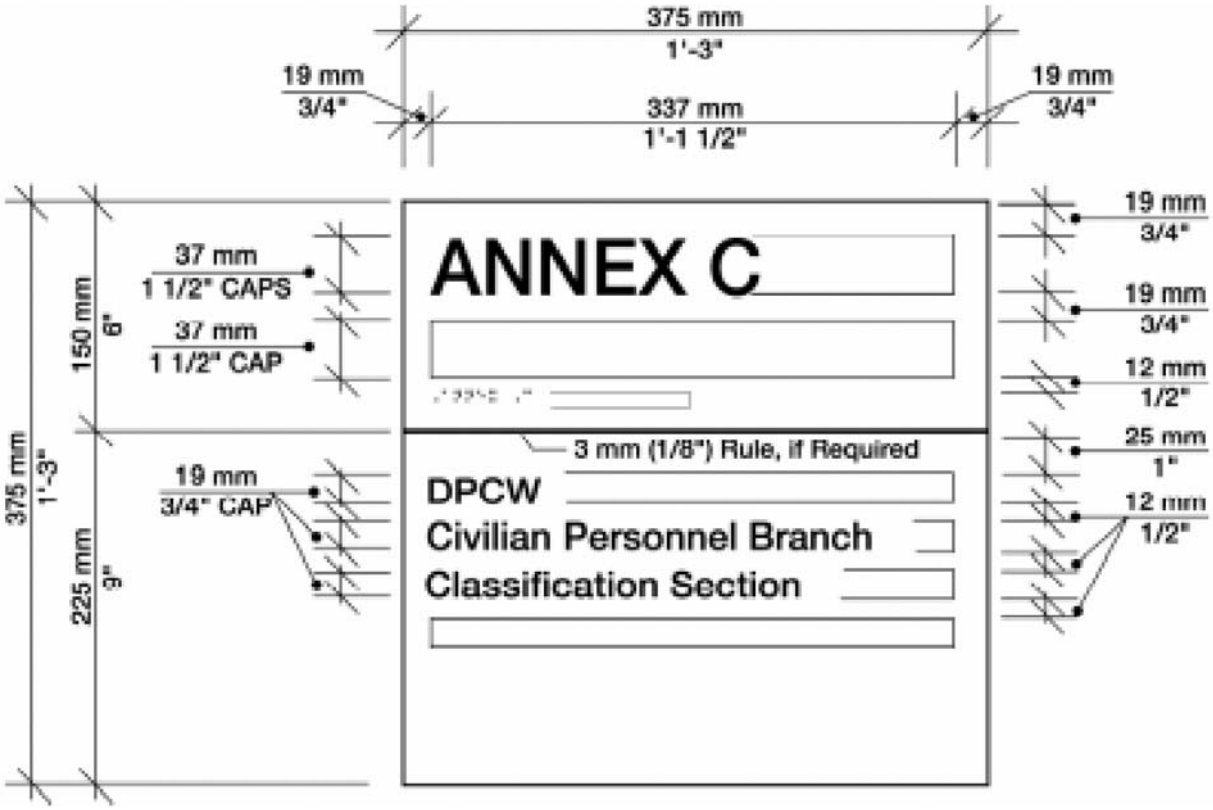


Figure 11.10. Office Identification Types BB2, BB3 and BB4 Layouts.

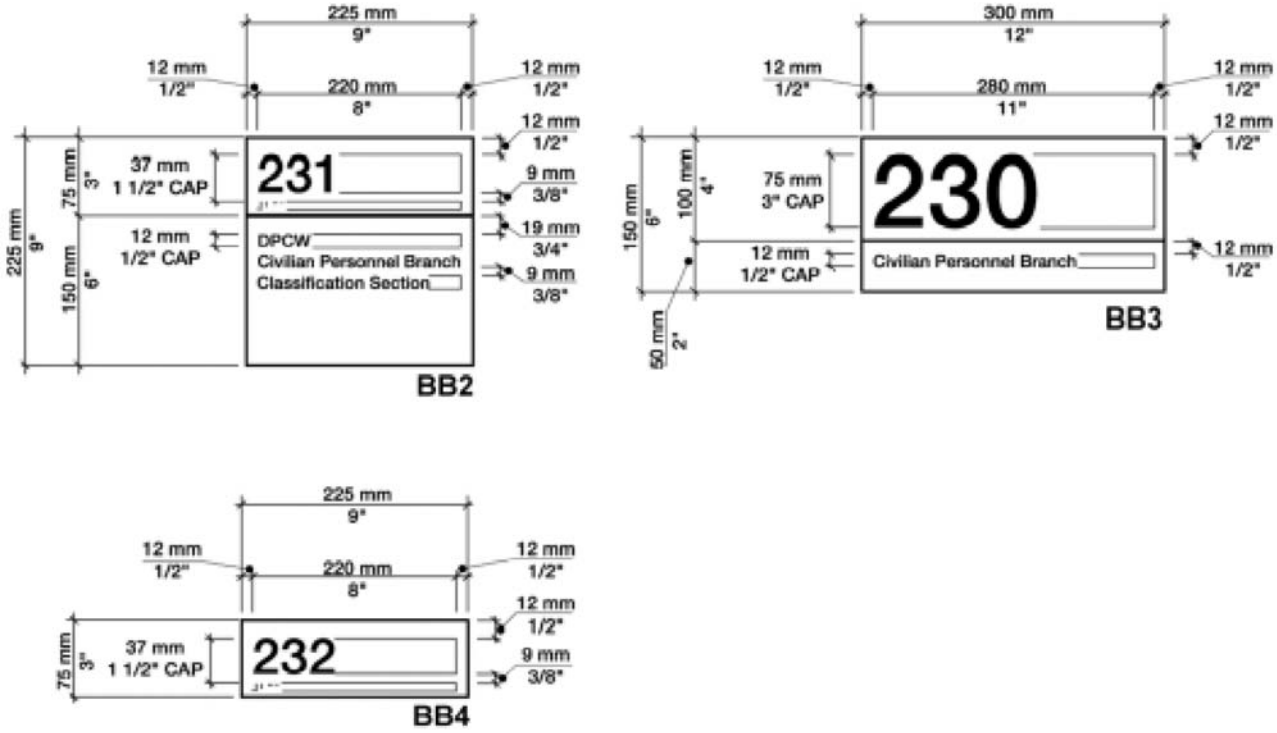


Figure 11.11. Placement of Identification Signs Types BB5, BB6 and BB7.

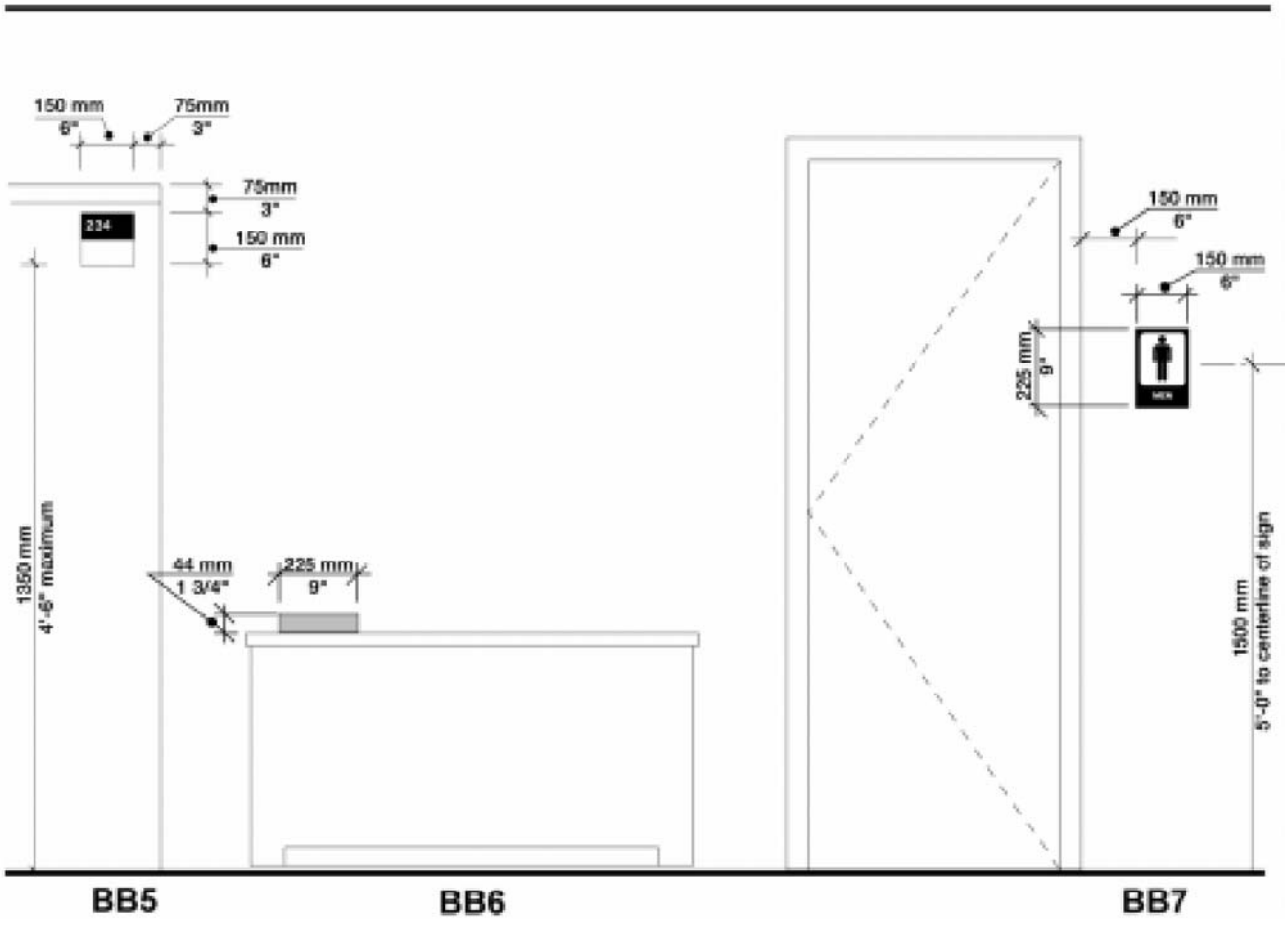
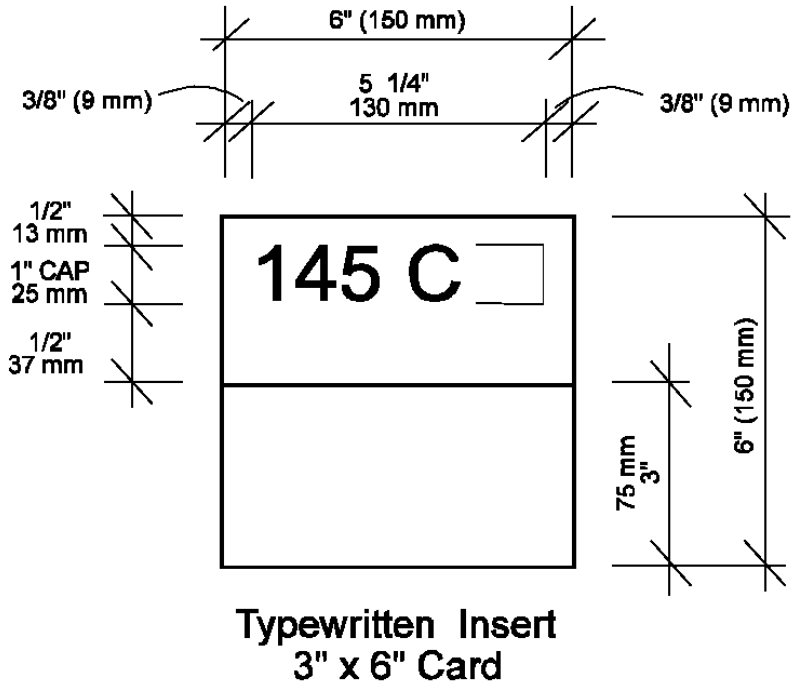


Figure 11.12. Office Partition Sign Identification Type BB5 Layout.



11.14.5. Office Identification Sign Type BB6 Layout - Desk Plaque.

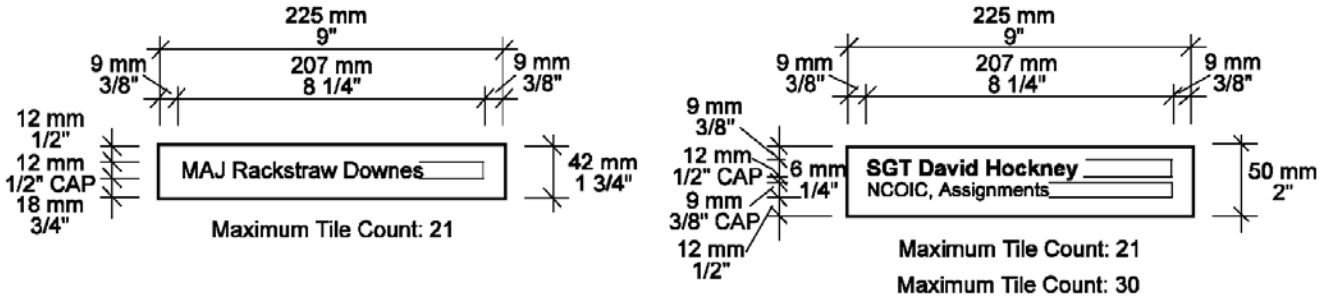
11.14.5.1. Colors. Colors should coordinate with the building interior design scheme.

11.14.5.2. Dimensions. 44 mm x 225 mm (1 ¾ " x 9") and 50 mm x 225 mm (2" x 9").

11.14.5.3. Typography.

- Name: upper and lower case Helvetica medium, 12 mm (½ ") capital letter height, flush left. The name line will accommodate a maximum of 21 tiles or characters.
- Title: upper and lower case Helvetica medium, 9 mm (3/8 ") capital letter height, flush left. The title line will accommodate a maximum of 30 tiles or characters.

Figure 11.13. Office Identification Sign Type BB6 Layout.



11.14.6. Office Identification Sign Type BB7 Layout - Service Identification.

11.14.6.1. Colors. Colors to coordinate with building interior design scheme.

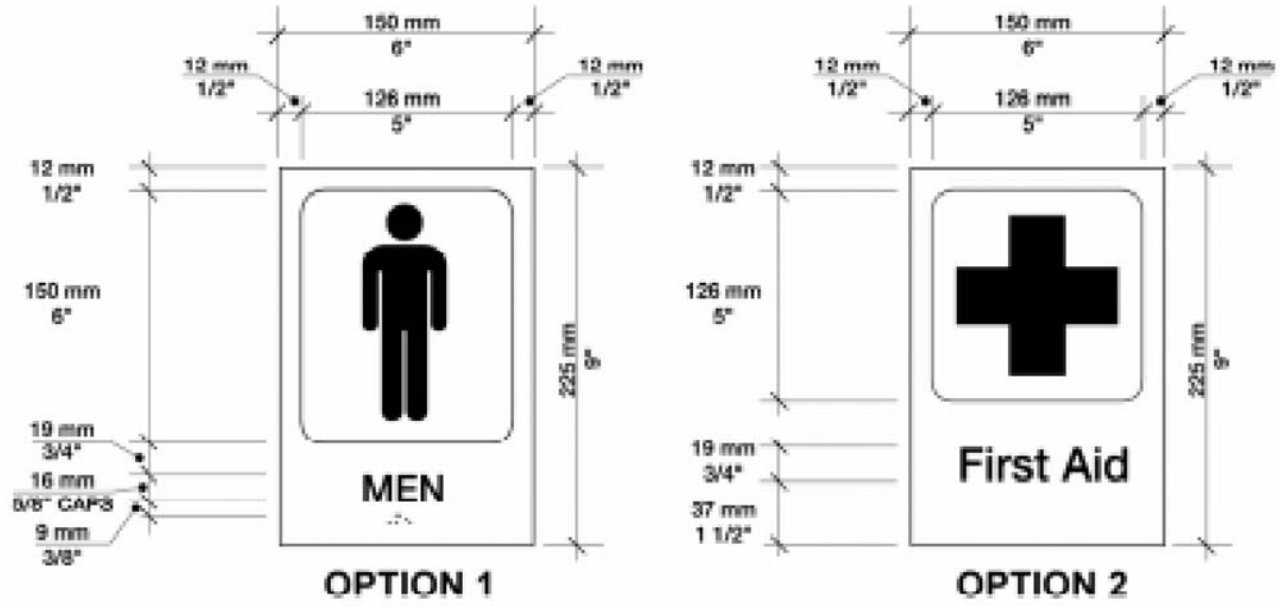
11.14.6.2. Symbols. Black symbol or red symbol (where appropriate) on white background.

