US Army
Corps
of Engineers
Fort Worth District

Design-Build Request For Proposal

AIT Battalion Headquarters
PN 64202, FY2009

Fort Sam Houston, Texas

W9216G-11-R-0093
November, 2010

SECTION 01 10 00
STATEMENT OF WORK

6.0 PROJECT SPECIFIC REQUIREMENTS

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
Battalion Headquarters (BNHQ)	Office Building

1.0.3 1.0.2 It is the Army's objective that these buildings will have a 25-year useful design life before a possible re-use/re-purpose or renovation requirement, to include normal sustainment, restoration, modernization activities and a 50-year building replacement life. Therefore, 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 site infrastructure will have at least a 50-year life expectancy with industry-accepted maintenance and repair cycles.The project site should be developed for efficiency and to convey a sense of unity or connectivity with the adjacent buildings and with the Installation as a whole.

1.0.4 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 AIT BATTALION HEADQUARTERS

Construct an Advanced Individual Training Battalion Headquarters (AIT BNHQ).

This facility type is to house administrative and command operations. Assume 20 percent of personnel are female, unless otherwise indicated.

The gross area for the BNHQ is 14,560 square feet.

The BNHQ floor plan is provided in Appendix J - Drawings indicate functional and operational arrangements that meet user operability requirements. These drawings are mandatory. The Design/Build (D/B) Contractor is required to adhere to these mandatory designs. Minor plan alterations are permitted to accommodate building system requirements and applicable codes, however the Minimum Area Requirements shall not be reduced.

2.2. SITE:

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

Approximate area available 1.90 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. All Computers and related hardware, copiers, faxes, printers, video projectors, VCRs and TVs are GFGI.

The following are also GFGI items: Vending machines and ice maker.

2.4. FURNITURE REQUIREMENTS

Provide furniture design for all 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.

2.5. NOT USED

3.0 ADVANCED INDIVIDUAL TRAINING COMPLEX (AIT)

3.1. General

Advanced Individual Training (AIT) complexes are required by the Army to encompass living, dining, training, and administrative/command operations. This AIT complex will be comprised of a Battalion Headquarters (BNHQ) facility. The facility, and any additional support facilities, shall be arranged on the site as a unit to allow the battalion to live, eat, train, and work together.

BNHQ is comprised of administration, command operations, special functions, storage and classroom components.

3.2. FUNCTIONAL AND AREA REQUIREMENTS

Gross building area shall be calculated in accordance with Appendix Q. Net area is measured to the inside face of the room or space walls. Minimum dimension where stated shall be measured to the inside face of the defining enclosure. Net area requirements for programmed spaces are included in this paragraph. If net area requirements are not specified, the space shall be sized to accommodate the required function and to comply with code requirements, overall gross area limitations, and any other requirement of this RFP. Area requirements for corridors, stairs, and mechanical rooms will typically be left to the discretion of the offeror.

3.2.1. ACCESSIBILITY REQUIREMENTS

The Headquarters buildings shall comply with the Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities as currently amended. In accordance ABA Section F203.6, Central Energy Plants, if provided, are exempt from accessibility requirements.

3.2.2. NOT USED

3.2.3. BNHQ

3.2.3.1. Functional Space Requirements

(a) S-1 Office: Provide a private administrative office.

(b) S-1 Waiting: Provide a waiting area adjacent to the Administrative Work Space. The S-1 Waiting area shall be separated from the Administrative Work Space by a partition and 36” countertop.

(c) Personnel and Administrative Work Spaces: Provide an office for multiple personnel.

(d) Staff Duty Office: Provide a security office for building surveillance. The walls separating this room from the corridors shall incorporate a built-in counter with a wrap around laminated glass picture window to provide the duty officer a view of the lobby. Picture window shall incorporate a lockable, laminated glass sliding window. Sliding glass window shall be 24 inches wide by 36 inches high minimum.

(e) Message Center: Provide a room for distributing directives. A built-in lockable counter with laminated sliding glass window shall be integrated with a rolling shutter door between this room and the entry Vestibule. Counter opening shall be 36 inches wide by 36 inches high minimum.

(f) Battalion Executive Officer (BN XO): Provide a private administrative office.

(g) Command Sergeant Major (CMD SGT MAJ): Provide a private administrative office.

(h) Battalion Commander (BN CO): Provide a private administrative office.

(i) Administrative Assistant/Waiting: Provide an Admin Assistant/waiting area to serve the BN XO, CMD SGT MAJ and BN CO offices.

(j) Command Suite Restroom: Provide for administrative area a toilet and shower with a built-in 18 inch wooden bench adjacent to the shower stall.

(k) Coffee Bar: Provide built-in counter with deep sink, wall and base cabinets, and shelf to accommodate microwave.

(l) Conference Room: Provide conference room with seating for approximately 20 persons. Provide built-in counter with deep sink, wall and base cabinets, and shelf to accommodate microwave and area for full size refrigerator.

(m) Supply Storage: Provide storage room for miscellaneous administrative items.

(n) S-2 Office: Provide a private administrative office.

(o) Intelligence Work Spaces: Provide an administrative office for multiple personnel.

(p) SIPRNET: Provide a secure telecommunications room constructed in accordance with AR 380-5, Section III, paragraph 7-13b, Department of the Army Information Security Program.

(q) Chaplain: Provide a private administrative office.

(r) Chaplain Assistant: Provide a private administrative office to serve as reception for the Chaplain.

(s) Chaplain Waiting Area: Provide a waiting area adjacent to the Chaplain Assistant and Chaplain office.

(t) S-3 Office: Provide a private administrative office.

(u) Training and Operations Work Spaces: Provide an administrative office for multiple personnel.

(v) S-4 Office: Provide a private administrative office.

(w) Supply and Logistics Work Spaces: Provide an administrative office for multiple personnel.

(x) Instructor Work Space: Provide an administrative office for multiple personnel.

(y) Classrooms 1 & 2: Large classroom space shall be divided into two equal classroom areas with ceiling hung, moveable partition. Partition shall have a minimum STC rating of 45. Each classroom must have a separate exit. Each classroom is intended to provide adequate space for training of 60-65 persons in a two classroom arrangement or to support large gatherings of approximately 140 persons with the partitions retracted.

(z) Classroom # 3: Classroom is intended to provide adequate space for training of 60-65 persons in a classroom arrangement or to support large gatherings of approximately 70 persons in an open arrangement.

(aa) Classrooms Corridor: Provide a circulation area in front of the classrooms.

(bb) Men's Restroom/Shower: Provide one shower stall and toilet facilities to serve the public and administrative personnel assigned to headquarters. Provide a dressing area with a built-in 18 inch wooden bench adjacent to each shower stall.