11.14.6.3. Dimensions. 225 mm x 150 mm (9" x 6").

11.14.6.4. Typography.

- Service name (Option 1): upper case Helvetica medium, 16 mm (5/8") capital letter height, centered with accompanying Grade Two Braille. The message line will accommodate a maximum of 7 tiles.
- Service name (Option 2): upper and lower case Helvetica medium, 19 mm (3/4") capital letter height, centered. The message line will accommodate a maximum of 9 tiles.

Figure 11.14. Service Identification Sign Type BB7 Layout.



11.15. Direction Signs Types CC1 and CC2.

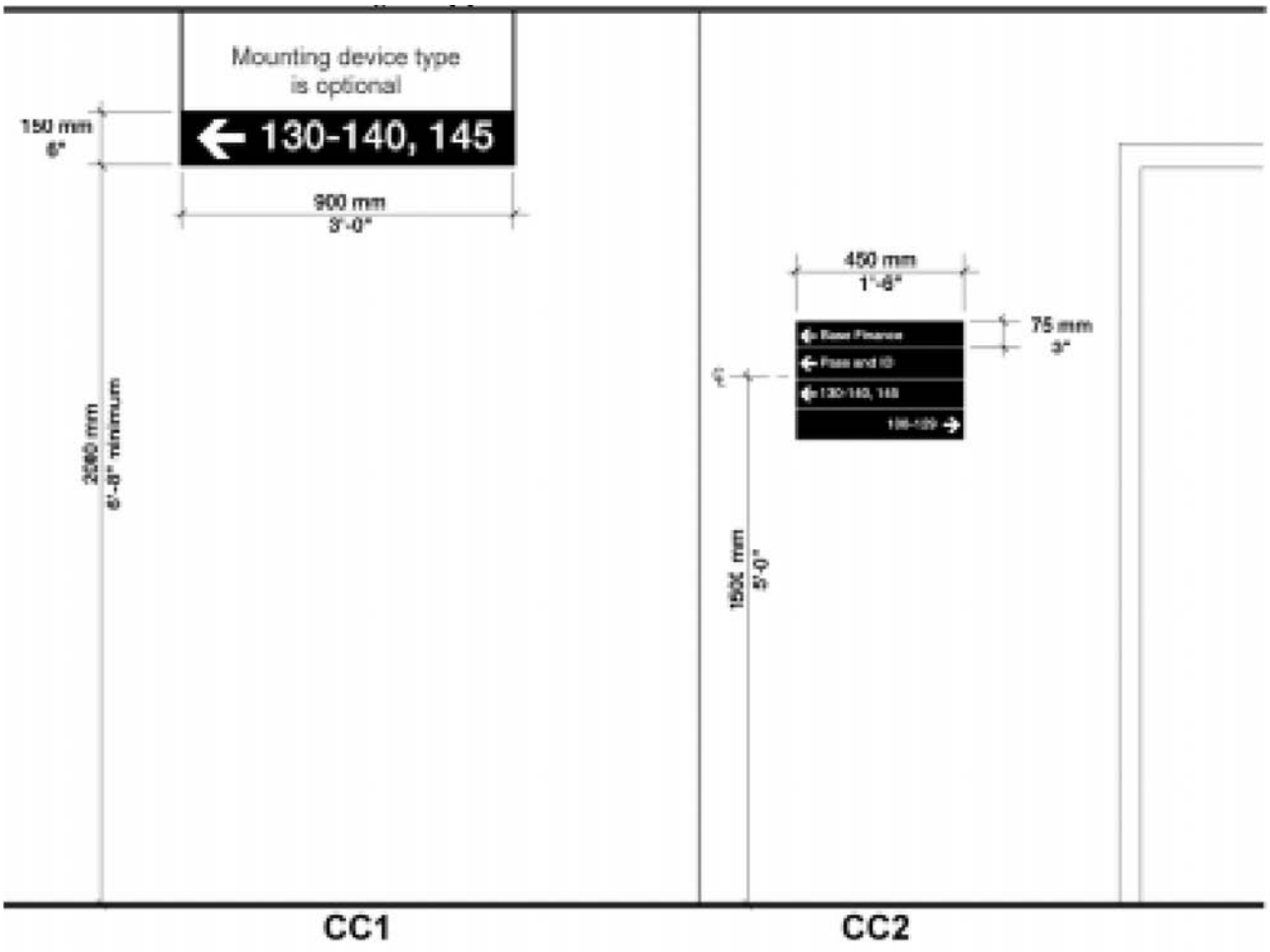
11.15.1. Types and Locations. There are two types of direction signs: the ceiling mounted Type CC1 sign and the wall mounted Type CC2 sign. A direction sign should be located at each decision point in the path of travel, for example, opposite elevators or stairways, and at each corridor intersection.

11.15.2. Information. Direction signs should indicate room numbers. The destinations most often sought by people entering the building for the first time (such as Finance, Pass and ID, or Vehicle Registration) should be listed by name. All others should be identified by room number alone. This greatly simplifies both initial fabrication and maintenance.

11.15.3. Signage System. Direction signs should tie into the interior signage system. Every building should have a directory (Sign Type AA2) at each entrance and a floor directory (Sign Type AA3) at each elevator or stairway landing. The directories should include room numbers in order to give continuity of directional information from entry through arrival on the floor and location of the room. Room numbers placed on or beside office doors complete the system.

11.15.4. Placement of Messages. Messages are placed flush left or flush right to the arrow. Arrows pointing to the left, up, or down, have flush left messages, and arrows pointing to the right have flush right messages. The arrow is centered in the space between the message and the edge of the sign.

Figure 11.15. Placement of Direction Signs Types CC1 and CC2.



11.15.5. Direction Signs Type CC1 Layouts.

11.15.5.1. Colors. Colors should coordinate with the building interior design scheme.

11.15.5.2. Dimensions. Slats - 150 mm x 900 mm (6" x 3’- 0”).

11.15.5.3. Typography. Upper and lower case Helvetica medium, 75 mm (3") capital letter height, flush left or right (to arrow). The message area of each slat will accommodate a maximum of 11 tiles or characters.

11.15.5.4. Arrow. Standard tile, 113 mm (4 ½") high, placed left or right as appropriate.

11.15.6. Direction Sign Type CC2 Layout.

11.15.6.1. Dimensions. Slats - 75 mm x 450 mm (3" x 1'- 6").

11.15.6.2. Typography. Upper and lower case Helvetica medium, 25 mm (1") capital letter height, flush left or right (to arrow). The message area of each slat will accommodate a maximum of 16 tiles or characters.

11.15.6.3. Arrow. Standard tile, 37 mm (1 ½") high, placed left or right as appropriate.

Figure 11.16. Direction Sign Type CC1 Layout.

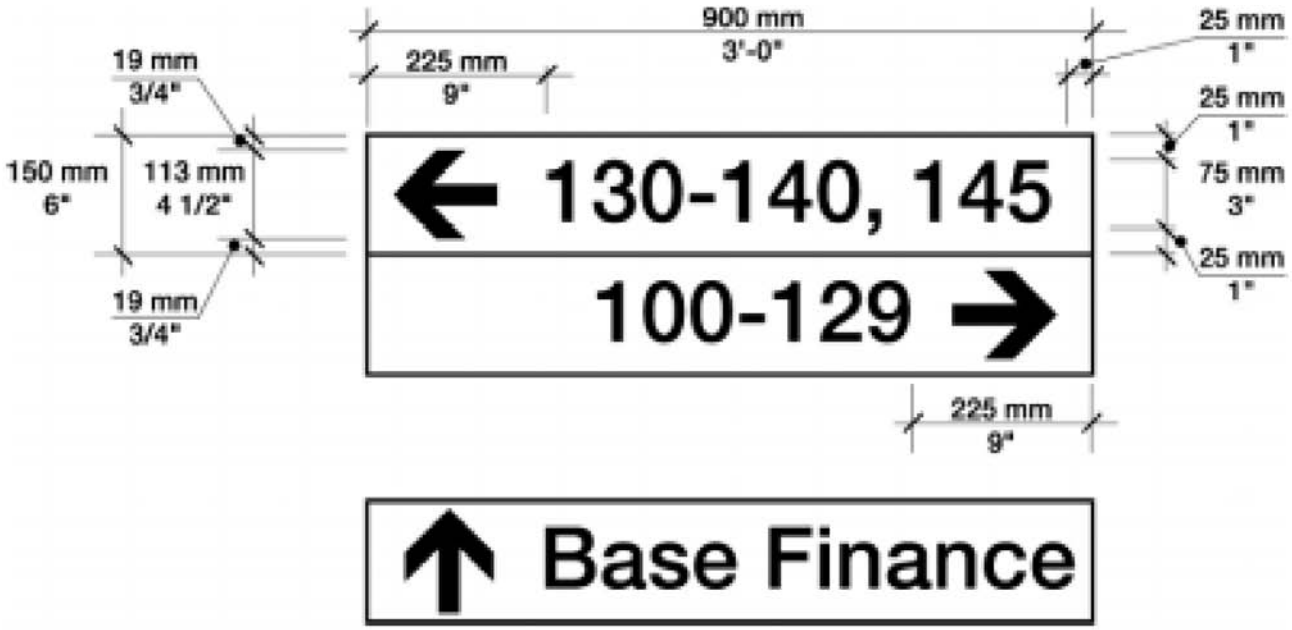
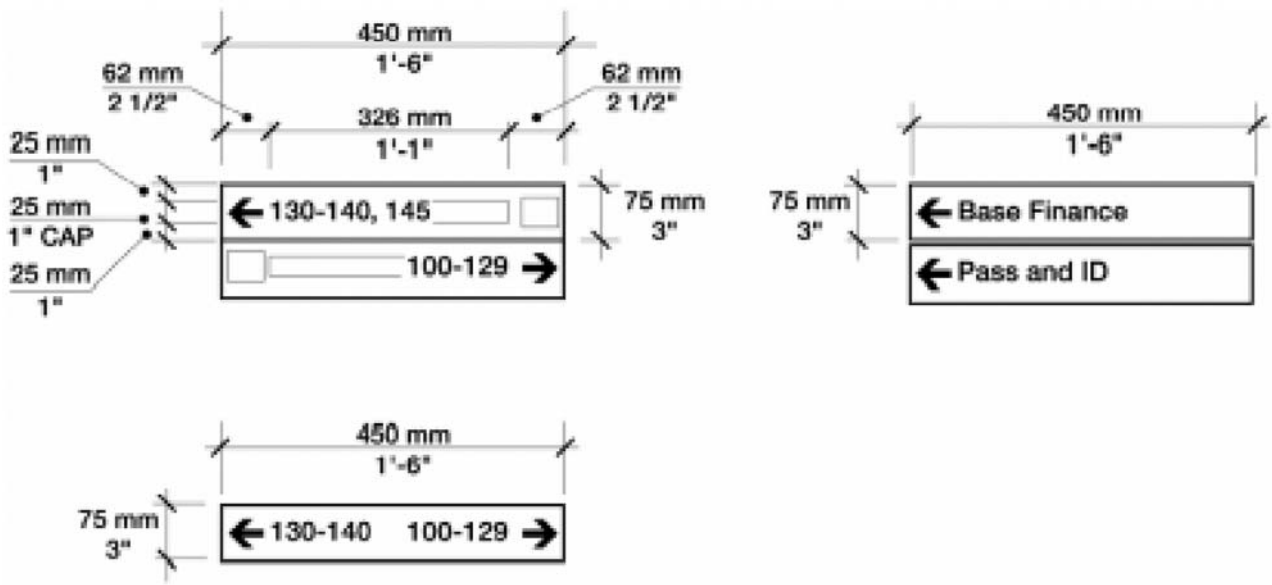


Figure 11.17. Direction Sign Type CC2 Layout.



11.16. Regulation Signs Types DD1 and DD2.

11.16.1. Standards. There are many regulation signs required for use in Air Force buildings. Air Force standards for safety signs are contained in AFOSH 9166, General Industrial Operations, and are updated by the Air Force Safety Center (AFSC/SEGS).

11.16.2. Locations. These signs should be located where specific warning or prohibitive information is required. The Type DD1 sign should be located in open areas (such as hangars or workshops), and the Type DD2 sign should be located in offices, labs and corridors.

11.16.3. Message. If the symbol on the Type DD2 sign needs reinforcement by a word message for clarity, use the sign layout for the Type BB7 sign. See Figure 11.14.

11.16.4. Regulation Signs Types DD1 and DD2 Layouts.

11.16.4.1. Colors. Symbols - black symbol and standard red circle with bar on white background.

11.16.4.2. Type DD1 Sign Dimensions. 225 mm x 225 mm (9" x 9").

11.16.4.3. Type DD1 Sign Symbol. 187 mm x 187 mm square (7 ½ " x 7 ½ ").

11.16.4.4. Type DD2 Sign Dimensions. 150 mm x 150 mm (6" x 6").

11.16.4.5. Type DD2 Sign Symbol. 125 mm x 125 mm square (5" x 5").

11.17. Bulletin Boards Sign Type EE1.

11.17.1. Usage. Bulletin boards are used to display many kinds of information, including notices, regulations, memoranda, and posters to promote worthwhile causes and advertise special events.

11.17.2. Appearance. The appearance of a bulletin board is completely dependent on the visual quality and organization of the materials mounted on it. The unit commander or the person in charge of maintaining the bulletin board must insist that materials are kept current and neatly arranged.

11.17.3. Description. The Type EE1 bulletin board consists of a permanent header panel with a general title, such as “Notices” or “Information”, and a cork panel for bulletins and announcements.

11.17.4. Colors. Colors to coordinate with building interior color scheme.

- Header panel - white letters on dark background.
- Cork panel - muted tone to coordinate with building interior color scheme.

11.17.5. Dimensions. 900 mm x 1 800 mm (3’- 0” x 6’- 0”).

11.17.6. Typography. Heading - upper and lower case Helvetica medium, 50 mm (2") capital letter height, flush left.

Figure 11.18. Placement of Regulation Signs Types DD1 and DD2.

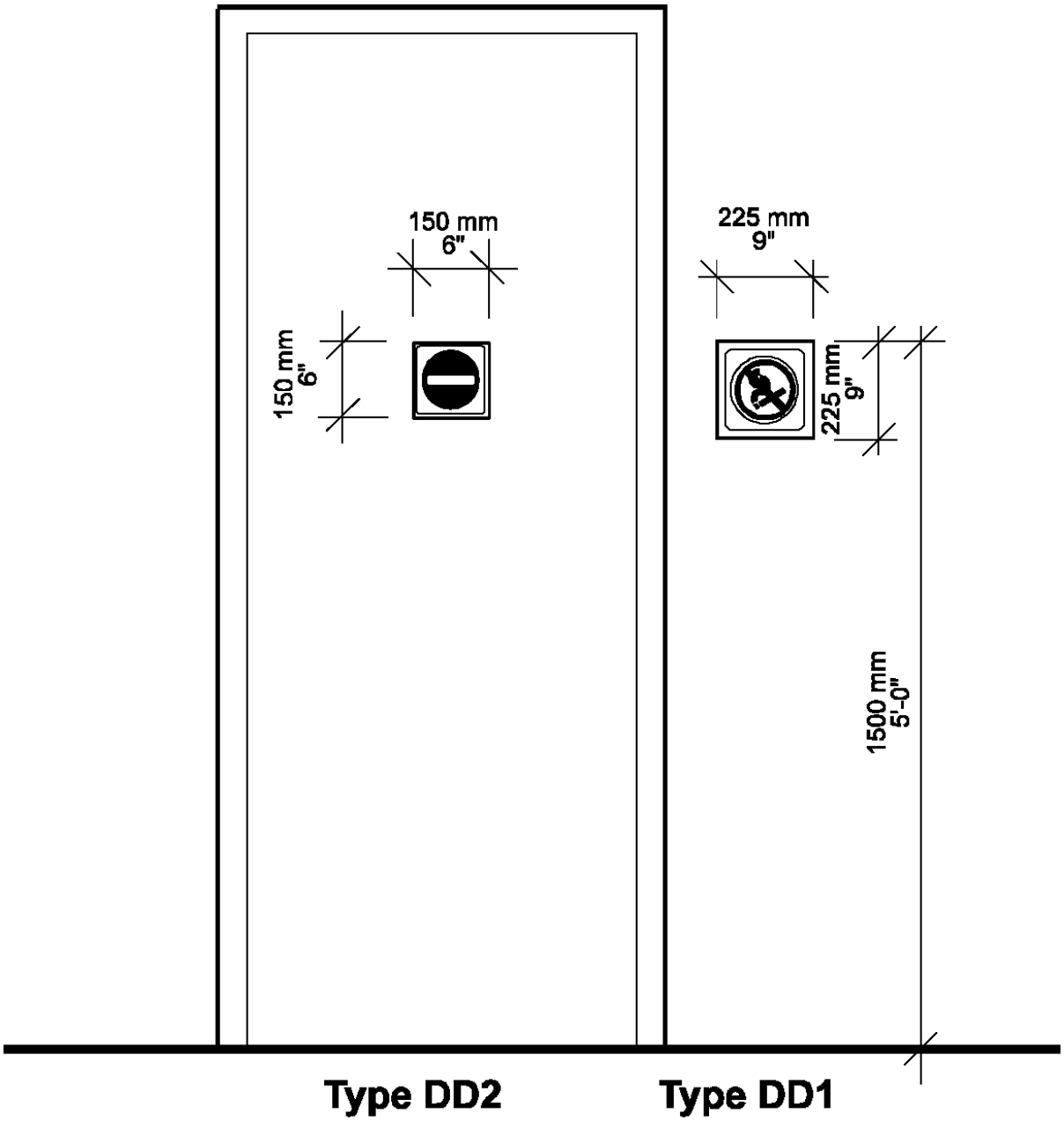


Figure 11.19. Regulation Signs Types DD1 and DD2 Layouts.

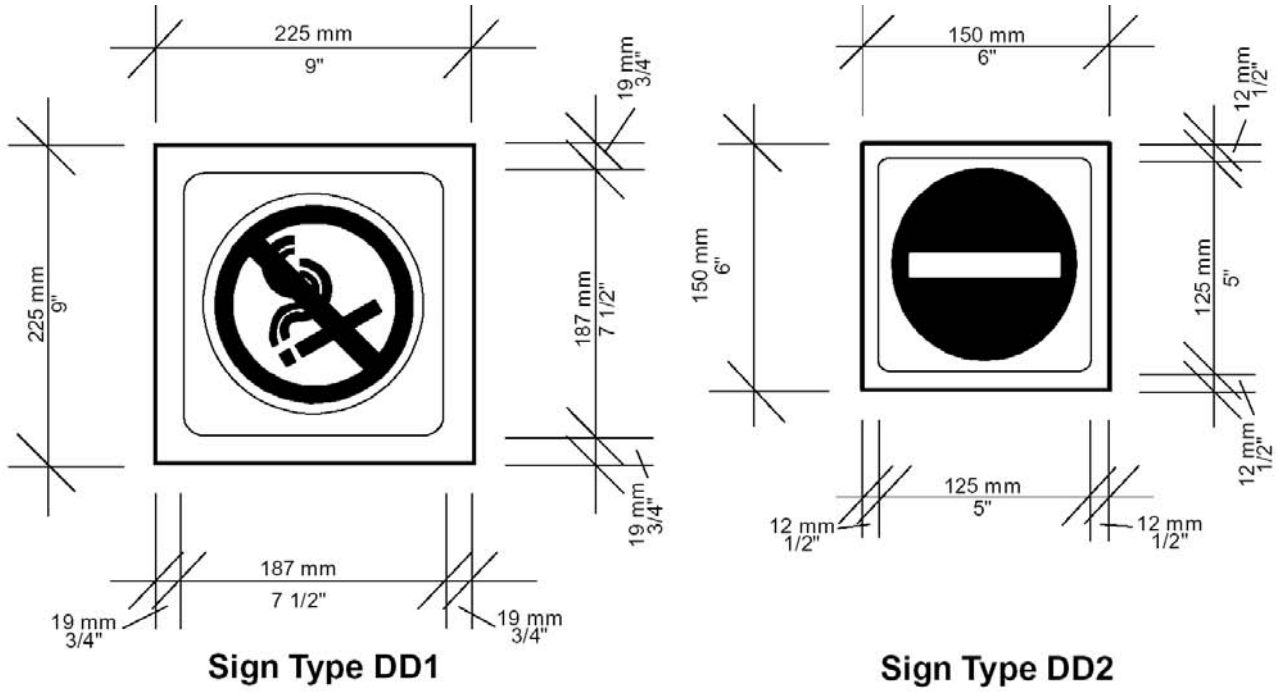


Figure 11.20. Placement of Bulletin Board Type EE1.

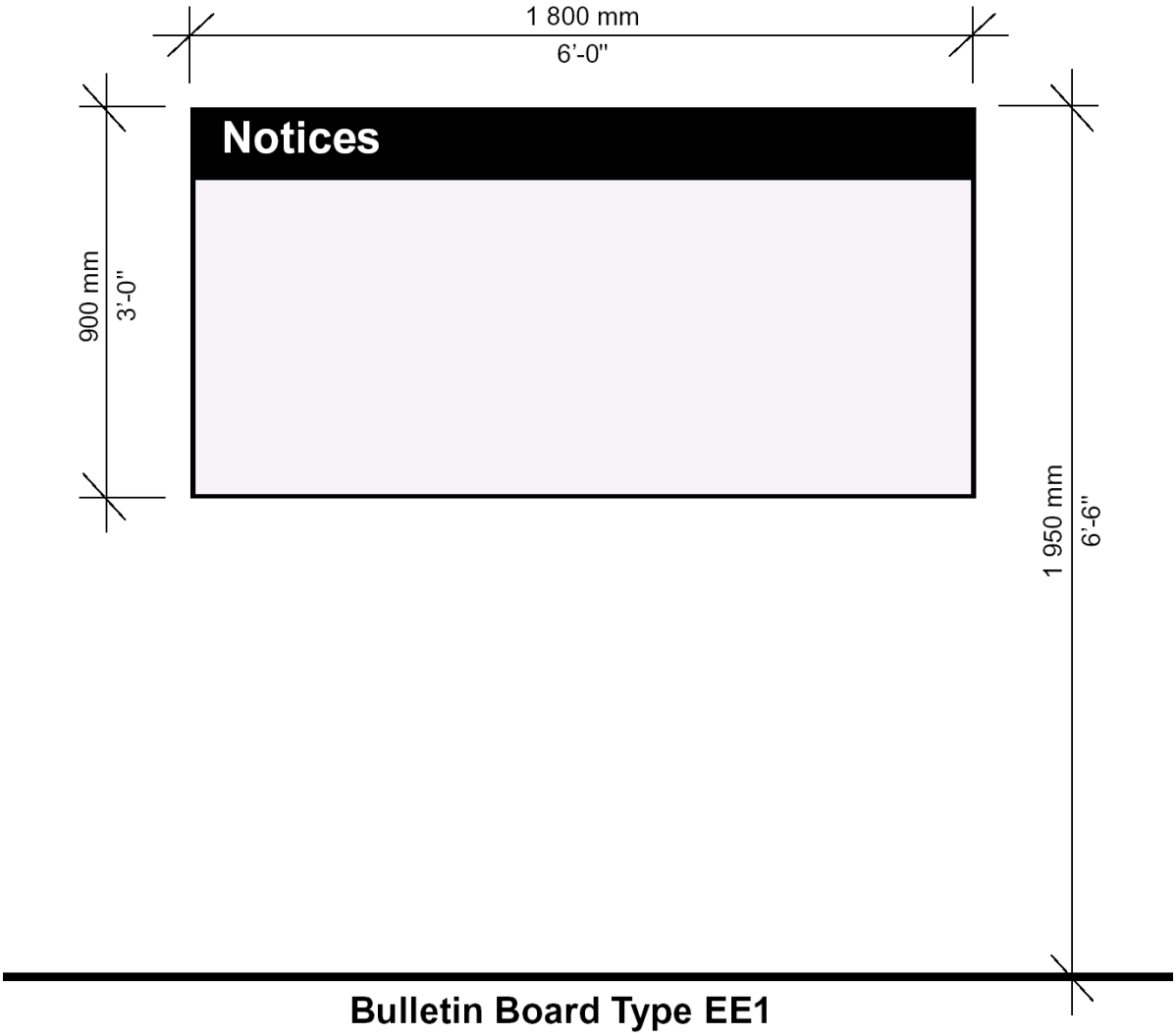
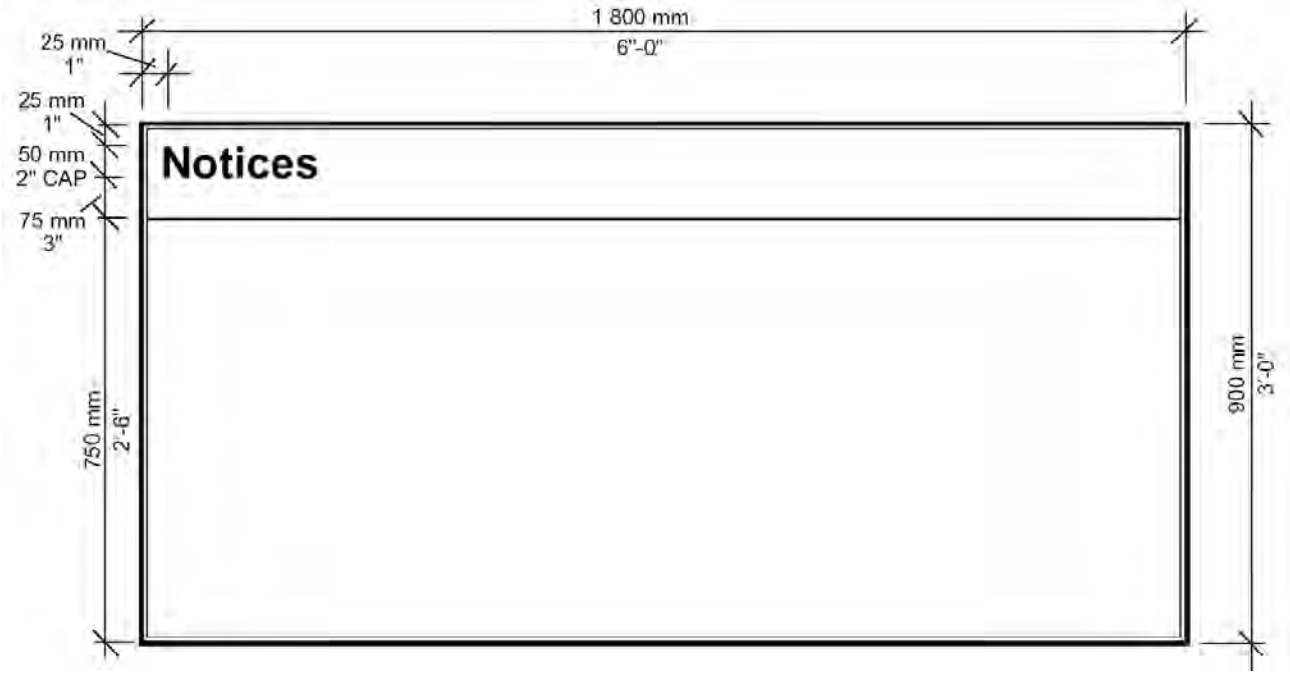


Figure 11.21. Bulletin Boards Sign Type EE1.



APPENDIX HH

MOLD & HUMIDITY CONTROL

Mold and Humidity Control

PARAGRAPH

G-1 Introduction
G-2 Building Envelope
G-3 Tight Buildings
G-4 Air Infiltration and Vapor Barriers
G-5 Gypsum Board and Wall Finishes
G-6 Attics
G-7 Crawl Spaces
G-8 System Selection / Space Humidity Considerations
G-9 Condensate Leaks
G-10 Barracks

G-1 INTRODUCTION:

Mold grows where mold spores, nutrients, correct temperature, and ample moisture are combined. Controlling moisture is the best approach to avoiding mold. Eliminating mold spores is impractical, the organic materials in buildings offer potential mold nutrients, and the temperature in buildings is conducive to mold growth. Thus minimizing moisture by eliminating leaks, drips, and condensation in the wrong places must be addressed. Undesired water and moisture usually comes from problems in either the building envelope or the building mechanical systems or both. Wet materials and surfaces are not always required for mold to grow. Even high humidity conditions contribute to mold growth. Air conditioning systems must be designed to keep space humidity at reasonable levels.

G-2 BUILDING ENVELOPE

The design of the building envelope must consider removal of all air entry points, cold bridges, multiple vapor barriers and gaps in the insulation system. Attics (with exceptions) and crawl spaces should no longer be ventilated. Interior floor slabs should be separated from foundations by insulated expansion joint materials. Cavity wall insulation should extend down to the footings. Insulated windows should be aligned with cavity wall insulation to remove gaps in the insulation system. Window sills, foundation sills and other veneer wall features should be isolated from the structural backup wall allowing cavity wall insulation to run continuously. Use only thermally broken windows. When designing with metal stud backup wall, apply minimum 1’ rigid

insulation over exterior sheathing to improve thermal performance. Consider the use of new insulation products such as Polyicynene which effectively eliminates air infiltration and vapor transmission.

G-3 TIGHT BUILDINGS:

Leaks of unconditioned outdoor bring moisture into the building and lead to condensation on cold surfaces with subsequent wetting of building materials followed by deterioration of the materials and mold growth. Therefore, buildings that are relatively air tight must be the goal. A ventilated attic directly over an insulated lay-in ceiling, for example, does not represent tight building construction. Keep in mind that a slight pressure difference usually exists between inside and outside the building. Insulation batts alone will not stop air flow through the batt if a pressure difference exists from one side if the batt to the other and should therefore not be the only barrier to outdoor air. Mechanical air handling and exhaust systems are typically designed to bring in more air that they exhaust in an attempt to pressurize the building to prevent infiltration of outdoor air. This pressurization however is impossible if the building is full of holes. Pay close attention to the details of construction where walls meet roof to eliminate sources of air leaks. Note that building air tightness is not the same as vapor tightness. Buildings may be designed with or without vapor barriers depending on the indoor and outdoor conditions; however, air tightness must always be the goal.

G-4 AIR INFILTRATION AND VAPOR BARRIERS:

Recent studies have shown that air infiltration/exfiltration is a more significant source of moisture accumulation in walls than water vapor diffusion. Air infiltration barriers (such as Tyvek) resist entry of air in walls that can transport moisture and create condensation problems while allowing water vapor to escape. These barriers also resist wind blown rain and water while protecting wall sheathing.

The use of vapor barriers, vapor retarders, and perm ratings for construction materials in the building envelope must be carefully considered for use by the designer. Vinyl wall coverings, bituminous damproofing, certain paint systems all have properties which may create vapor retarders. If used, vapor barriers must be placed at a location where the temperature is above the dew point temperature in both the heating and the cooling seasons. It is critical to eliminate multiple vapor retarders in wall systems which can trap moisture and create potential mold conditions.

G-5 GYPSUM BOARD AND WALL FINISHES:

Do not place paper covered gypsum board or other surfaces that may provide nutrients for mold behind wall mounted fan coil units. Condensate drips from the valves and cold piping inside the fan coil cabinet and a small splash occurs with each drip. Because manufacturers provide no rear panel to the fan coil cabinet, the splashed

droplets dampen the wall surface behind the fan coil unit. Conventional gypsum board material at this location insures mold growth. Provide a wall liner made of plastic, metal, or other material that will not be a nutrient source for mold behind wall mounted fan coil units.

Do not use vinyl wall coverings on the interior surfaces of exterior walls or wall surfaces opposite kitchens or shower rooms. Moisture from these high humidity spaces will be trapped and condense behind the vinyl. Use of vinyl wall covering is not permitted in locations with predominant air conditioning loads rather than heating loads.