(cc) Women's Restroom/Shower: Provide one shower stall and toilet facilities to serve the public and administrative personnel assigned to headquarters. Provide a dressing area with a built-in 18 inch wooden bench adjacent to the shower stall.

(dd) Janitor Closet: Provide janitor’s closet with a 10 inches deep floor mounted stainless steel mop sink, with hot and cold service faucet, a four mop holder rack, and two 18 inch deep by 48 inch long heavy duty stainless steel shelves for storage of cleaning supplies. Janitor’s closet shall have space for storage of buckets and vacuum.

(ee) Vending: Vending area shall be sized to accommodate three full-size vending machines. Provide Recycling area adjacent to vending area.

(ff) Lobby: Provide a handicapped accessible entry lobby. Lobby shall include a vestibule or enclosed transition space between the exterior and interior of the building. The vestibule shall be a minimum of 7 feet between doors.

(gg) Charge of Quarters (CQ) Station: Provide a built-in CQ Station located in the central portion of the lobby with a minimum area of 100 net square feet. Built-in station shall provide modesty screening for occupant. Station provides visual control of building circulation. The CQ Station shall provide space for two people. The CQ Station shall have a minimum of six lockable file drawers. Securable compartments for the computer monitor, keyboard, and CPU shall be built-in the reception station.

(hh) Corridor: Provide 6 foot minimum width corridors throughout facility except at Entry Lobby. Entry Lobby corridor shall be 10’-0” wide.

(ii) Biz Hub: Provide data connections and power supply for these areas. A Biz Hub is located within a required space, and is used as a printer/scanner/copier area. Refer to paragraphs 3.7 ELECTRICAL AND TELECOMMUNICATIONS REQUIREMENTS for additional information.

(jj) Mechanical, Electrical, and Telecommunications Rooms: Mechanical rooms shall accommodate space for equipment maintenance/repair access without having to remove other equipment. Mechanical, electrical and telecommunications rooms shall be keyed separately for access by Installation maintenance personnel. Exterior access is required for mechanical room. All telecommunications rooms shall be conditioned space. Telecommunications room will be provided in accordance with the latest I3Acriteria. Refer to paragraphs 3.6 MECHANICAL REQUIREMENTS and 3.7 ELECTRICAL AND TELECOMMUNICATIONS REQUIREMENTS for additional information.

(kk) Battalion Storage: Provide storage area to support Battalion activities surrounding the Headquarters building. The Battalion Storage shall have an uncovered loading dock and 8’-0” x 8’-0” coiling overhead door. The loading dock shall have a loading dock. The space shall be conditioned independently from the rest of the facility. Provide clerestory windows to allow daylighting.

3.2.3.2. Space Allocation

BNHQ MINIMUM SQUARE FOOTAGE REQUIREMENTS NET SQUARE FEET (NSF)	
	TOTAL NSF
S-1	110
S-1 WAITING	100
PERSONNEL AND ADMINISTRATIVE WORK SPACES	1,050
STAFF DUTY OFFICE	110
MESSAGE CENTER	150
EXECUTIVE OFFICER (XO)	150
SERGEANT MAJOR	150
BATTALION COMMANDER (CO)	200
BATTALION COMMANDER CLOSET	12
COMMAND SUITE RESTROOM	50
ADMIN ASST/WAITING	250
COFFEE BAR	45
CONFERENCE ROOM	450
SUPPLY STORAGE	100
BATTALION STORAGE	2,000
S-2	110
INTELLIGENCE WORK SPACES	400
SIPRNET ROOM	65
CHAPLAIN	150
CHAPLAIN ASSISTANT	110
CHAPLAIN WAITING	100
S-3	110
TRAINING AND OPERATIONS WORK SPACES	530
S-4	110
SUPPLY AND LOGISTICS WORK SPACES	210
INSTRUCTOR WORK SPACE	325

BNHQ MINIMUM SQUARE FOOTAGE REQUIREMENTS NET SQUARE FEET (NSF)	
	TOTAL NSF
CLASSROOMS (Three)	3,075 (1075 SF Each)
CLASSROOM STORAGE (One in each Classroom)	75 (25 SF Each)
MEN'S PUBLIC RESTROOM W/SHOWER	230
WOMEN'S PUBLIC RESTROOM W/SHOWER	230
JANITOR CLOSET	30
VENDING	45
CORRIDORS AND VESTIBULE	MINIMUM 6'-0" WIDE
LOBBY WITH VESTIBULE (Including CQ Station Area)	MINIMUM 10'-0" WIDE
MECHANICAL AND ELECTRICAL	AS NEEDED
TELECOMMUNICATIONS	110

3.3. SITE REQUIREMENTS

Site requirements are in Appendix J.

3.4. ARCHITECTURAL REQUIREMENTS

3.4.1. Hardware

(a) Knox Box: A recessed Knox box shall be provided for the facility. The location of the Knox box shall be determined by the Fort Sam Houston Fire Department; generally the location will be immediately adjacent to the closest entrance to the building from the fire lane. The following features shall be included:

(i) Adequate room for all master keys for the facility, including but not limited to fire alarm and mass notification keys

(ii) Flush mounted

(iii) Hinged lid

(iv) Temper switches connected to the fire alarm systems: activation of these switches shall transmit a supervisory signal through the Monaco to the supervising station

(v) Dark bronze finish

(vi) Knox-Vault 4400 Series (Single Lock Model)

(vii) Fire Department (Emergency) Vehicle Access

(b) Finish Hardware: All hardware shall be consistent and shall conform to ANSI/BMHA standards for Grade 1. All requirements for hardware keying shall be coordinated with the Contracting Officer. Hardware finish shall conform to ANSI/BHMA A156 18; finish shall be polished stainless steel or chrome plated non-ferrous metal. Extension of the existing installation keying system shall be provided. Installation keying system is BESTLOCK. Locksets shall have interchangeable cores. Cores shall have no fewer than seven pins. Cores for locksets other than those for mechanical, electrical and telecommunications rooms shall be manufactured by BESTLOCK Corporation (stamped "for government use, do not duplicate). Mechanical and electrical room locks and deadbolts to be Seargant U-Keyway. Locksets for mechanical, electrical, janitor's closets, Supply Storage and telecommunications rooms only shall be keyed to the existing Installation utilities master keying system. Lock for telecommunications room shall be OMNI: 93KOM-0-DV-15-OM500-B-S3-626-SCH (should come with SCHLAGE tail piece to accommodate key cylinder) with SCHLAGE Key-In-Knob Cylinder, Schlage C Keyway and, Satin Chrome finish. Disassembly of knob or lockset shall not be required to remove core from lockset. All locksets and exit devices shall accept same interchangeable cores. Plastic cores are unacceptable. Door hardware and security requirements must be coordinated with the functional requirements, the room-by-room criteria, and the electrical security/fire alarm system requirements of this document. Provide all hardware necessary to meet the requirements of applicable codes for fire doors and exit doors. Provide closers for all doors opening to corridors and as required by codes. Design/Build Contractor shall contact DPW for bitting.