G-6 ATTICS:

Because mold is becoming more associated with the entry of moisture laden air in the building envelop, it is strongly recommended that ventilated attics be used only in limited applications. However, if an attic is ventilated, do not use a vapor barrier under the insulation installed on top of the ceiling. This is because in the cooling season, this puts the vapor barrier in a location made cold by air discharging from supply air diffusers.

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G-7 CRAWL SPACES:

Do not ventilate crawl spaces. Doing so introduces moisture to the crawl space which will migrate through floors and condense on the underside of floor coverings. The moisture can also condense on cold pipe surfaces within the crawl space; even the outer surface of the insulation on a chilled water line can easily reach temperatures below the dew point of a ventilated crawl space.

Use a 10 mil vapor barrier on the ground surface to prevent moisture migration from the ground. Cover the vapor barrier with gravel.

G-8 SYSTEM SELECTION / SPACE HUMIDITY CONSIDERATIONS:

Direct humidity control using reheat is rarely necessary except in the most demanding climate control situations such as libraries or museums. Indirect humidity control can reasonably be achieved through thoughtful system design.

The paragraphs below are not meant to dictate equipment or system types. Rather, the goal is to point out the advantages and disadvantages of various systems with regard to space humidity for designer consideration.

Most systems are designed to do a good job of limiting humidity at full cooling load. The problem with high space humidity usually occurs at part load.

Oversized equipment essentially runs at part load all the time, so over sizing must be avoided.

Make sure the occupant's needs for temperature and humidity are known.

Design systems to limit space relative humidity to 45% instead of the usual 50% at full load. Use an indoor design condition of 78 deg F / 45% RH.

Design systems to limit space relative humidity to 60% at part load conditions.

Size cooling coils handling outdoor air for the design dry bulb temperature day, or the design humidity day which ever gives the greater coil capacity.

Single Zone Systems:

These systems modulate the supply air temperature in response to the space temperature.

Avoid adding safety factor to the cooling loads. Doing so increases the supply airflow, and with excess airflow comes high supply air temperature which leads to high space humidity.

A typical single zone air handling system serving a small office area is an example. Assess the cooling loads carefully and do not arbitrarily increase airflow or oversize the equipment.

Simple single zone systems serving a theater, an auditorium, or a gymnasium can be a problem, particularly if one air handler is used for the entire area. The wide fluctuation in load caused by the wide variation in the occupancy of these facilities leads to problems at part load conditions. In many cases, a single air handling unit sized for full occupancy can maintain space temperature setpoint with a supply air temperature that is within a degree or two of the space temperature when the facility is at minimal occupancy. This insures part load humidity problems.

Get the airflow right and full load humidity problems are less likely. Always consider what will happen to the supply air temperature and the resulting space humidity at part load conditions. Consider the following possible solutions to part load humidity problems when using single zone equipment:

Colder Supply Air – Design for colder supply air. Then at part load the air will be colder than it would otherwise be, more moisture will be removed from the air stream, space humidity at part load will be lower. (Designing for lower space relative humidity will require colder supply air.)

Variable Air Volume Single Zone System – The single zone cooling coil provides constant discharge air temperature while the fan speed is modulated based on space temperature. After the fan reaches minimum speed the supply air temperature is modulated by decreasing.

Return Air Bypass Single Zone System – Using face and bypass dampers, bypass return air (not mixed air) around the cooling coil as the space cooling load is satisfied while the cooling coil operates with full flow.

Multiple Single Zone Systems – Use more than one air handling system. As the cooling load falls shut down one or more units. This causes the remaining units to supply colder air to maintain the space temperature setpoint.

Multizone Systems:

As with single zone, accurate determination of the cooling loads and zone airflow leads to good humidity control at full load conditions.

During warm weather, many multizone systems are operated without heating water to the heating coil because the boiler is turned off. Then at part load, mixed air is essentially bypassed around the cooling coil through the hot deck. The moisture laden mixed air is then delivered to the space causing a rise in the space humidity.

Improved part load performance space humidity performance can be achieved by resetting the hot deck temperature upward during periods of high humidity. (Of course this requires operating the boiler during the warm weather months.)

A Texas multizone with individual heating coils in the individual zone ducts also offers a possible solution to the part load humidity problem by providing a means of reheat.

Carefully consider the part load space humidity before using a multizone system.

Dual Duct Systems:

These systems typically have a hot and a cold deck and are similar to multizone systems. Instead of zone dampers, modulating dual duct mixing boxes mounted near the space combine the hot and cold air streams from separate ducts then deliver the mixture to the space. The part load humidity problems are the same as with a multizone.

Improved part load space humidity performance can be achieved by resetting the hot deck temperature upward during periods of high humidity. Of course this requires operating the boiler during the warm weather months.

A modified arrangement known as a Dew Point Dual Duct system could be employed for good humidity control. All of the mixed air in the air handler passes through the cooling coil. Then a portion of this air is split off and passes through the hot coil then to the hot duct. Both hot and cold air streams have the same low dew point temperature giving this arrangement its name.

Carefully consider the part load space humidity before using a dual duct system. The system may be more expensive than other alternatives due to the requirement for two supply main ducts. As with a variable air volume system, terminal boxes are required, and these create additional maintenance.

Variable Air Volume Systems:

Because a VAV air handler maintains cold discharge air, it automatically maintains reasonable space humidity and should be considered where applicable and when budget permits.

However, VAV systems are not a panacea. The valve, heating coil, controls, and often filter and fan inside every VAV box represent additional maintenance. The maintenance aggravation is amplified when the VAV boxes are not easily accessible.

Computer Room Units:

Oversized computer room units are common. Determining the cooling load by summing all the nameplate amp ratings of all the computer equipment will surely result in an oversized unit and cause inefficient operation. Space humidity may not be a problem only because the computer room unit has reheat capability. The unit adds enough heat to make up for the excess in airflow. Size computer room units to accommodate the estimated heat release from the computer equipment; airflows will be decreased, the supply temperatures will be lower for a longer period of time, and the reheat will operate far less frequently. Always consider multiple computer room units to split the cooling load.

Fan Coil Systems:

Fan coils usually handle sensible loads but often fall short on the latent load.

Do not design fan coil units to handle outdoor air because the cooling coils are usually not deep enough, because cycling the coil flow insures periods when no moisture removal occurs, and because local exhaust systems can cause bypass of outdoor air around the cooling coil directly into the space.

In lieu of specifying the total coil load for fan coil units, specify the entering and leaving air conditions, and specify that these conditions must be met at all fan speeds. Where multi-speed fan coil units are used, schedule the maximum airflow at the high fan speed setting.

Fan coil units represent a great maintenance burden. The multiple cooling coils with multiple filters, multiple condensate pans, multiple potential leak sources, and multiple potential locations for mold growth must be considered.

Fan coils shall be installed in a manner that will prevent water from dripping or splashing outside the drain pans. Require back splash panels to contain the splashing cause by drips from coil valves and uninsulated piping within the cabinet enclosure.

Direct Expansion (DX) Equipment

Avoid the use of DX coils in air handlers with constant running fans that handle outdoor air. When the sensible load is satisfied and the compressor turns off, unconditioned outdoor air is then delivered to the space and any water on the wet cooling coil is evaporated into the supply air and also delivered to the space. The result is poor part load humidity control.

G-9 CONDENSATE LEAKS:

Condensate drain pans and drain lines from air conditioning equipment must be designed to allow access for cleaning and flushing. Blockages in fan coil condensate

lines are notorious for causing overflowing drain pans and wet floors, walls, and ceilings.

Improper trapping of condensate discharge in air handling units leads to water hold-up and overflow at the condensate drain pain.

Provide details of the condensate traps on the design drawings. Require adequate slope in two directions on condensate drain pans and drain lines (1/4 inch per foot). Make certain that the equipment curb or equipment frame affords ample elevation of the pan outlet connection above the floor or roof to accommodate the required trap dimensions and drain line slope.

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G-10 BARRACKS:

Barracks have historically had high humidity problems leading to mold growth in the living space.

In barracks, follow the technical design guidance found in TI 800-01 Appendix B Unaccompanied Personnel Housing for the mechanical systems in barracks. This guidance requires that outside air be treated (heated / cooled) by a separate dedicated air handling unit to a neutral temperature, or as necessary to handle the latent load, and ducted to each living / sleeping room (Dedicated Outside Air System, DOAS).

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APPENDIX II

GENERAL CONFORMITY
RULE CHECKLIST

This document is owned by the Fort Campbell Environmental Division, Air Quality Program, and is UNCONTROLLED when printed or electronically copied from the Fort Campbell LAN san server SIMS folder.

General Conformity Rule Checklist
General Information

Name of Project:_____

Construction Company:_____

POC Name:_____

Phone Number/Email:_____

Anticipated Start Date: _____ Anticipated End Date: _____

Construction Equipment Listing

Equipment Type	Qty	Hours of Operation	Miles	Fuel Type
Bulldozer				
Grader				
Excavator				
Backhoe				
Dump Truck				
Fuel/Service Trucks				
Tractors				
Pug Mills (on site)				
Concrete Batch Plant (on site)				
Scraper				
Ready-Mix Truck				
Screed, Concrete				
Portable Paint Sprayer				
Air Compressor				
Lay Down Machines				
Rollers				
Compactors				
Water Trucks				
Pavement Stripping Machines				
Traffic Road Striping				
Loaders				

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Generators				
Compactors				
Curb and Gutter Pavers				
Other:_____				
Other:_____				

Emergency Generator Information

(This information will be needed for all stationary emergency generators associated with the project, attach a sheet if necessary)

Manufacturer: _____

Model Number:_____

Horsepower:_____

Max. Fuel consumption (gal/hr):_____

Fuel Type:_____

Serial number if currently available:_____

Stationary Fuel Burning Equipment

(This information will be needed for all stationary sources such as boilers, hot water heaters, etc that will be installed attach a sheet if necessary)

Type: _____

Manufacturer: _____

Model Number:_____

BTU Value:_____

Fuel Type:_____

Serial number if currently available:_____

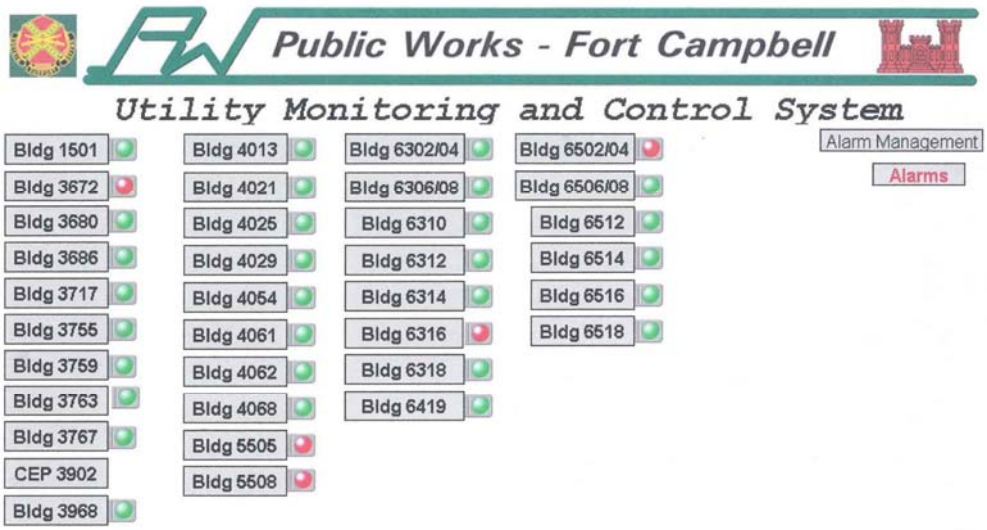
Personal Occupancy Vehicle Information

Vehicle Type	Qty	Miles driven on Post	Fuel Type
Light Duty Truck			
Heavy Duty Truck			
Car/SUV/Van			

Submitted by:_____ Date:_____

APPENDIX JJ

FMCS GRAPHICS


Public Works - Fort Campbell
Utility Monitoring and Control System
Alarm Management
Alarms
Bldg 1501
Bldg 3672
Bldg 3680
Bldg 3686
Bldg 3717
Bldg 3755
Bldg 3759
Bldg 3763
Bldg 3767
CEP 3902
Bldg 3968
Bldg 4013
Bldg 4021
Bldg 4025
Bldg 4029
Bldg 4054
Bldg 4061
Bldg 4062
Bldg 4068
Bldg 5505
Bldg 5508
Bldg 6302/04
Bldg 6306/08
Bldg 6310
Bldg 6312
Bldg 6314
Bldg 6316
Bldg 6318
Bldg 6419
Bldg 6502/04
Bldg 6506/08
Bldg 6512
Bldg 6514
Bldg 6516
Bldg 6518