(c) Key Card Access System: A Programmable Electronic Key Card Access System shall be provided on all exterior entry/egress doors, on all office entry doors, classroom entry doors, SIPRNET, Battalion Storage, Message Center and Conference room. Extension of the existing Installation key card access system shall be provided, the existing Installation key card access system is IDentiPass. A programmable Electronic Key Card Access System Manufacturer’s Representative shall install all hardware and software necessary for the operation of the Electronic Key Card Access System and program all locksets. Include all necessary conduit and low voltage wire connections at each door with a computer at the CQ desk to manage/operate the system. Electronic keyboard access system shall interconnect/interface with CCTV system. Provide key cards containing both a chip for use with the IDentipass system and a magnetic strip for use with the contractor provided programmable key card programmer. Provide six (6) blank key cards for each personnel. The Design-Build Contractor shall furnish in three-ring binders, one full set of the system manufacture’s system training manual, system maintenance manual, and one training video (in format provided by the system manufacturer), with each system installed. The Programmable Electronic Key Card Access System Manufacturer’s Representative shall provide two (2) separate 4-hour classes of training for the user on software use, programming locks, encoding cards and printing reports. The building shall be furnished with a complete stand-alone key card system package. Provide a two (2) year warranty on the system and all components and locksets. All special tools, software, connecting cables and proprietary equipment necessary for the maintenance, testing and programming of the system shall be furnished to the contracting Officer Representative.

3.4.2. Special Acoustical Requirements

3.4.2.1. Exterior walls and roof/floor/ceiling assemblies, doors, windows and interior partitions shall be designed to provide for attenuation of external noise sources such as airfields in accordance with applicable criteria.

3.4.2.2. Sound conditions and levels for interior spaces, due to the operation of mechanical and electrical systems and devices, shall not exceed levels as recommended by ASHRAE handbook criteria. Provide acoustical treatment for drain lines and other utilities to prevent noise transmission into the interior of sleeping units.

3.4.2.3. NOT USED

3.4.3. Exterior Design Objectives

3.4.3.1. Exterior Walls: Provide durable materials.

3.4.3.2. Roof System: Minimum roof slope for membrane roof systems shall be 1/4 inch per foot. Minimum roof slope for pitched roof systems shall be 3 inches per foot. Membrane roof systems shall be fully adhered. Structural standing seam metal roofs shall comply with the requirements of ASTM E 1592. Roof system shall be Underwriters Laboratory (UL 580 Class 90) rated or Factory Mutual Global (FM) I-90 rated. Roof system shall comply with applicable criteria for fire rating.

(a) Roof Mounted Equipment: For roof mounted equipment, provide permanent access walkways and platforms to protect roof. Roof mounted equipment on pitched roof systems is unacceptable. Roof mounted equipment on membrane roof systems shall be completely screened by the roof parapet.

(b) Roof access from building exterior is prohibited.

3.4.3.3. Trim and Flashing: Gutters, downspouts, and fascias shall be factory pre-finished metal and shall comply with SMACNA Architectural Sheet Metal Manual.

3.4.3.4. Bird Habitat Mitigation: The Design/Build Contractor shall provide details in the design necessary to eliminate the congregating and nesting of birds at, on, and in the facility.

3.4.3.5. Exterior Doors and Frames:

(a) Main Entrance Doors: Aluminum storefront doors and frames with Architectural Class 1 anodized finish, fully glazed, with medium or wide stile for entry into lobbies or corridors. Provide doors complete with frames, framing members, subframes, transoms, sidelights, trim, applied muntins, and accessories. Framing systems shall have thermal-break design. Storefront systems shall comply with wind-load requirements of applicable codes and criteria and shall comply with the requirements of UFC 4-010-01.

(b) Other Exterior Doors: Exterior doors and frames opening to spaces other than corridors or lobbies shall be galvanized insulated hollow metal and comply with ANSI A250.8/SDI 100. Doors shall be heavy duty (grade 2) insulated with 18-gage steel cladding; top edge closed flush; A60 galvannealed. Frames shall be 12-gauge, with continuously welded mitered corners and seamless face joints. Doors and frames shall be constructed of hot dipped zinc coated steel sheet, complying with ASTM A653, Commercial Steel, Type B, minimum A40 coating weight; factory primed. Fire-rated openings shall comply with applicable codes, and the requirements of the labeling authority. Door and frame installation shall comply with applicable codes and criteria including UFC 4-010-01.

3.4.3.6. Exterior Windows: Provide insulated, high efficiency window systems, with thermally broken frames complying with applicable codes and criteria including UFC 4-010-01. Curtain wall systems shall be capable of withstanding area wind loads, thermal and structural movement required by location and project requirements, and shall comply with applicable codes and criteria including UFC 4-010-01.

3.4.3.7. Exterior Louvers: Exterior louvers shall have bird screens and shall be designed to exclude wind-driven rain. Exterior louvers shall be made to withstand wind loads in accordance with the applicable codes. Wall louvers shall bear the Air Movement & Control Association (AMCA) International certified ratings program seal for air performance and water penetration in accordance with AMCA 500-D and AMCA 511. Louver finish shall be factory applied.

3.4.4. Building Interior

Interior Design Objectives: Provide durable materials and furnishings that are easily maintained and replaced. Maximize use of daylighting. Provide interior surfaces that are easy to clean and light in color. Design headquarters building with an office ambience.

3.4.4.1. Not Used

3.4.4.2. Bulletin Boards: In the headquarters building provide one bulletin board near the main entrance. A second bulletin board shall be provided by the staff entrance near the command suite. Each bulletin board shall be 4 feet high and 6 feet wide and shall have a header panel and lockable, glazed doors.

3.4.4.3. Corner Guards: Provide surface mounted, high impact resistant, integral color, snap-on type resilient corner guards, extending from floor to ceiling for wall and column outside corners in high traffic areas. Factory fabricated end closure caps shall be furnished for top and bottom of surface mounted corner guards.

3.4.4.4. Chair Rail: Chair rails shall be installed in areas prone to hi-impact use, such as corridors, conference room and lobby seating areas.

3.4.4.5. Casework: Provide cabinets complying with Architectural Woodwork Institute Quality Standards. Countertops shall have waterfall front edge and integral coved backsplash.

3.4.4.6. Window Treatment: Provide horizontal mini blinds at all exterior windows. Uniformity of window covering color and material shall be maintained to the maximum extent possible throughout each building.

3.4.4.7. Toilet Accessories: Furnish and install the items listed below and all other toilet accessories necessary for a complete and usable facility. All toilet accessories shall be Type 304 stainless steel with satin finish.

(a) Public Restrooms/Showers: Accessories shall include the following items.

- Glass mirrors on stainless steel frame and shelf – at each lavatory
- Hands free liquid soap dispenser – at each lavatory
- Hands free paper towel dispenser at each lavatory/toilet area

- Waste receptacle – recessed mounted at each lavatory/toilet area
- Sanitary napkin disposal at each female toilet
- Toilet paper dispenser – lockable multiple roll at each toilet
- Sanitary toilet seat cover dispenser – at each toilet stall
- Grab bars – as required by ABA
- Shower curtain rod - extra heavy duty
- Shower curtain – white anti-bacterial nylon/vinyl fabric shower curtain
- Soap dish – in shower
- Robe hook – adjacent to shower enclosure entry
- Toilet Partitions

(b) Not Used

3.4.4.8. Fire Extinguisher Cabinets and Fire Extinguisher Mounting Brackets: Furnish and install recessed fire extinguisher cabinets and fire extinguisher Mounting brackets as required by applicable codes and criteria. Furnish a list of installed recessed fire extinguisher cabinets and mounting brackets (including location, size and type) to the Contracting Office Representative.

3.4.5. Finishes

3.4.5.1. Paint

(a) All paints used shall be listed on the "Approved Product List" of the Master Painters Institute (MPI). Application criteria shall be as recommended by MPI guide specifications for the substrate to be painted and the environmental conditions existing at the project site.

(b) Exterior surfaces, except factory pre-finished material or exterior surfaces receiving other finishes shall be painted a minimum of one prime coat and two finish coats. Paints having a lead content over 0.06 percent by weight of nonvolatile content are unacceptable. Paints containing zinc-chromate, strontium-chromate, mercury or mercury compounds, confirmed or suspected human carcinogens shall not be used on this project. Exterior paints and coating products shall be classified as containing low volatile organic compounds (VOCs) in accordance with MPI criteria. Application criteria shall be as recommended by MPI guide specifications. Provide an MPI Gloss Level 5 Finish (semi-gloss), unless otherwise specified.

(c) Interior surfaces, except factory pre-finished material or interior surfaces receiving other finishes shall be painted a minimum of one prime coat and two finish coats. Paints having a lead content over 0.06 percent by weight of nonvolatile content are unacceptable. Paints containing zinc-chromate, strontium-chromate, mercury or mercury compounds, confirmed or suspected human carcinogens shall not be used on this project. Interior paints and coating products shall contain a maximum level of 150 grams per liter (g/l) of VOCs for non-flat coatings and 50 g/l of VOCs for flat coatings. Provide an MPI Gloss Level 5 Finish (semi-gloss) in wet areas and a flat finish in all other areas.

3.4.5.2. Minimum Interior Finishes-General

(a) Designers are not limited to finishes listed in the following INTERIOR FINISHES table(s) and are encouraged to offer higher quality finishes.

(b) Wall, ceiling and floor finishes and movable partitions shall conform to the requirements of the IBC, NFPA and UFC 3-600-01 Fire Protection Engineering for Facilities. Where code requirements conflict, the most stringent code requirement shall apply.

(c) Carpet shall be minimum of 2 yarn ply, modular tile conforming to ISO 2551, ASTM D 418, ASTM D 5793, ASTM D 5848, solution dyed, tufted, cut and loop pile, commercial 100% branded (federally registered trademark) nylon continuous filament. Vinyl composition tile (VCT) shall be minimum 1/8 inch thick, conforming to ASTM F 1066, Class 2, through pattern tile, Composition 1, asbestos free, with color and pattern uniformly distributed throughout the thickness of the tile.

(d) Walls: All wall finish shall be minimum 5/8” painted gypsum board, except where stated otherwise. All gypsum board shall achieve a score of 10, the highest level of performance for mold resistance under the ASTM D 3273 test method. All gypsum board shall be transported, handled, stored and installed in accordance with the GYPSUM ASSOCIATION – Guidelines For Prevention Of Mold Growth On Gypsum Board (GA-238-03). Use impact resistant gypsum board in corridors, storage rooms, stairwells and activity rooms and centralized laundries (if centralized laundries are required by RFP).

(e) All ceiling finishes shall be minimum 5/8” painted gypsum board, except where stated otherwise. All gypsum board shall achieve a score of 10, the highest level of performance for mold resistance under the ASTM D 3273 test method. All gypsum board shall be transported, handled, stored and installed in accordance with the GYPSUM ASSOCIATION – Guidelines For Prevention Of Mold Growth On Gypsum Board (GA-238-03)

(f) All grout used for ceramic and quarry tile applications shall be mold and mildew resistant.

3.4.5.3. Not Used

3.4.5.4. BNHQ Interior Finishes

BNHQ MINIMUM INTERIOR FINISHES													
	FLOORS					BASE		WALLS		CEILING			REMARKS
	RESILIENT FLOORING	CARPET	CERAMIC TILE	RECESSED ENTRY MAT	SEALED CONCRETE	RESILIENT BASE	CERAMIC BASE	PAINT	CERAMIC	GYPSUM WALLBOARD	ACOUSTICAL CEILING TILE	MINIMUM HEIGHT	
Mechanical					•	•		•				EXP	SEE NOTES 4 & 6
Electrical					•	•		•				EXP	SEE NOTE 4
Communications					•	•		•		•		10'-0"	SEE NOTE 5
Janitor			•				•	•	•	•		8'-0"	SEE NOTE 2
Classrooms #1 and 2	•					•		•			•	10’-0”	
Classroom #3		•				•		•			•	10’-0”	
Instructor Workspace	•					•		•			•	8’-0”	
Men's Public Restroom			•				•	•	•	•		8'-0"	SEE NOTES 2 & 6
Women's Public Restroom			•				•	•	•	•		8'-0"	SEE NOTES 2 & 6
Vending (W/Recycling Area)	•					•		•		•		8’-0”	SEE NOTE 1
Chaplain		•				•		•			•	8’-0”	
Chaplain Assistant		•				•		•			•	8’-0”	
Lobby (including CQ Station area)	•					•		•		•		9'-0"	
Corridor	•					•		•		•		9'-0"	