Schedules

Second Floor

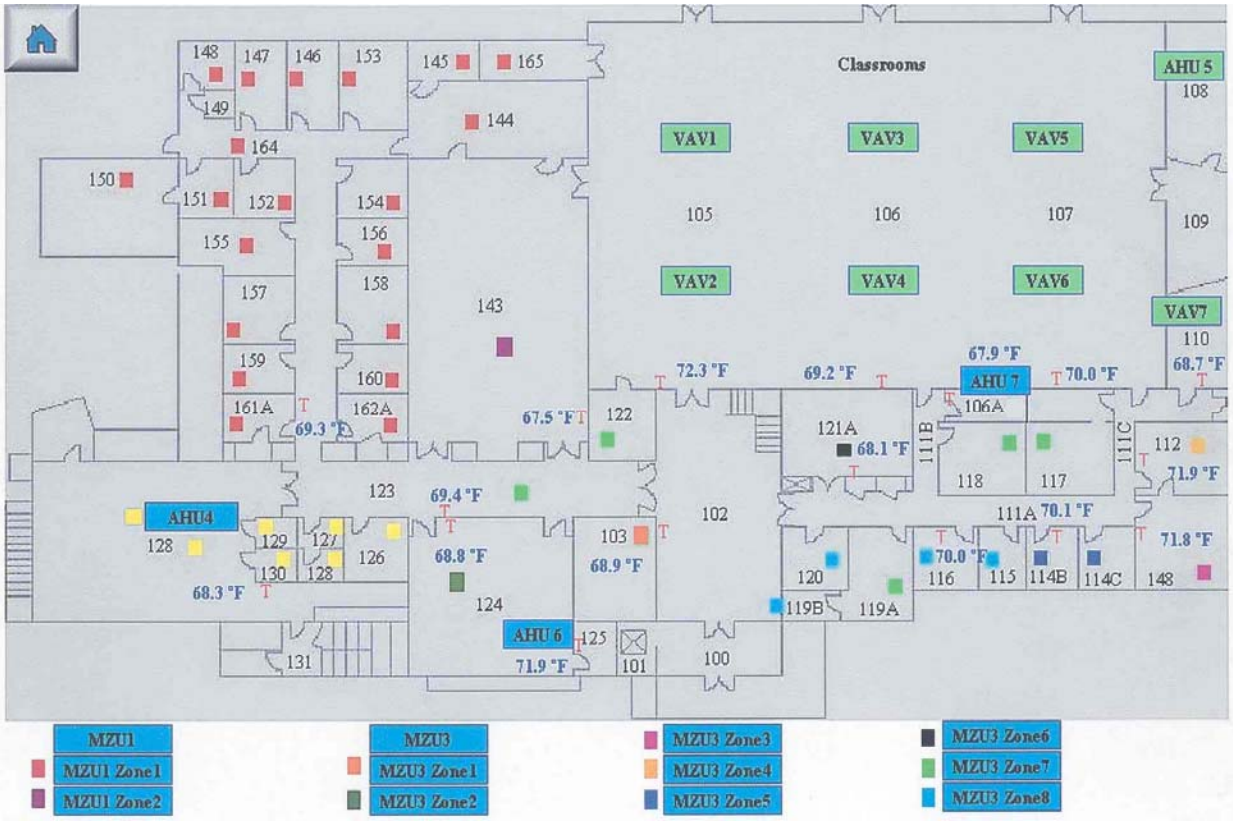
First Floor

Basement

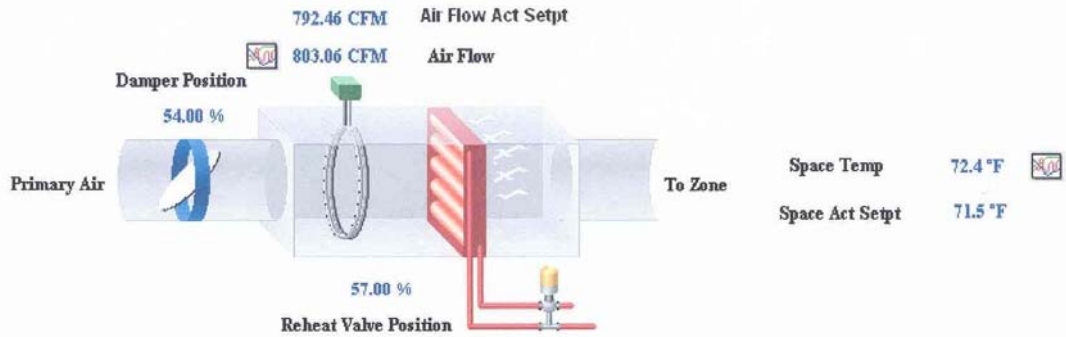
Index

Family Readiness Center Building 1501

Honeywell Webs EMCS System
Installed by C-Tech, Inc.
615-672-8210

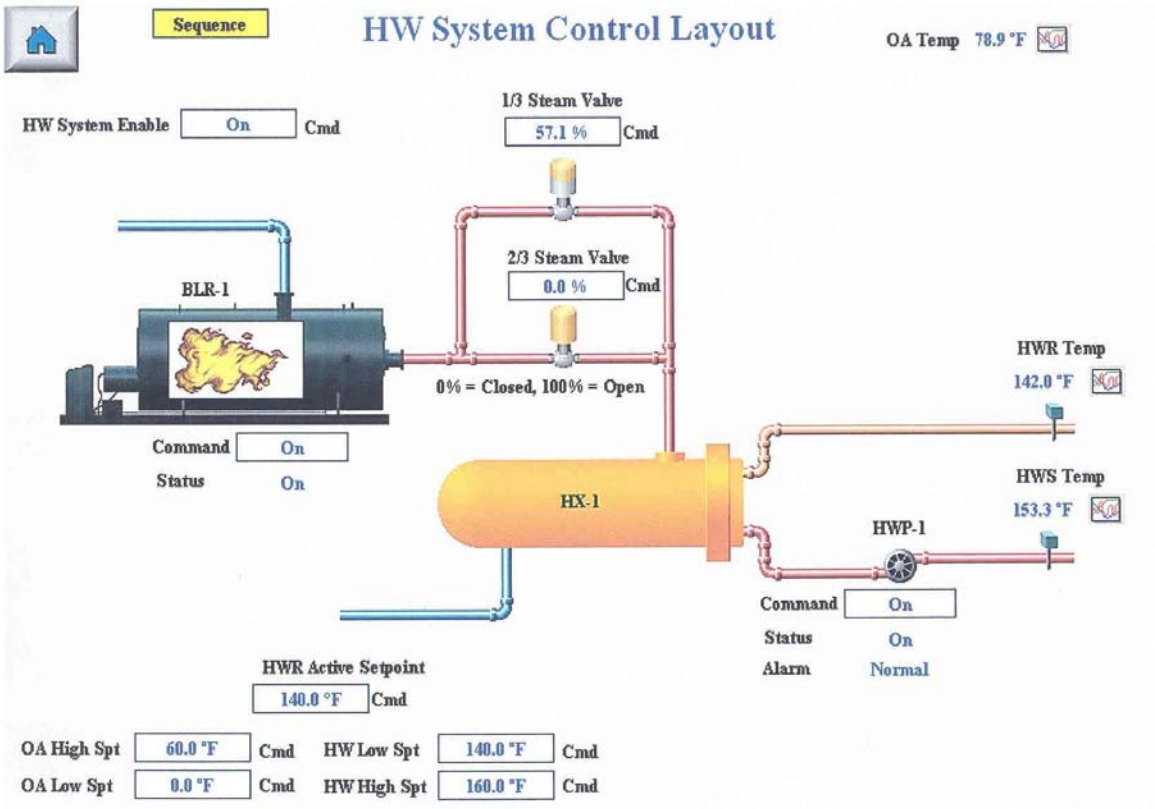

Classrooms
AHU 5
VAV1
VAV3
VAV5
VAV2
VAV4
VAV6
VAV7
AHU 7
AHU4
AHU 6
67.9 °F
72.3 °F
69.2 °F
70.0 °F
68.7 °F
67.5 °F
69.3 °F
68.1 °F
71.9 °F
69.4 °F
70.1 °F
68.8 °F
68.9 °F
71.8 °F
70.0 °F
68.3 °F
71.9 °F
MZU1
MZU1 Zone1
MZU1 Zone2
MZU3
MZU3 Zone1
MZU3 Zone2
MZU3 Zone3
MZU3 Zone4
MZU3 Zone5
MZU3 Zone6
MZU3 Zone7
MZU3 Zone8

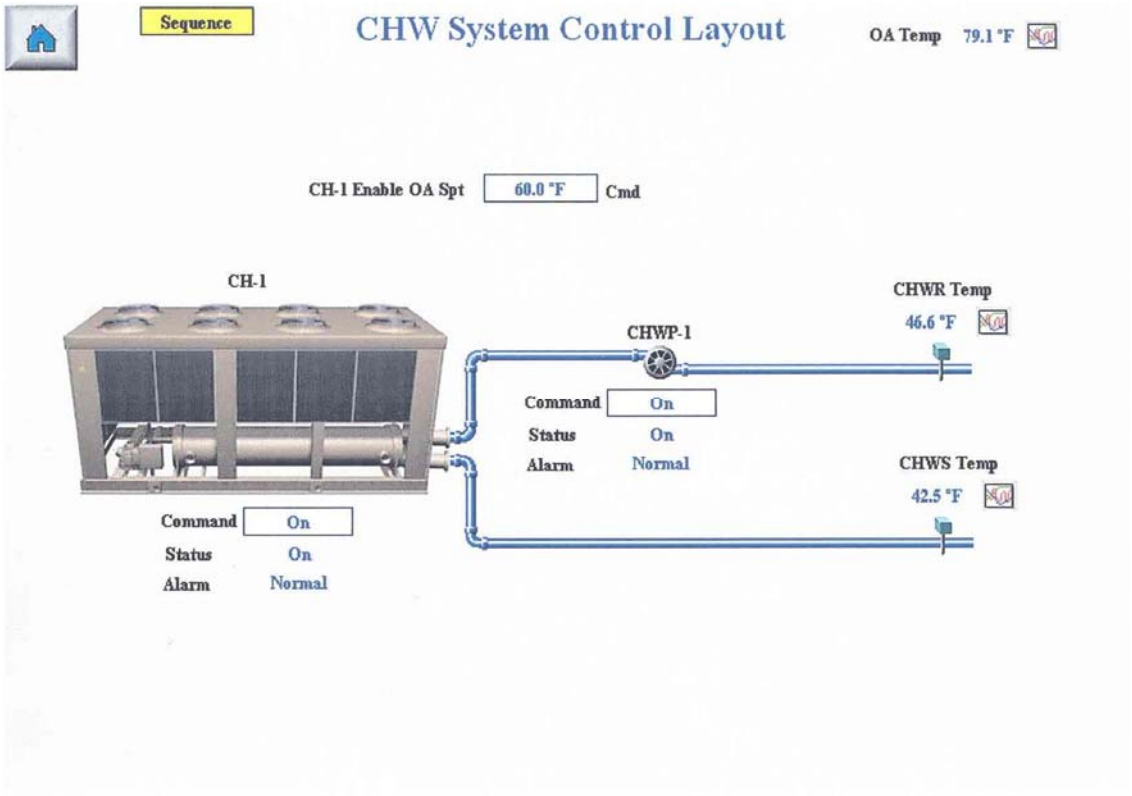
VAV-01

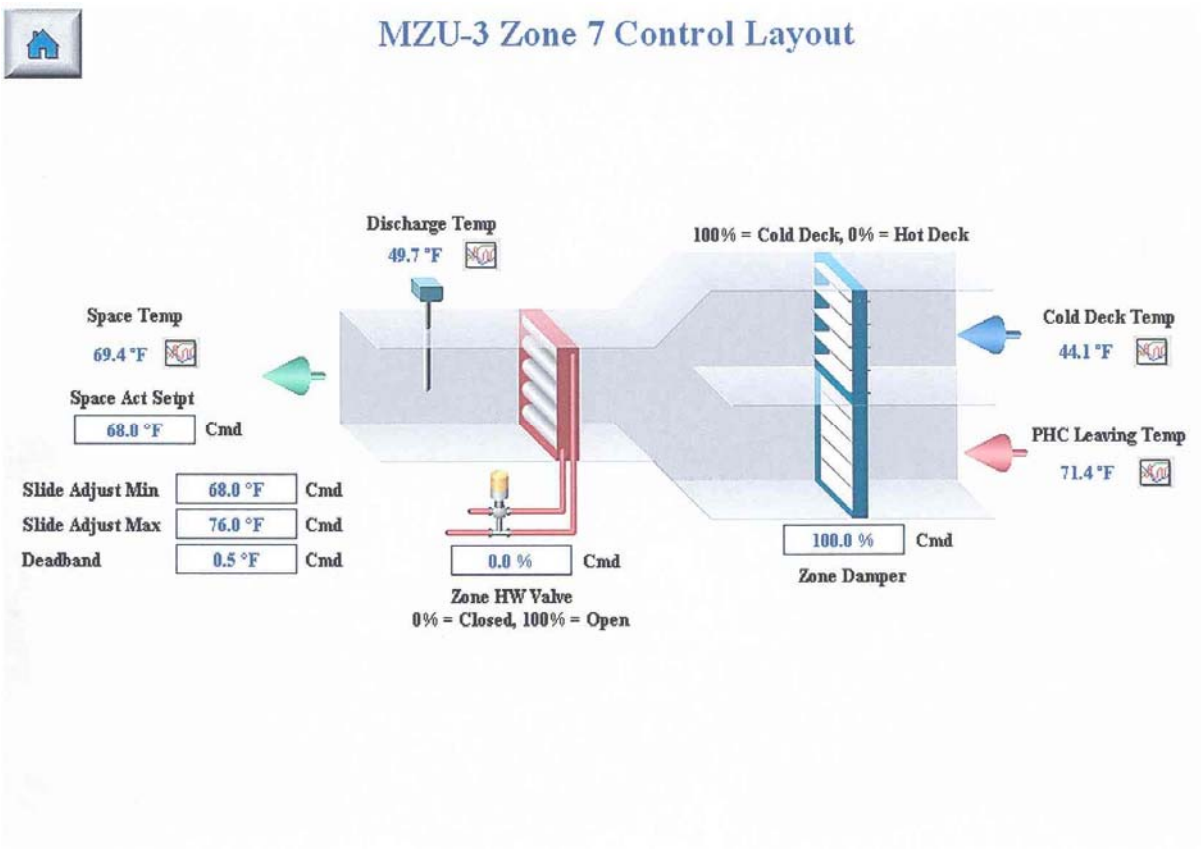


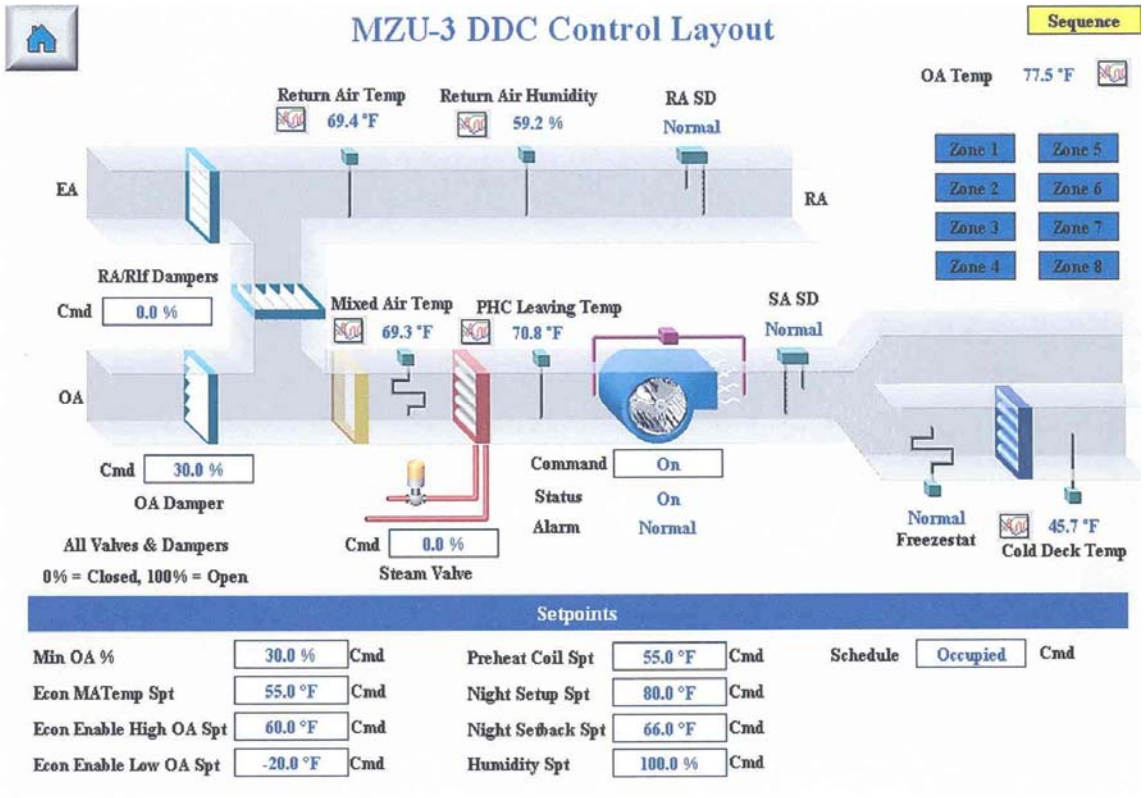
Setpoints			
UnOccCool	82.40 °F	Manual Setpoint Override	NaN °F
Standby Cool	77.00 °F	Slide Adjust Min	55.00 °F
Occ Cool	72.00 °F	Slide Adjust Max	84.00 °F
Occ Heat	70.00 °F	Bypass Time	180 Min
Standby Heat	66.18 °F	Max Cool CFM	1593.40 CFM
UnOcc Heat	60.80 °F	Min CFM	792.46 CFM
		Max Heat CFM	792.46 CFM

Mode	
Control Mode	ReHeat
Occupancy	occupied
Sched Occ	occupied
Manual Occ	Null
Low Flow	false


Sequence
HW System Control Layout
OA Temp 78.9 °F
HW System Enable On Cmd
1/3 Steam Valve
57.1 % Cmd
2/3 Steam Valve
0.0 % Cmd
BLR-1
0% = Closed, 100% = Open
HWR Temp
142.0 °F
Command On
Status On
HX-1
HWS Temp
153.3 °F
HWP-1
Command On
Status On
Alarm Normal
HWR Active Setpoint
140.0 °F Cmd
OA High Spt 60.0 °F Cmd
OA Low Spt 0.0 °F Cmd
HW Low Spt 140.0 °F Cmd
HW High Spt 160.0 °F Cmd


Sequence
CHW System Control Layout
OA Temp 79.1 °F
CH-1 Enable OA Spt 60.0 °F Cmd
CH-1
CHWP-1
CHWR Temp
46.6 °F
Command On
Status On
Alarm Normal
CHWS Temp
42.5 °F
Command On
Status On
Alarm Normal


MZU-3 Zone 7 Control Layout
Discharge Temp
49.7 °F
100% = Cold Deck, 0% = Hot Deck
Space Temp
69.4 °F
Cold Deck Temp
44.1 °F
Space Act Setpt
68.0 °F
Cmd
PHC Leaving Temp
71.4 °F
Slide Adjust Min
68.0 °F
Cmd
Slide Adjust Max
76.0 °F
Cmd
Deadband
0.5 °F
Cmd
100.0 %
Cmd
Zone Damper
0.0 %
Cmd
Zone HW Valve
0% = Closed, 100% = Open


MZU-3 DDC Control Layout
Sequence
OA Temp 77.5 °F
Return Air Temp 69.4 °F
Return Air Humidity 59.2 %
RA SD Normal
EA
RA
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Zone 7
Zone 8
RA/Rlf Dampers
Cmd 0.0 %
Mixed Air Temp 69.3 °F
PHC Leaving Temp 70.8 °F
SA SD Normal
OA
Cmd 30.0 %
OA Damper
All Valves & Dampers
0% = Closed, 100% = Open
Cmd 0.0 %
Steam Valve
Command On
Status On
Alarm Normal
Normal Freezestat
45.7 °F Cold Deck Temp
Setpoints
Min OA % 30.0 % Cmd
Econ MATemp Spt 55.0 °F Cmd
Econ Enable High OA Spt 60.0 °F Cmd
Econ Enable Low OA Spt -20.0 °F Cmd
Preheat Coil Spt 55.0 °F Cmd
Night Setup Spt 80.0 °F Cmd
Night Setback Spt 66.0 °F Cmd
Humidity Spt 100.0 % Cmd
Schedule Occupied Cmd

SpaceTempLog
°F
73
72
71
70
69
68
67
66
1pm
2pm
3pm
4pm
5pm
6pm
7pm
8pm
9pm
10pm
11pm
12am
1am
2am
3am
4am
5am
6am
7am
12pm 6-Sep-2006 to 8am 7-Sep-2006
AUTO
Y
M
D
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M
S
73.81035 °F | 12:00:00pm 06-Sep-2006 CDT

APPENDIX KK

DISTRIBUTION MATRIX

DESIGN SUBMITTAL DISTRIBUTION AND QUANTITIES
MAILING LIST

**The following information only takes prescedence over the Submittal Distribution and Quantities found in Section 01 33 16, Para 3.9.1 (Matrix) and 3.9.3.1.