BNHQ MINIMUM INTERIOR FINISHES													
	FLOORS					BASE		WALLS		CEILING			REMARKS
	RESILIENT FLOORING	CARPET	CERAMIC TILE	RECESSED ENTRY MAT	SEALED CONCRETE	RESILIENT BASE	CERAMIC BASE	PAINT	CERAMIC	GYPSUM WALLBOARD	ACOUSTICAL CEILING TILE	MINIMUM HEIGHT	
Duty Officer	•					•		•			•	8’-0”	
Message Center	•					•		•			•	8’-0”	
S-2 office	•					•		•			•	8’-0”	
Intelligence Work Spaces	•					•		•			•	8’-0”	
S-3 Office	•					•		•			•	8’-0”	
Training and Operations Work Spaces	•					•		•			•	8’-0”	
S-4 office	•					•		•			•	8’-0”	
Supply and Logistics Work Spaces	•					•		•			•	8’-0”	
Personnel and Administrative Work Spaces	•					•		•			•	8’-0”	
S-1 office	•					•		•			•	8’-0”	
BN XO		•				•		•			•	8’-0”	
SGT MJR		•				•		•			•	8’-0”	
BN CO		•				•		•			•	8’-0”	
Supply Storage	•					•		•		•		8’-0”	
Command Suite Restroom			•				•	•	•	•		8'-0"	SEE NOTES 2 & 6
Coffee Bar	•					•		•			•	8’-0”	SEE NOTE 3
Conference Room	•					•		•			•	8’-0”	SEE NOTE 3
Battalion Storage					•	•		•				EXP	
Chaplain Waiting		•				•		•			•	8’-0”	
S-1 Waiting	•					•		•			•	8’-0”	
Administrative Assistant/Waiting		•				•		•			•	8’-0”	
1. FLOOR IN VENDING OR RECYCLABLES STORAGE AREA, MATCH ADJACENT FLOORING, WALL, AND CEILING FINISHES													
2. ALL WET WALLS SHALL HAVE A 4'-0" HIGH CERAMIC TILE WAINSCOT OR FULL HEIGHT TILE WALLS													
3. ALL COUNTERS SHALL HAVE A MINIMUM OF 4" HIGH BACKSPLASH													
4. CEILING MAY BE EXPOSED IF ALLOWED BY LOCAL CODES. PAINT STRUCTURE													
5. CEILING MAY BE EXPOSED HOWEVER ROOM SHALL HAVE POSITIVE PRESSURIZATION. PAINT STRUCTURE													
6. PROVIDE FLOOR DRAIN IN CENTER OF ROOM.													

3.4.5.5. Not Used

3.4.5.6. Not Used

3.4.5.7. BNHQ Furniture Chart

BNHQ FURNITURE CHART		
Description	**Comments**	**Furniture Required**
Battalion Commander	Private Office	L-shaped executive desk with two pedestals, two 4-drawer lateral files, one conference table, four conference chairs, two guest chairs, one executive chair
Executive Office (XO, CMD SGT MAJ)	Private Office	L-shaped executive desk with two pedestals, one double pedestal credenza, hutch, two 4-drawer lateral files, two guest chairs, one managerial chair
Office 1 (S-1, S-2, S-3, S-4)	Private Office	L-shaped executive desk with two pedestals, one double pedestal credenza, hutch, one 4-drawer lateral file, two guest chairs, one managerial chair
Office 2 (Chaplain)	Private Office	L-shaped executive desk with two pedestals, one double pedestal credenza, hutch, one 4-drawer lateral file, one guest chair, one 3-seat upholstered arrangement, one managerial chair
Office 3 (Chaplain Asst)	Office	L-shaped desk with two pedestals, two 4-drawer lateral files, two guest chairs, one task chair
Personnel and Admin	48 NSF Open Workstations	Nine (9) Systems furniture workstations with work surface, file pedestals, and overhead storage, two 4-drawer lateral files per workstation, one guest chair and one task chair per workstation
Training and Operations Area	48 NSF Open Workstations	Three (3) Systems furniture workstations with work surface, file pedestals, and overhead storage, two 4-drawer lateral files per workstation, one guest chair and one task chair per workstation
Supply and Logistics	48 NSF Open Workstations	Two (2) Systems furniture workstations with work surface, file pedestals, and overhead storage, two 4-drawer lateral files per workstation, one guest chair and one task chair per workstation
Instructor Work Space	48 NSF Open Workstations	Three (3) Systems furniture workstations with work surface, file pedestals, and overhead storage, two 4-drawer lateral files per workstation, one guest chair and one task chair per workstation
Intelligence Area	48 NSF Open Workstations	Three (3) Systems furniture workstations with work surface, file pedestals, and overhead storage, two 4-drawer lateral files per workstation, one guest chair and one task chair per workstation, four 4-drawer safes.
Executive Reception (Executive Suite Waiting)	Reception Desk	Reception furniture workstation with work surfaces, transaction top, file pedestals, and overhead storage, one task chair, four reception chairs, one side table
Classroom	Multi-Purpose	200 tablet-arm chair desks, movable partitions to divide large classroom space into three equally-sized spaces
Conference Room	Commander's Conference Room	Boat-shape12 eight side chairs, one small storage credenza
Lobby	Waiting Area	Six guest chairs, two side tables
Duty Officer	Reception Desk	One task chair, one 4-drawer lateral file
Message Mail Center	Mail Room	One single pedestal desk, two task chairs, one mail sorter for four companies
Supply Storage	Storage	Two lockable storage cabinets

3.4.5.8. Not Used

3.5. STRUCTURAL REQUIREMENTS

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

3.5.1. Live Loads: Design live loads shall be per the IBC but not less than the following minimums.

Note that the minimum live loads indicated do not include partition loads. Partition live loads of 15 pounds per square foot (psf) shall be added to all areas with a live load of 80 psf or less.

(a) Elevated floors — 60 pounds per square foot (psf)

(b) Slab on grade — 150 psf

3.6. ENERGY CONSERVATION

3.6.1 Energy Performance

The building, including the building envelope, HVAC systems, service water heating, power, and lighting systems shall be designed to achieve a non-plug load 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 2007 (see paragraph 5.9 Energy Conservation) (Note: Plug loads shall be included in building energy modeling but are subtracted in the final calculation of Energy Performance. See section “Design After Award” for additional guidance.)

3.7. MECHANICAL REQUIREMENTS

3.7.1. Plumbing

3.7.1.1. Maximum plumbing fixture flow rates shall be as follows:

Water closets (Flush Valve): 1.28 gallons per flush (or dual flush type with an equivalent average flush volume)

Showers: 1.5 gpm

Bathroom sinks: 0.5 gpm

Kitchen / Bar sinks: 1.5 gpm

Janitor sinks: 1.5 gpm

Urinals: Ultra low flow 0.125 gallons per flush (supersedes paragraph 01 10 00-5.6.7)

Floor sinks in mechanical room shall have half grate if more than one drain line is routed to floor sink.

Floor drains with infrequent drainage shall have automatic trap primers.

Floors shall have adequate slope to floor drains and floor sinks for complete drainage.

3.7.1.2. Expansive soils are present and will require specific design and construction provisions to prevent piping damage and failure due to pipe/building differential movement. Design shall indicate how piping systems will protect against damage or backfall due to soil heave from penetration of slab to building five foot line. Design shall include features to control forces resulting from soil heave. Solutions should include, but are not limited to, flexible expansion joints, slip joints, horizontal offsets with ball joints, or multiple bell and spigot gasketed fittings on water and sewer lines entering and leaving the building. For structurally supported slabs, piping shall be suspended from the structure with adequate space provided below the pipe for anticipated soil movement. Minimum crawlspace area shall be 36 inches where subfloor access is required.

3.7.1.3. Water Supply and Wastewater Impact Fees: Listed are the various impact fees for water supply and wastewater as assessed by San Antonio Water System (SAWS). These fees shall be coordinated and verified with the Fort Sam Houston DPW and SAWS for this project.

Water Supply: $1242

Water Delivery Flow: $1098

Water Delivery System Development: $668

Wastewater Treatment: $453

Wastewater Collection: $413

3.7.1.4 Additional Plumbing Criteria: UFC 3-420-01, Plumbing Systems.

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

3.7.2.1. HVAC system shall utilize existing 4” condenser water supply and return distribution lines stubbed out at northeast side of building. Condenser water is supplied at 85 Deg F with a 10 to 12 Deg F range. Variable speed redundant secondary loop pumps in mechanical room of BNHQ shall pump secondary loop condenser water to building water source heat pump HVAC system. Condenser loop water shall be designed for 85 Deg F supply to the water source heat pumps with a flow rate of 3 GPM per nominal ton (net refrigeration effect) of heat pump capacity. Water source heat pumps shall incorporate solenoid isolation valves or 2-way control valves to eliminate flow through coils when heat pump unit is not operating. Minimum temperature of existing condenser water loop is maintained at 50 Deg F.

3.7.2.2. Supply air conditions from dedicated outdoor air units (DOAU), if used, shall have maximum 48 degree F dew point.

3.7.2.3. All air handling units shall be located in mechanical rooms accessible only through an exterior door. Mechanical rooms shall be sized for ease of service, maintenance, and replacement of HVAC equipment. Air filters shall be located in the mechanical room.

Each divided classroom and conference room shall be zoned separately. Other space zoning shall be based on exterior envelope exposures. Where VAV systems are used, limit individual zones to a maximum of 2,500 cfm.

Air handling units shall run continuously during occupied hours. Similarly, outdoor ventilation air required by ASHRAE 62.1 shall be continuous during occupied hours.

Paragraph 3.7.1.2 regarding expansive soils applies equally to building connection to condenser water piping.

3.7.2.4 Additional HVAC Criteria:

(a) Energy Independence and Security Act (EISA) 2007

(b) Engineering Technical Letter (ETL) 04-3, Change 1: Design Criteria for Prevention of Mold in Air Force Facilities.

(c) U.S. Army Corps of Engineers Air Leakage Test Protocol for Measuring Air Leakage in Buildings.

(d) UFC 3-400-02, Design-Engineering Weather Data

3.7.3. Fire Protection

Fire suppression systems shall be designed in accordance with the latest edition of UFC 3-600-01. The facility shall be protected throughout by a complete automatic sprinkler system. Fire alarm systems shall be addressable type with addressable devices. The type, function and location of the fire alarm annunciator shall be coordinated with the local authority having jurisdiction.

3.8. ELECTRICAL AND TELECOMMUNICATIONS REQUIREMENTS

Select electrical characteristics of the power system to provide a safe, efficient, and economical distribution of power based upon the size and types of loads to be served. Use distribution and utilization voltages of the highest level that is practical for the load to be served. The effect of nonlinear loads such as computers, other electronic equipment and electronic ballasts shall be considered and accommodated as necessary. Transient voltage surge protection shall be provided on service equipment.

3.8.1. Power

Power shall be provided for all installed equipment requiring power including all GFGI equipment. Power poles are not allowed. All duplex and quadraplex receptacles shall be rated for 20 amperes. The following shall also be provided.

3.8.1.1. Provide 125-volt duplex receptacles per NFPA 70 in conjunction with the proposed equipment and furniture layouts, and as per other stated requirements elsewhere in the RFP.

3.8.1.2. In addition to receptacles required elsewhere in the RFP provide one 125-volt duplex receptacle per wall in all normally occupied spaces.

3.8.1.3. For housekeeping purposes provide a minimum of one 125-volt duplex receptacle per corridor and a minimum of one 125-volt duplex receptacle within the lobby. No point along bottom of corridor walls shall be more than 25 feet from a receptacle.

3.8.1.4. Provide 125-volt duplex receptacles mounted adjacent to lavatories. Provide a minimum of one for every two adjacent lavatories. Each single lavatory shall also be provided a receptacle.

3.8.1.5. Provide a minimum of one 125-volt duplex receptacle on each wall in each mechanical room and a minimum of one 125-volt duplex receptacle in each electrical room.

3.8.1.6. Provide a 125-volt duplex receptacle on a dedicated circuit for the user provided CQ station. This receptacle is in addition to the other power requirement within the lobby.

3.8.1.7. Provide a 125-volt duplex receptacle on a dedicated circuit above the microwave shelf in the conference room and the coffee bar.

3.8.1.8. Provide a minimum of two 125-volt duplex receptacles above the countertop in the conference room and the coffee bar.

3.8.1.9. Provide a minimum of two 125-volt duplex receptacles on a dedicated circuit in each of the designated biz hub areas for printers and copiers.

3.8.1.10. Provide a minimum one 125-volt quadraplex receptacle each for two workstations in the battalion storage room.

3.8.1.11. Acceptance testing shall be provided in accordance with ANSI/NETA ATS (2009), American National Standard for Acceptance Testing Specifications for Electrical Power and Systems.

3.8.1.12. In addition to the 15% space requirement of paragraph 5.7.3.1, provide 10% spare circuit breakers in all panelboards.

3.8.1.13. In addition to the criteria listed in paragraph 4.1, NFPA 70E shall also be followed.

3.8.2. Grounding

Grounding shall be provided in accordance with NFPA 70 and the Technical Criteria for I3A.

3.8.3. Lighting

Interior lighting controls shall be provided in accordance with ASHRAE 90.1 and as stated elsewhere within the RFP. Local manual controls shall supplement automatic controls in offices, large open work spaces and specialized areas such as conference rooms and classrooms. Compact fluorescent lamps of 12 watts or less shall not be used. Electronic ballasts for linear fluorescent lamps shall be the high efficiency programmed start type. Provided lighting levels shall be within +/- 10% of required lighting levels.