	Activity & Address	Drawing Size (Full Size) 22x34 Full	Design Analysis & Specs	Drawing Size (Half Size) 11x17 Half	Non-BIM Data CD-ROM (D.A., Specs, pdf & CADD.dwg)	Structural Interior Design Submittal	BIM Data DVD	E-Mail Address
INSTALLATION	**Len May** Master Planning Project Engineer 852 16th St Master Planning Division Fort Campbell, KY 42223-5130 Ph#: 270-798-7311	0	0	1	1	1	1	len.may1@us.army.mil
	Karen Kopp-Voshel DPW Environmental SIMS Action Officer 16th & Bastogne (Bldg 865) Environmental Division Fort Campbell, KY 42223-5130	0	0	0	1	0	0	karen.kopp@us.army.mil
	Ron Ballard DPW Environmental Conservation Branch 16th & Bastogne (Bldg 865) Environmental Division Fort Campbell, KY 42223-5130 Ph#: 270-798-9645	0	0	0	1	0	0	rondal.ballard@us.army.mil
	Jeff Atkins DPW Environmental Conservation Branch 16th & Bastogne (Bldg 865) Environmental Division Fort Campbell, KY 42223-5130 Ph#: 270-798-9858	0	0	0	1	0	0	jeffrey.atkins@us.army.mil
	Trudy Carr DPW Environmental Compliance Branch/Stormwater 16th & Bastogne (Bldg 865) Environmental Division Fort Campbell, KY 42223-5130 Ph#: 270-798-2877	0	0	0	1	0	0	trudy.carr@us.army.miml
	Mike Davis DPW Environmental Pollution Prevention 16th & Bastogne (Bldg 865) Environmental Division Fort Campbell, KY 42223-5130 Ph#: 270-798-9767	0	0	0	1	0	0	mike.davis3@us.army.mil
	Gene Zirkle DPW Environmental NEPA 16th & Bastogne (Bldg 865) Environmental Division Fort Campbell, KY 42223-5130 Ph#: 270-798-2738	0	0	0	1	0	0	gene.zirkle@us.army.mil
	Russ Godsave DPW Environmental (Tanks) 16th & Bastogne (Bldg 865) Environmental Division Fort Campbell, KY 42223-5130 Ph#: 270-798-9637	0	0	0	1	0	0	russ.godsave@us.army.mil
	Jeremy Rains DPW Environmental (Restoration) 16th & Bastogne (Bldg 865) Environmental Division Fort Campbell, KY 42223-5130 Ph#: 270-798-9768	0	0	0	1	0	0	jeremy.l.rains@us.army.mil
	Patty Lockard DPW Environmental (Air Quality) 16th & Bastogne (Bldg 865) Environmental Division Fort Campbell, KY 42223-5130 Ph#: 207-798-9603	0	0	0	1	0	0	patricia.ann.lockard@us.army.mil

INSTALLATION	**Wayne Bricker** DPW Environmental (TSCA) 16th & Bastogne (Bldg 865) Environmental Division Fort Campbell, KY 42223-5130 Ph#: 270-798-9604	0	0	0	1	0	0	wayne.bricker@us.army.mil
	Dan Etson DPW Environmental Stormwater 16th & Bastogne (Bldg 865) Environmental Division Fort Campbell, KY 42223-5130 Ph#: 270-798-9784	0	0	0	1	0	0	dan.etson@us.army.mil
	Ron Grayson DPW Environmental (Archaeologist) 16th & Bastogne (Bldg 865) Environmental Division Fort Campbell, KY 42223-5130 Ph#: 270-412-8174	0	0	0	1	0	0	ronald.i.grayson@us.army.mil
	Linda Alderdice DPW Environmental (Forestry) 16th & Bastogne (Bldg 865) Environmental Division Fort Campbell, KY 42223-5130 Ph#: 270-412-2616	0	0	0	1	0	0	linda.alderdice@us.army.mil
	Richard Huser DPW Environmental (HazMat) 16th & Bastogne (Bldg 865) Environmental Division Fort Campbell, KY 42223-5130 Ph#: 270-956-2738	0	0	0	1	0	0	richard.huser@us.army.mil
	Bruce Franklin DPW Environmental (Urban Forester) 16th & Bastogne (Bldg 865) Environmental Division Fort Campbell, KY 42223-5130 Ph#: 270-956-2452	0	0	0	1	0	0	bruce.franklin@us.army.mil
	Andy Anderson DPW Maintenance 16th & Bastogne (Bldg 865) Maintenance Division Fort Campbell, KY 42223-5130 Ph#: 270-798-5082	1	0	1	1	0	0	anthony.j.anderson1@us.army.mil
	Bill Doll DPW Engineering 16th & Bastogne (Bldg 865) Fort Campbell, KY 42223-5130 Ph#: 270-798-9705	0	0	0	1	0	0	william.r.doll@us.army.mil
	James Lee DPW Engineering 16th & Bastogne (Bldg 865) Fort Campbell, KY 42223-5130 Ph#: 270-798-1111	0	0	0	1	0	0	james.lee12@us.army.mil
	Ted Reece DPW Utilities Management 16th & Bastogne (Bldg 865) Fort Campbell, KY 42223-5130 Ph#: 270-798-9700	0	0	0	1	0	0	ted.a.reece@us.army.mil

INSTALLATION	**Greg Winters** Electrical Inspector Bldg 893 16th Street Fort Campbell, KY 42223-5130 Ph#: 270-798-9975	0	0	0	1	0	0	greg.winters@us.army.mil
	Billy Goodwin Comcast Attn: Billy Goodwin, Construction 2501 McGavock Pk STE 1200 Nashville, TN 37214 615-244-7462, ext. 1115646 (office) 615-405-5589 (cell)	0	0	0	1	0	0	Billy_Goodwin@cable.comcast.com
	Gary Coplen Fire Inspector Bldg 1747, Fire Station #1 First Street & Tennessee Ave Fort Campbell, KY 42223 Ph#: 270-798-7995	1	0	1	1	0	0	gary.l.coplen@us.army.mil
	Greg Lantz NEC Bldg 907 Bastogne Ave Fort Campbell, KY 42223 270.798.6238 (Greg	0	0	1	1	0	0	gregory.lantz@us.army.mil
	David Coleman NEC Bldg 907 Bastogne Ave Fort Campbell, KY 42223 Ph#: 270-461-0709	0	0	0	1	0	0	David.J.Coleman@us.army.mil
	Randall Lewis Clarksville Gas & Water 2215 Madison St. Clarksville, TN 37041-0387	0	0	0	1	0	0	randall.lewis@clarksville.com
	Anthony Saylor DES Force Protection Forrest Road, Bldg 123 Fort Campbell, KY 42223 Ph#: 270-412-5864	0	0	0	1	0	0	anthony.saylor@us.army.mil
	Chris Semler CH2MHill **Fedex:** Building 5101 Tennessee Avenue Fort Campbell, KY 42223-5130 **USPS:** Box 595 Ft. Campbell, KY 42223 Ph: 931-431-2015	0	0	0	1	0	0	csemler@ch2m.com
	Wally Crow DPW Roadways 852 16th St Fort Campbell, KY 42223-5130 Ph#: 270-798-5643	0	0	0	1	0	0	wally.crow@us.army.mil
	Harvey Jones Installation Safety Building 2601 Indiana Avenue Fort Campbell, KY 42223 Ph#: 270-798-7433	0	0	0	1	0	0	harvey.v.jones@us.army.mil
	Gordon Sutton AT/FP Building 5740 Screaming Eagle Fort Campbell, KY 42223 Ph#: 270-798-5006	0	0	0	1	0	0	gordon.sutton@us.army.mil
	Rick McCoy DPW Energy Manager 16th & Bastogne (Bldg 865) Fort Campbell, KY 42223-5130	0	0	0	1	0	0	james.r.mccoy76.civ@mail.mil
	Robert Burchett/ISEC QA	0	0	0	1	0	0	robert.burchett@us.army.mil

CONSTRUCTION AREA OFFICE	**James (Miller) Moore** 16th & Bastogne (Bldg 849) Resident Office Fort Campbell, KY 42223-5130 Ph#: 270-798-9154	1	1	1	1	1	0	james.m.moore@usace.army.mil
	Stephen Sewell 16th & Bastogne (Bldg 849) Resident Office Fort Campbell, KY 42223-5130 Ph#: 270-798-9692	1	1	1	1	1	0	stephen.e.sewell@us.army.mil
USAISEC	**George Gaffney** ISEC, USAISEC-FDED ATTN: ELIE-ISE-DE (Gaffney), 1435 Porter St, Suite 230, Ft. Dietrick, MD 21702. Ph# 301-619-6501	1	1	1	1	0	0	george.gaffney@us.army.mil
OTHER OFFICE	**Anthony (Tony) Crawford** DFMWR Sports Bldg 5663, Wickham Ave. Fort Campbell, KY 42223 Ph#: 270-798-7504	0	0	1	1	0	0	anthony.crawford4@us.army.mil
GEOGRAPHICAL DISTRICT	**Andrew Dettmer** PM, USACE Louisville District 600 MLK Jr Place, Louisville, KY 40202. PH# 502-315-6810	1	1	1	1	1	0	Andrew.J.Dettmer@usace.army.mil
	Amanda Hardawy PE/A, USACE Louisville District ED-D-A, Rm 970 600 Dr Martin Luther King Jr Pl. Louisville, KY 40202-2239 PH# 502-315-6467	1	7	7	7	2	0	Amanda.L.Hardaway@usace.army.mil
CENTER OF STANDARDIZATION (COS)	**Greg Havo** COS Project Manager US Army Engineering & Support Center 2J307 4820 University Sq Huntsville, AL 35816 Ph#: 256-895-1056	0	1	1	1	1	0	Greg.V.Havo@usace.army.mil
	Jay Clark COS Architect US Army Engineering & Support Center 3F-506 4820 University Sq Huntsville, AL 35816 Ph#: 256-895-1673	1	0	1	1	1	1	James.T.Clark@usace.army.mil
TOTAL:		**7**	**12**	**18**	**47**	**8**	**2**	

APPENDIX LL

EXTERIOR & INTERIOR FINISHES

The following are Ft. Campbell's standard color schedule for **Exterior Finishes** and special items:

STANDING SEAM METAL ROOF AND FASCIA
Manufacturer: Varies
Color: Butler, Kyner 500, color "Terra Brown" or approved equal

METAL SIDING (When approved)
Manufacturer: Varies
Color: Butler, Kyner 500, color "Country Wheat" or approved equal

EXTERIOR DOORS, FRAMES, TRIM AND ANODIZED ALUMINUM WINDOWS
Manufacturer: Varies
Color: Match standing seam metal roof color

BRICK
Manufacturer: Palmetto Brick Company
Color: ".75 Greystone"

Manufacturer: Acme Brick
Color: "Ko-Ko Brown"

Manufacturer: Sioux City Brick
Color: Beige Grey Velour

ACCENT BRICK
Manufacturer: Acme Brick
Color: "Ko-Ko Plus Chocolate"

Manufacturer: Palmetto Brick Company
Color: "1.25 Greystone"

Manufacturer: Sioux City Brick
Color: Charcoal Grey Velour

SPLIT-FACE CONCRETE MASONRY UNITS
Manufacturer: Southland Supply style
Color: Goldenrod, 24H

MORTAR
Manufacturer: Quickrete
Color: Ochre 2

Manufacturer: Holcim Cement
Color: PCL S Buff

ROOF FIXTURES
Manufacturer: Varies
Color: Match standing seam metal roof

DOWNSPOUTS, GUTTERS, LOUVERS, FLASHING
Manufacturer: Varies
Color: Match standing seam metal roof

EXTERIOR SOFFITS AND CEILING
Manufacturer: Varies
Color: White (factory finish)

The following are Ft. Campbell's standard color schedule for **Interior Finishes** and special items:

Plastic Laminate, Vertical: **Wilsonart, "1500N-60, Grey"**
Wilsonart, "D432-60, Cashmere"

Plastic Laminate, Horizontal: **Wilsonart "4640-60, Dove Moraine"**
Wilsonart "4608-60, Caldera Beige"

Solid Surface Material: **Wilsonart "1521-MG, Light Beige Mirage"**
Wilsonart "D431-MG, Alabaster Mirage"

Vinyl Base: **Azrock, 4" Vinyl Base, "CB-66"**
Flexco, 4" Vinyl Base, "VCB-031 Zephyr"

VCT: **Azrock, 12"xl2"x1/8" "V869, Tundra, Cortina Colors"**
Azrock, 12"xl2"x1/8" "V787, Stratus"

Sheet Flooring: **Tarket, "18319"**

ACT: **USG "2110, 2'x2'x5/8" White, Radar"**

ACT Grid: **USG "Donn DX, 15/16", White"**

Window Blinds: **Valencia Deluxe, "0285, 1" Metal**
Valencia Deluxe, "0023, 1" Metal

Carpet: **Lees, 115 Mauve, Pebble Weave II**
Lees, 305 Cloisonne, Pebble Weave II
Lees, 204 Vienna Woods, Pebble Weave II