3.8.3.1. The mechanical room, battalion storage room and electrical room shall be illuminated to a level of 30 foot-candles.

3.8.3.2.The lobby shall be illuminated to a level of 20 foot-candles.

3.8.3.3.Lighting shall be compatible with security cameras and security requirements.

3.8.3.4. Lighting shall be provided for the dock. Lighting fixture(s) shall utilize lamps with a minimum CRI of 82.

3.8.3.5. The conference room shall utilize ballasts and switches that are compatible and capable of providing continuous dimming between 5% and 100% of lamp rated output.

3.8.3.6. All normally occupied spaces to include corridors shall be controlled through dual-technology occupancy sensors through the use of a relay panel and timer.

3.8.3.7. Linear fluorescent fixtures shall utilize T-5 lamps.

3.8.3.8. The following shall supersede the requirement of paragraph 5.7.5.1(f). Full cut-off type luminaries shall be used.

3.8.3.9. Exterior lighting shall be on a timer controlled relay with an on/off/manual cut-off switch.

3.8.4. Telecommunications System

Telecommunication outlets shall be provided per the applicable criteria based on functional purpose of the space within the building and in accordance with other provisions of this RFP. The acronym DOIM is no longer an applicable term when referring to Installation telecommunications personnel. Therefore, all occurrences of DOIM in the RFP shall be a referral to the Network Enterprise Center (NEC) on the Installation.

3.8.4.1. Provide voice and data connection capability to all workstations.

3.8.4.2. Provide a dual (voice and data) 8-pin modular jack outlet at the front of each classroom and the conference room.

3.8.4.3. The following supersedes paragraph 6.10.2.3. Provide type LC connector to type SC connector patch cords.

3.8.4.4. The following supersedes paragraph 6.10.2.5. Provide fiber optic patch panels with type SC connectors.

3.8.4.5. Provide one of the 4” service entrance conduits for outside plant cabling with 4-1” inner ducts.

3.8.4.5. Provide a single jack outlet for voice with a mounting lug faceplate to accommodate wall-mounted phones in the mechanical, electrical and telecommunications rooms.

3.8.4.6. Provide 4-4” concrete encased ducts stubbed up 6” above the floor adjacent to the wall behind the telecommunications equipment racks to the 5’ line of the building. Contractor shall coordinate location with the site contractor and shall connect ducts to the ducts provided by the site contractor at the 5’ line. One duct shall contain 4-1” inner ducts. All ducts shall be provided with pull wires.

3.8.5. Video Teleconferencing

Provide a dual (fiber optic and 8-pin modular) jack outlet for video teleconferencing connectivity in each classroom and conference room.

3.8.6. Intrusion Detection System (IDS)

An IDS shall be provided for the SIPRNET room as required per the Technical Guide for the Integration of Secret Internet Protocol Router Network (SIPRNET). Provide a control panel, balanced magnetic switch, motion sensor, and duress switch unless specified otherwise in paragraph 6. System requirements shall be coordinated with the Installation.

3.8.7. CATV

All CATV outlet boxes, connectors, cabling, and cabinets shall conform to the Technical Criteria for I3A unless noted otherwise. All horizontal cabling shall be homerun from the CATV outlet to a common location. The telecommunications room shall not be used for CATV equipment. See paragraph 6.0 PROJECT SPECIFIC REQUIREMENTS and Appendix CC for additional requirements. CATV connectivity shall be provided in all classrooms, the conference room and private offices.

3.8.8. Secure Telecommunications

The SIPRNET room shall be designed in accordance with paragraph 6.3.4.3 of the Technical Guide for the Integration of SIPRNET.

3.8.9. Paging System

A zoned paging system shall be provided throughout the facility and integrated with the telephone system. System shall not utilize mass notification amplifiers and speakers, but shall be overridden by the mass notification system if mass notification system is activated while the paging system is being utilized. System shall have a minimum capacity of eight zones. Facility shall be zoned per user requirements.

3.8.10. Security Infrastructure (Security Equipment Not in Contract)

The security infrastructure shall be installed to support Government furnished equipment including cameras, door alarms, and motion sensors. These devices will be utilized at all exterior entrances with the exception of utility room entrances. Infrastructure shall consist of conduit, pull wire and outlet boxes per user requirements. Conduits shall be homerun from outlet boxes for equipment connection to duty officer room.

3.8.11. Audio/Visual System

Provide an empty 1” conduit (with pull wire) above the ceiling from each GFGI ceiling mounted projector location to a wall mounted outlet box at the front of each classroom and the conference room.

3.9. FIRE ALARM REQUIREMENTS

3.9.1. All software, software locks, special tools and any other proprietary equipment required to maintain, add devices to or delete devices from the system, or test the Fire Alarm system shall become property of the Government and be furnished to the Contracting Officer’s Representative prior to final inspection of the system.

3.9.2. The fire alarm system installation shall be supervised by a National Institute for Certification of Engineering Technologies (NICET) 3 (minimum) technician.

3.10. The IEC code reference in paragraph 4.1 shall be replaced with the following: IECC, International Energy Conservation Code (IECC) – Applicable only to the extent specified herein. Refer to Chapter 5, COMMERCIAL ENERGY EFFICIENCY 2006 requirements.

3.11 CORROSION CONTROL

3.11.1. Cathodic protection shall be furnished on all ferrous metal pipes, tanks or other equipment in contact with earth. Cathodic protection shall comply with the recommendations of National Association of Corrosion Engineers (NACE).

3.11.2. The Design/Build Contractor shall obtain the services of a "corrosion expert" to design, supervise, inspect, and test the installation and performance of the cathodic protection system. "Corrosion expert" refers to a person, who by thorough knowledge of the physical sciences and the principles of engineering and mathematics, acquired by professional education and related practical experience, is qualified to engage in the practice of corrosion control of buried or submerged metallic surfaces. Such a person shall be accredited or certified by the National Association of Corrosion Engineers (NACE) as a NACE Accredited Corrosion Specialist or a NACE Certified Cathodic Protection (CP) Specialist or be a registered professional engineer who has certification or licensing that includes education and experience in corrosion control of buried or submerged metallic piping and tank systems, if such certification or licensing includes 5 years experience in corrosion control on underground metallic surfaces of the type under this contract. The "corrosion expert" shall obtain soil resistivity data, acknowledging the type of pipeline coatings to be used and reporting to the Design/Build Contractor the type of cathodic protection required.