Return to Finishes
Return to Table of contents

APPENDIX MM

DIRECTIONS TO DOWNLOAD WATER & WASTEWATER DESIGN GUIDE & CONSTRUCTION STANDARDS

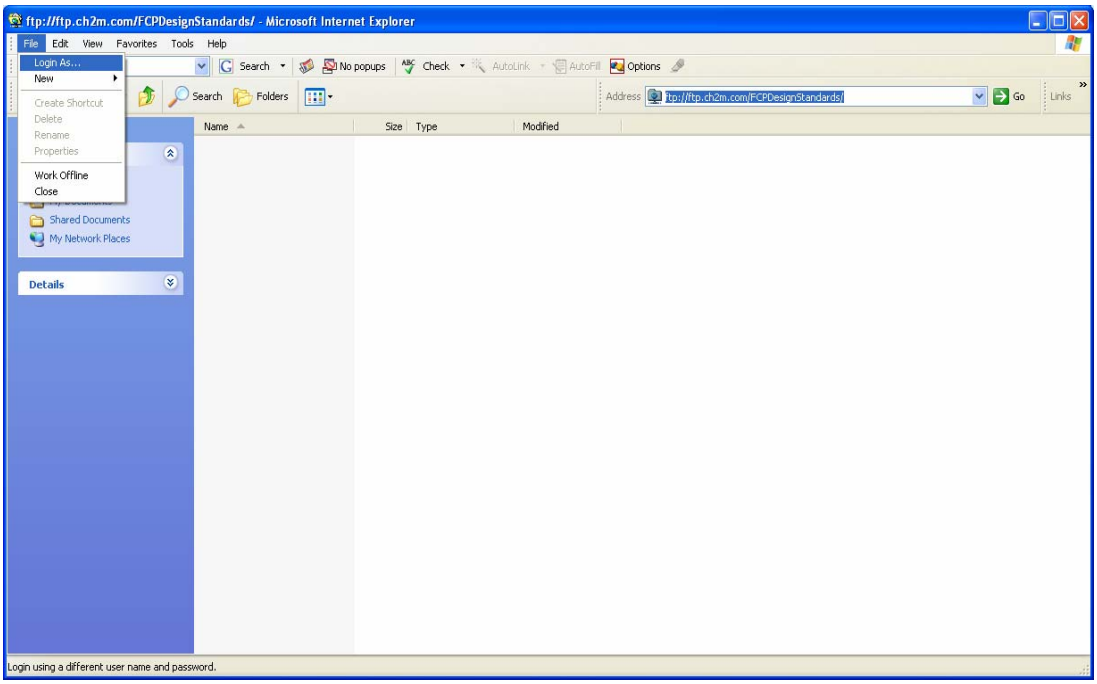
CH2M HILL's "Fort Campbell Water and Wastewater Design and Construction Standards" on the Web

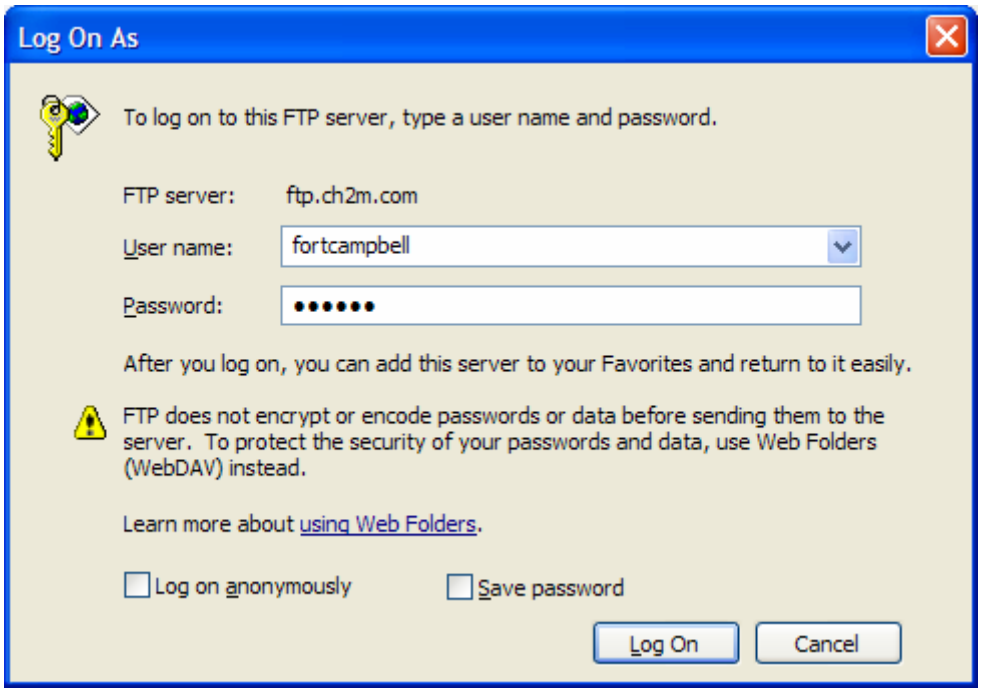
You will need Adobe Acrobat Reader to open the standards as a .PDF file.

It is recommended you use an FTP program available from your system administrator or as shareware from many sites on the web such as Smart FTP or CuteFTP. (Typing "FTP" in Google will find dozens.)
URL: ftp://ftp.ch2m.com/fcpdesignstandards
Username: fortcampbell
Password: fcpftp
Filename: FCP W+WW Design Guide and Const Standards Rev3 Feb07.pdf

Alternately, you can use Microsoft Internet Explorer as your FTP program. However, results are often slow & inconsistent. Directions below:

1. Enter the following in the Internet Explorer address bar:
ftp.ch2m.com/fcpdesignstandards
2. Hit return. An error message may appear. Just ignore it.
3. Under the "View" pull-down menu, go to "Open FTP site in windows explorer". An FTP window will open on your computer.
3. Go to the File→Login As…as shown below.





4. The user name is “fortcampbell” and the password is “fcpftp”. Make sure you check the box marked “Save password”.
5. Select the “FCP W+WW Design…PDF” file and copy it to your computer.

Alternative Path for Download

Follow link below:
http://www.lrl.usace.army.mil/ed/

Click on Guide Specs, Publications and Ft. Campbell TDG on the right of the screen.

Click on Fort Campbell Water and Wastewater Design and Construction Standards on the main portion of the screen.

Follow instructions on screen.

APPENDIX NN

GREEN PROCUREMENT

Fort Campbell (FTC) Guide to Green Procurement for Construction

Chapter 1
Introduction

1-1. Purpose
This Guide serves as a broad overview of green procurement requirements relevant to Fort Campbell (FTC) and is intended to aid construction designers, specification writers, and contractors. For specific requirements, refer to your organizational procedures and the applicable design standards/ specifications or other language of the contract.

1-2. Background
Various laws and Executive Orders direct federal agencies to purchase environmentally preferable products to the maximum extent practicable. Collectively, these legal requirements are referred to as "green procurement." Department of Defense (DoD) and Department of the Army (DA), require FTC to maintain a Green Procurement Program in accordance with these laws.

1-3. Applicability
This Guide is informational in nature and intended for projects on FTC, KY. FTC is working to incorporate green procurement requirements into its own construction, renovation, and repair contracts and design standards. The U.S. Army Corps of Engineers and other federal organizations also include various green procurement requirements in their contracts. Construction designers and contract writers working on FTC projects shall ensure all applicable green procurement requirements are incorporated into their project designs and contracts. Contractors and subcontractors shall ensure that all green procurement requirements stated in their contract, construction specifications, and/or request for proposal are met, including the submission of green procurement records and information. Note that FAR clause 52.236-7 requires compliance with Federal laws, including green procurement laws.

1-4. References
A complete listing of referenced publications can be found in Attachment 1.

1-5. Acronyms and Terms
Acronyms and special terms used in this document are explained in Attachment 2.

1-6. Questions/Points of Contact
Questions regarding this document or green procurement in general may be directed to the following:

DIRECTORATE OF PUBLIC WORKS
ATTN: IMSE-CAM-PWE (Green Procurement Program Coordinator)
BUILDING 865, 16th Street & Bastogne
FORT CAMPBELL, KY 42223

The FTC Green Procurement Program Action Officer can also be reached at (270) 798-9634.

Chapter 2
Green Procurement Requirements

2-1. Recycled/Recovered Materials

The Resource Conservation and Recovery Act (RCRA), Section 6002, requires federal construction, renovation, and repair contracts to incorporate recycled/recovered materials to the maximum extent practicable. Under this regulation, the Environmental Protection Agency (EPA) establishes Comprehensive Procurement Guidelines (CPG) that designate product categories included in this requirement and Recovered Materials Advisory Notices (RMAN) that provide the acceptable level of recovered material and postconsumer content for each product category. When using designated CPG items, construction, renovation, and repair projects are required to incorporate the highest recovered material content level practicable and should, at a minimum, meet the total recovered material and postconsumer content levels stated in the RMAN. When using items not designated by the EPA, construction, renovation, and repair projects should incorporate recycled content products to the maximum extent practicable in accordance with Executive Orders 13423 (PL 111-8) and 13514 as well as the Federal Acquisition Regulation (Part 23.4). Such items should have the highest recovered material content level practicable in accordance with the requirements of the design standards or contract.

More information can be found at: http://www.epa.gov/epawaste/conserve/tools/cpg/products/index.htm.

The following list includes the CPG categories most likely to be associated with construction, renovation, and repair:

- Building insulation products
- Carpet (polyester)
- Carpet cushion
- Cement and concrete containing:
  -Coal fly ash
  -Ground granulated blast furnace slag
  -Cenospheres
  -Silica fume
- Consolidated and reprocessed latex paint
- Floor tiles
- Laminated paperboard
- Modular threshold ramps
- Non-pressure pipe
- Patio blocks
- Roofing materials
- Shower and restroom dividers/partitions
- Structural fiberboard
- Park benches and picnic tables
- Plastic fencing
- Playground equipment
- Playground surfaces
- Running tracks
- Bike racks
- Blasting grit
- Signage
- Compost and fertilizer made from recovered organic materials
- Garden and soaker hoses
- Hydraulic mulch
- Lawn and garden edging
- Plastic lumber landscaping timbers and posts

2-1-1. Exceptions
Specific exceptions to the EPA requirements are allowed if NO CPG compliant item:

- Is available within a reasonable period of time;
- Is available at a reasonable price; or
- Can meet the applicable performance standards

If your contract requires exception documentation, ensure it is submitted to the contracting officer for every case in which an exception is claimed. Designers and requirements generators should check the applicable design standards/specifications (including the FTC Design Standards, where appropriate) to determine exception justification and submission procedures.

2-1-2. Associated Federal Acquisition Regulation (FAR) Clauses
52.223-17 “Affirmative Procurement of EPA-designated Items in Service and Construction Contracts”; 52.223-9 “Estimate of Percentage of Recovered Material Content for EPA-Designated Item”; 52.236-7 “Permits and Responsibilities.”

2-1-3. Associated Legal Requirements and Policy
RCRA, Section 6002; Executive Order 13423; Executive Order 13514; Federal Acquisition Regulation, Parts 23.4 and 36.601-3; and DoD/DA/policy.

2-2. Biobased Materials
The Farm Security and Rural Investment Act of 2002, Section 9002, requires federal construction, renovation, and repair contracts to incorporate designated biobased products. When using items designated under the BioPreferred Program established by the U.S. Department of Agriculture (USDA), construction, renovation, and repair projects should use products meeting the minimum biobased content percentage established by USDA. When using items not designated by the USDA, construction, renovation, and repair projects should incorporate rapidly renewable and certified sustainable wood products to the maximum extent practicable per Executive Orders 13423 and 13514 and the Federal Acquisition Regulation (Parts 23.4 and 23.7) and in accordance with the requirements of the design standards or contract.

More information can be found at: http://www.biopreferred.gov/ProposedAndFinalItemDesignations.aspx

The following list includes the designated biobased categories most likely to be associated with construction, renovation, and repair:

- Acoustical Composite Panels
- Interior Composite Panels
- Plastic Lumber Composite Panels
- Structural Interior Composite Panels
- Structural Wall Composite Panels
- Concrete and Asphalt Release Fluids
- Dust Suppressants
- Wood and Concrete Sealers
- Carpet
- Spray-In-Place Plastic Insulating Foam
- Roof Coatings
- Adhesive and Mastic Removers
- Fertilizer
- Transformer Dielectric Fluid
- Water Tank Coating
- Graffiti and Grease Removers
- Cable and Chain Lubricants
- Corrosion Preventatives

2-2-1. Exceptions
Specific exceptions to USDA requirements are allowed if NO compliant biobased item:

- Is available within a reasonable period of time;
- Is available at a reasonable price; or

- Can meet the applicable performance standards

If your contract requires exception documentation, ensure it is submitted to the contracting officer for every case in which an exception is claimed. Designers and requirements generators should check the applicable design standards/specifications (including the FTC Design Standards, where appropriate) to determine exception justification and submission procedures.

2-2-2. Overlap with CPG Requirements
Per federal guidance, whenever an item falls under both the EPA recovered materials requirements and USDA bio-based requirements, the product should, at a minimum, meet the EPA recovered materials requirement.

2-2-3. Associated Federal Acquisition Regulation (FAR) Clauses
52.223-1 “Bio-based Product Certification”; 52.223-2 “Affirmative Procurement of Bio-based Products Under Service and Construction Contracts”; 52.236-7 “Permits and Responsibilities.”

2-2-4. Associated Legal Requirements and Policy
Farm Security and Rural Investment Act of 2002, Section 9002; Energy Policy Act of 2005, Section 943; Executive Order 13423; Executive Order 13514; Federal Acquisition Regulations, Parts 23.4 and 36.601-3; and DoD/DA/policy.

2-3. Energy Efficient Materials
The Energy Policy Act of 2005, Section 104, requires federal construction, renovation, and repair contracts to incorporate designated energy efficient materials to the maximum extent practicable.

When using energy-consuming items that fall under an Energy Star or Federal Energy Management Program (FEMP) product category, construction, renovation, and repair projects are required to use Energy Star or FEMP qualified products. In addition, AR 420-1 contains metering requirements for Army construction and renovation.

More information and a listing of qualified products or standards can be found at:
http://www.energystar.gov/
http://www1.eere.energy.gov/femp/technologies/eep_purchasingspecs.html

The following list includes the Energy Star categories most likely to be associated with construction, renovation, and repair:

- Room Air Conditioning
- Central Air Conditioning
- Boilers
- Ceiling Fans
- Furnaces
- Air-source Heat Pumps
- Geothermal Heat Pumps
- Light Commercial Heating and Cooling
- Programmable Thermostats
- Ventilating Fans
- Water Heaters
- Roof Products
- Compact Fluorescent Light Bulbs (CFLs)
- Fluorescent Light Fixtures
- LED Lighting

The following list includes the FEMP categories most likely to be associated with construction, renovation, and repair:

- Compact Fluorescent Lamps
- Fluorescent Tube Lamps
- Fluorescent Ballasts
- Fluorescent Luminaries
- Downlight Luminaries
- Industrial HID Luminaries
- Lighting Controls

- Commercial Unitary Air Conditioners
- Air-Cooled Chillers
- Water-Cooled Chillers
- Commercial Heat Pumps
- Ground-Source Heat Pumps
- Boilers
- Distribution Transformers (Medium)
- Electric Motors
- Centrifugal Pumping System
- Room Air Conditioners
- Central Air Conditioners
- Air Source Heat Pumps
- Ground-Source Heat Pumps
- Gas Furnaces
- Electric Water Heaters
- Gas Water Heaters
- Faucets
- Showerheads
- Urinals
- Roof Products
- Low Standby Power (for products that can operate in a standby power mode)

2-3-1. Exceptions
Specific exceptions are allowed if NO Energy Star or FEMP qualified item:

- Has a lower or equal life cycle cost compared to a non-compliant option; or
- Can meet the applicable functional requirements

Per Department of Energy guidance, life cycle cost determination shall rely on the life cycle cost analysis method in 10 CFR 436, subpart A or another method determined to be equivalent by the Department of Defense.

If your contract requires exception documentation, ensure it is submitted to the contracting officer for every case in which an exception is claimed. Designers and requirements generators should check the applicable design standards/specifications (including the FTC Design Standards, where appropriate) to determine exception justification and submission procedures.

2-3-2. Roofing
Roofing is not classified as an energy-consuming product by the Department of Energy and is thus not covered under the Energy Policy Act of 2005. However, Executive Orders 13423 and 13514 direct federal new construction, major renovation, and repair and alteration to incorporate Energy Star or FEMP qualified products to the maximum extent practicable without restricting the applicability to energy-consuming products. Thus, federal projects should utilize Energy Star qualified roofing whenever life cycle cost effective and permissible under the requirements and cost structure of the contract.

2-3-3. Solar Hot Water Heaters
The Energy Independence and Security Act of 2007 and Executive Orders 13423 and 13514 require new construction and major renovation of federal buildings to provide at least 30% of a building's hot water requirements through solar heating methodologies unless the results of a life cycle cost analysis demonstrate that no solar hot water system is life cycle cost effective in comparison with other reasonably available hot water heating technologies.

2-3-4. Additional Lighting Guidance
Army Regulation 420-1, paragraph 22-12(d)(1), states that interior lighting fixtures for new construction, remodeling, and modular office furniture shall use either the T-8 lamp with instant start electronic ballast or the T-5 lamp. Day-lighting and occupancy controls shall be used when determined to be cost-effective.

In addition, consideration should be given to LED lighting when it meets other requirements such as performance and cost. LED lighting can offer additional efficiency and life cycle cost benefits.

2-3-5. Ground Source Heat Pumps
Per Executive Orders 13423 and 13514, renewable energy features such as ground source heat pumps should be used when lifecycle cost effective. Thus, FTC projects should give full consideration to such features. Note that Energy Star requirements apply to smaller geothermal heat pumps.

2-3-6. Associated Federal Acquisition Regulation (FAR) Clauses
52.223-15 "Energy Efficiency in Energy-Consuming Products"; 52.236-7 "Permits and Responsibilities."

2-3-7. Associated Legal Requirements and Policy
Executive Order 13423; Executive Order 13514; Executive Order 13221; Energy Policy Act of 2005, Section 104; Energy Independence and Security Act of 2007, Sections 523-525; 74 FR 10830 "Federal Procurement of Energy Efficient Products – Final Rule"; Federal Acquisition Regulation, Parts 23.2 and 36.601-3, Army Regulation 420-1; DoD Electronics Stewardship Implementation Plan; and DoD/DA Policy.

2-4. EPEAT Computers
Executive Order 13423 and the Federal Acquisition Regulation require federal purchasers to buy computing equipment that is Electronic Products Environmental Assessment Tool (EPEAT) registered. When including desktop computers, laptops, workstation computers, integrated desktop computers, or monitors as part of the contract (e.g. as part of a Direct Digital Control System), construction and renovation contracts should specify EPEAT registered products. Per federal guidance, such equipment shall be EPEAT registered at a minimum Bronze level, but preferably at Silver or above. Computers and monitors must also meet the FEMP standard for standby power efficiency.

More information and a listing of qualified products or standards can be found at:
http://www.epeat.net/
http://www1.eere.energy.gov/femp/technologies/eep_standby_power.html

2-4-1. Associated Federal Acquisition Regulation (FAR) Clauses
52.223-15 "Energy Efficiency in Energy-Consuming Products" and 52.223-16 "IEEE 1680 Standard for the Environmental Assessment of Personal Computer Products"; 52.236-7 "Permits and Responsibilities."

2-4-2. Associated Legal Requirements and Policy
Executive Order 13423; Executive Order 13514; Executive Order 13221; Energy Policy Act of 2005, Section 104; Federal Acquisition Regulation, Parts 23.2, 23.7, and 36.601-3; DoD Electronics Stewardship Implementation Plan.

2-5. Water Efficient Materials and Services
Executive Orders 13423 and 13514 direct federal agencies to implement water efficiency measures, including a preference for Water Sense products and services. Thus, when using items or services that fall under a designated EPA Water Sense efficiency standard: construction, renovation, and repair projects should incorporate products and services that, at a minimum, meet the Water Sense standard. This includes a preference for irrigation designers and contractors certified by a Water Sense qualified program. If an item is not within a Water Sense category but does fall under a FEMP category, it should meet the associated FEMP efficiency standard. In addition, AR 420-1 contains metering requirements for Army construction and renovation.

More information can be found at:
http://www.epa.gov/watersense/
http://www1.eere.energy.gov/femp/technologies/eep_purchasingspecs.html

The following list includes the Water Sense and FEMP categories most likely to be associated with construction, renovation, and renovation:

- Bathroom Sink Faucets
- Urinals, Flush Type
- Showerheads
- Toilets, Flush Tank Type
- Landscape Irrigation Services
- Pre-Rinse Spray Valves

Note: Medical and other sanitary facilities should utilize appropriate conservation fixtures (e.g., laminar flow faucets rather than aerators) in accordance with medical/sanitary requirements.

2-5-1. Exceptions
Specific exceptions may be allowed if NO Water Sense or FEMP-designated item:

- Is reasonably available that meets the performance requirements; or
- Is cost effective over the life of the product taking energy and water cost savings into account

If your contract requires exception documentation, ensure it is submitted to the contracting officer for every case in which an exception is claimed. Designers and requirements generators should check the applicable design standards/specifications (including the FTC Design Standards, where appropriate) to determine exception justification and submission procedures.

2-5-2. Associated Federal Acquisition Regulation (FAR) Clauses
52.236-7 “Permits and Responsibilities.”

2-5-3. Associated Legal Requirements and Policy
Executive Order 13423; Federal Acquisition Regulation, Parts 23.2 and 36.601-3; and DoD/DA policy.

2-6. Low Emitting Materials
Executive Orders 13423 and 13514 instruct federal new construction, major renovation, and repair contracts to incorporate low emitting interior products to the maximum extent practicable. Thus, such projects should specify interior materials and products with low emissions, including composite wood products, adhesives, sealants, interior paints and finishes, carpet systems, and furnishings. Guidance for low emission composite wood, adhesives, sealants, interior paints and finishes, carpet systems, and furnishings can be found in LEED NC credits IEQ 4.1 through 4.4 and LEED CI credit IEQ 4.5. Additional guidance is offered by third-party certifiers such as Greenguard and the Carpet and Rug Institute.

More information can be found at:
http://www.usgbc.org/ShowFile.aspx?DocumentID=5546 (LEED NC)
http://www.usgbc.org/ShowFile.aspx?DocumentID=5543 (LEED CI)
http://www.carpet-rug.org/commercial-customers/green-building-and-the-environment/index.cfm
http://www.greenguard.org

2-6-1. Associated Legal Requirements and Policy
Executive Order 13423; Federal Acquisition Regulation, Part 36.601-3; and DoD/DA/ policy.

2-7. Ozone Depleting Chemical (ODC) Alternatives
The Clean Air Act Amendments of 1990 instituted a production and importation phase-out of ozone depleting chemicals (ODC) within the United States. Army, and FTC policy is to eliminate dependency on ODCs. Thus, FTC construction, renovation, and repair projects should eliminate the use of ODCs before and after construction to the maximum extent practicable whenever alternative environmentally preferable products are available. EPA-designated acceptable alternatives can be found at the Significant New Alternatives Policy (SNAP) Program website: http://www.epa.gov/ozone/snap/ <http://www.epa.gov/ozone/snap/> .

For contracts that install/modify refrigerant containing equipment, the use of ODCs on FTC is restricted to refrigerants that have an ozone depleting potential (ODP) of 0.05 or less. The FTC Air Quality Program maintains an inventory of all refrigerant containing equipment on the installation (excluding Housing).

Any activity/shop/operation on FTC that will be conducting refrigerant repair/recovery work is required to comply with the applicable requirements in the "Air Quality Refrigerant Compliance System" and the applicable air quality procedure. Prior to commencement of refrigerant work, the activity/shop/operation must receive training by the FTC Air Quality Program personnel (Bldg 2182). Shops are required to procure refrigerant from the Pollution Prevention Operation Center (PPOC) located at 3rd Street and Wickham Avenue.

2-7-1. Associated Federal Acquisition Regulation (FAR) Clauses
52.223-11, “Ozone-Depleting Substances” and 52.223-12, “Refrigeration Equipment and Air Conditioners.”

2-7-2. Associated Legal Requirements and Policy
Clean Air Act Amendments of 1990; Executive Order 13423; Executive Order 13514; Federal Acquisition Regulation, Parts 23.8 and 36.601-3; and DoD/DA policy.

2-8. Additional Environmentally Preferable Products

Certain specifications may include additional environmental performance requirements such as the use of less hazardous or non-toxic materials. Consult applicable contracts or design standards for specific requirements.

2-9. Guiding Principles for High Performance and Sustainable Buildings

Note that Executive Orders 13423 and 13514 require federal new construction, major renovation, and repair and alteration to comply with the *Guiding Principles for High Performance and Sustainable Buildings* to the maximum practicable extent. Consult http://www.wbdg.org/references/fhpsb.php and applicable guidance.

ATTACHMENT 1

REFERENCED LAWS AND APPLICABLE POLICY

- **74 FR 10830** "Federal Procurement of Energy Efficient Products – Final Rule) http://edocket.access.gpo.gov/2009/pdf/E9-5459.pdf
- **Clean Air Act Amendments** of 1990 (Clean Air Act, Title VI) (http://www.epa.gov/air/caa/title6.html)
- **Energy Independence and Security Act** of 2007 (http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=110_cong_bills&docid=f:h6enr.txt.pdf)
- **Energy Policy Act** of 2005 (http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_bills&docid=f:h6enr.txt.pdf)
- **Executive Order 13221**, "Energy Efficient Standby Power Devices," 2 August 2001 (http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=2001_register&docid=fr02au01-128.pdf)
- **Executive Order 13423**, "Strengthening Federal Environmental, Energy, and Transportation Management," 24 January 2007 (http://edocket.access.gpo.gov/2007/pdf/07-374.pdf), (http://www.fedcenter.gov/_kd/Items/actions.cfm?action=Show&item_id=6825&destination=ShowItem), and (http://www.wbdg.org/references/fhpsb.php)
- **Executive Order 13514, "Federal Leadership in Environmental, Energy, and Economic Performance,"** 8 October 2009 (http://edocket.access.gpo.gov/2009/pdf/E9-24518.pdf)
- **Farm Security and Rural Investment Act** of 2002 (http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=107_cong_public_laws&docid=f:publ171.107.pdf)
- **Federal Acquisition Regulation** (http://www.acquisition.gov/far/)
- **Resource Conservation and Recovery Act**, Section 6002 (http://www.ornl.gov/adm/ornlp2/sec6002.htm)
- **Army Regulation 200-1**, "Environmental Protection and Enhancement" (13 December 2007)
- **Army Regulation 420-1**, "Army Facilities Management" (12 February 2008)
- Memorandum, OUSD (AT&L), 27 August 2004, subject: **Establishment of the DoD Green Procurement Program**
- **DoD Green Procurement Strategy**
- Memorandum, OUSD (AT&L), 17 August 2006, subject: **Department of Defense Biobased Products and Green Procurement Program**
- Memorandum, DA, 22 November 2006, subject: **Establishment of the Army Green Procurement Program**
- **Army Green Procurement Guide**, Version 1, August 2006**DoD Green Procurement Strategy:**
- **http://www.fedcenter.gov/_kd/Items/actions.cfm?action=Show&item_id=12371&destination=ShowItem**
- **DoD Electronics Stewardship Implementation Plan** (http://www.fedcenter.gov/_kd/Items/actions.cfm?action=Show&item_id=6825&destination=ShowItem)
- **U.S. Army Energy Strategy for Installations**, 8 July 2005
- **Army Strategy for the Environment**: Sustain the Mission, Secure the Future, 1 October 2004
- Memorandum, ACSIM, 7 January 2003, subject: **Change in Army Policy for the Elimination of Ozone Depleting Chemicals**
- Memorandum, ASA (I&E), 22 November 2002, subject: **Elimination of Ozone-Depleting Chemicals (ODCs) in Army Facilities**
- **CAMREG 200-1**, "Installation Environmental Strategy Plan"

ATTACHMENT 2

ACRONYMS AND TERMS

AR – Army Regulation
CFR – Code of Federal Regulations
CPG – Comprehensive Procurement Guidelines
DA – Department of the Army
DoD – Department of Defense
EPA – Environmental Protection Agency
EPEAT – Electronic Product Environmental Assessment Tool
IEQ – Indoor Environmental Quality
FAR – Federal Acquisition Regulation
FEMP – Federal Energy Management Program
HM – Hazardous Material(s)
LED – Light Emitting Diode
LEED – (U.S. Green Building Council's) Leadership in Energy and Environmental Design (Rating System)
LEED CI – LEED Commercial Interiors (Rating System)
LEED NC – LEED New Construction (Rating System)
ODC – Ozone Depleting Chemical
PL – Public Law
PW – Directorate of Public Works, JBLM
RCRA – Resource Conservation and Recovery Act
RMAN – Recovered Materials Advisory Notice
RUL – Restricted Use List
SNAP – Significant New Alternatives Policy
UFGS – Unified Facilities Guide Specifications
USDA – U.S. Department of Agriculture

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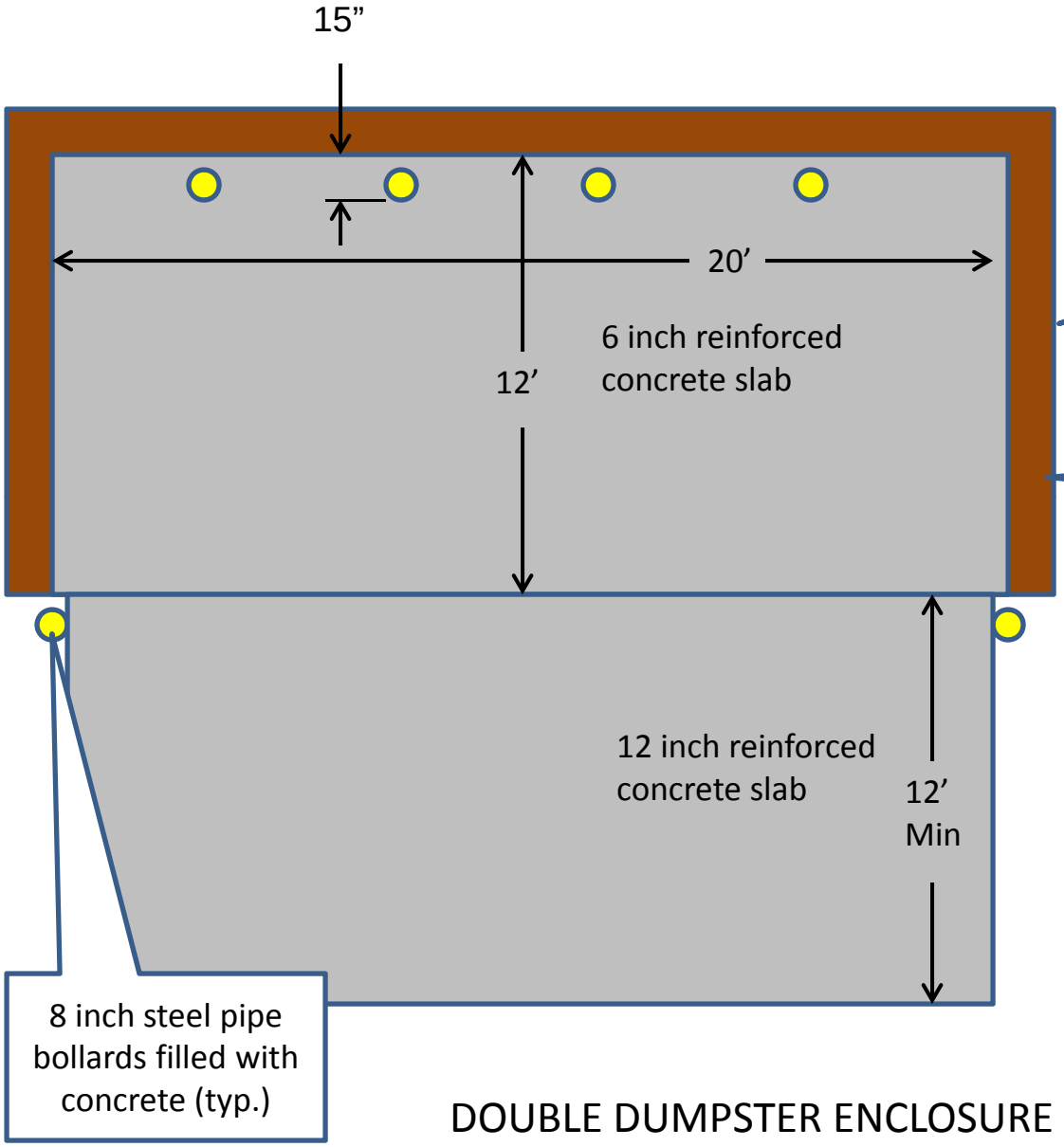
APPENDIX OO

DUMPSTER ENCLOSURE REQUIREMENTS



8 inch concrete block with veneer on the exterior to match the décor of the buildings.

Walls 8 feet high with cap to match the buildings

DOUBLE DUMPSTER ENCLOSURE

Consider the vehicle turning radius for the approach to the enclosure. No gates. Add radii to approach slab as necessary. Pipe bollards in back are to protect the wall as the dumpster is picked up. Approach slab is to support the weight of the front wheels while picking up the loaded dumpster