3.12 ARC FLASH ANALYSIS

Arc flash hazard analysis shall be performed and all equipment shall be marked in accordance with NFPA 70.

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 C2-2007	National Electrical Safety Code
ANSI/AF&PA NDS-2001	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.)
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(1997)	Standard Practice for Thermographic Inspection of Insulation Installations in Envelope Cavities of Frame Buildings
ASTM E 779 (2003)	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
ASTM E1827-96(2002)	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 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) TG for the Integration of SECRET Internet Protocol (IP) Router Network (SIPRNET). 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://rfpwizard.cecer.army.mil/HTML/docs/Refs/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. 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. Pending the publication of the 2010 version of ASHRAE 90.1, 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 such as at elevator shafts.

5.5.2.9. Damper and control to close all ventilation or make-up air intakes and exhausts, atrium smoke exhausts and intakes, etc when leakage can occur during inactive periods.

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) 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 either pressurization or depressurization or both. 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.

(b) 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.

(c) 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 vitreous china, wall-mounted, wall outlet, non-water using, with integral drain line connection, and with sealed replaceable cartridge or integral liquid seal trap. Either type shall use a biodegradable liquid to provide the seal and maintain a sanitary and odor-free environment. Install, test and maintain in accordance with manufacturer's recommendations. Slope the sanitary sewer branch line for non-water use urinals a minimum of 1/4 inch per foot. Do not use copper tube or pipe for drain lines that connect to the urinal. Manufacturer shall provide an operating manual and on-site training to installation operations personnel for the proper care and maintenance of the urinal. For complexes, non-water using urinals are not required for barracks type spaces.

5.6.8. BUILDING WATER USE REDUCTION. Reduce building potable water use in each building 30 percent using IPC fixture performance requirements 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 shall be provided 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. Provide a high level of lighting system control by individual occupants or by specific groups in multi-occupant spaces (classrooms, conference rooms) to promote the productivity, comfort and well being of the building occupants. In office spaces, the preferred lighting should be a 30 FC ambient lighting level with occupancy sensor controlled task lighting in the work spaces to provide a composite lighting level of 50 FC on the working surfaces. Consider incorporating daylighting techniques for the benefit of reducing lighting energy requirements while improving the quality of the indoor spaces. If daylight strategies are used, additional coordination is required with the architect and mechanical engineer. Additionally, incorporate electric lighting controls to take advantage of the potential energy savings.

(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. Avoid the use of direct expansion cooling coils in air handling units with constant running fans that handle outside air.

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,(including SIPRNET ROOMS, where applicable for specific facility type). Comply with ANSI/EIA/TIA 569 and the I3A.

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 consisting of a building control network , and integrate the building control network into the UMCS as specified.

The building control network shall be a single complete non-proprietary Direct Digital Control (DDC) system for control of the heating, ventilating and air conditioning (HVAC) systems as specified herein. 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..

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.

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

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 (CA), certified as a CA by AABC, NEBB, or TABB, as described in Guideline 1.1. The CA 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 CA 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. All buildings with Minimum LEED Silver (or better) requirement will earn LEED Credit EA3 Enhanced Commissioning.

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 Engineering Criteria) 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 SAM HOUSTON, TX

6.1. GENERAL

The requirements of this paragraph augment the requirements indicated in Paragraphs 3 through 5.

6.2. APPROVED DEVIATIONS

The following are approved deviations from the requirements stated in Paragraphs 3 through 5 that only apply to this project: NONE

6.3. SITE PLANNING AND DESIGN

6.3.1. General:

6.3.1.1. Site Development Plan (SDP). The SDP provided by the government is included within the Appendices. Bring any discrepancies which are found in the furnished plans to the attention of the Contracting Officer's Representative.

6.3.1.2. Building Setback and Force Protection: Lay the site out based on the facility threat security level to protect against exterior attack by providing standoff distance between an aggressor or bomb, barriers, and to facilitate visual monitoring of the site. See the force protection requirements in UFC 4-010-01.

6.3.1.3. Building Spacing: Fire clearance separations shall be in accordance with UFC 3-600-01 and the International Building Code. Verify that fire clearances and access for equipment is acceptable to the installation's Fire Chief. Separation for buildings shall conform to force protection requirements per UFC 4-010-01.

6.3.1.4. Confine pad preparation operations to the work area defined by the SDP.

6.3.1.5. . Walks: Locate walks paralleling buildings beyond the eave drip line and at least 5 feet from the foundation. Walks paralleling parking areas shall be at least 6 feet wide and shall abut the back of the curb.

6.3.1.6. Troop Formation Areas: Walkways for troops marching in formation shall be wide enough to accommodate personnel walking four abreast. The walkways shall be constructed of concrete

6.3.1.7. Parking Areas:

6.3.2. Site Structures and Amenities

6.3.2.1. Dumpsters: Coordinate location of the dumpsters with the Installation. Provide concrete loading aprons for the first 15 feet in front of the dumpster pads to accommodate loading and to avoid rutting of the pavement in front of the dumpsters. Provide the following number of dumpsters

Provided by Site Contractor.

6.3.3. Site Functional Requirements:

6.3.3.1. Stormwater Management (SWM) Systems.

(a) Comply with the requirements of general permit number

TXR150000

(b) Storm Drainage System Plans are shown within the SDP. Tie into these systems as appropriate for his areas of design responsibility. Design and construction of the storm drainage system shall be 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, URBAN DRAINAGE DESIGN MANUAL; and U.S. Weather Bureau Technical Paper No. 40, dated May 1961, Rainfall Frequency Atlas of the United States for Durations from 30 minutes to 24 hours, and return periods from 1 to 100 years. Base the design of drainage structures on a 10-year storm frequency. Incorporate the principles of Low Impact Development (LID), as detailed in UFC 3-210-10 DESIGN: LOW IMPACT DEVELOPMENT MANUAL. Construct manholes, surface inlets, and curb inlets of reinforced concrete or pre-cast reinforced concrete. Design structures in pavement to handle H-20 loading. Structures in turfed areas can be constructed for lighter weight loading. Design the storm drainage system to be as economical as possible, while taking into account the topography, drainage area, and outfall locations, as well as coordination with existing drainage systems, and existing and future underground utilities. Profiles are required for underground storm drainage systems and sections are required for culverts.

(c) Underground Systems: Whenever possible, match pipe crowns in elevations. Profiles of pipes shall show all existing and new underground utilities and pertinent surface features. Design the minimum pipe gradient shall be designed to provide a minimum velocity (full flow) of 3.0 fps. Design the new outfall and receiving channel to withstand the shear stress acting on the channel from the runoff to prevent erosion. Size new underground storm drainage pipes by computation of backwater surface profiles. The minimum pipe size shall be 12 inches, unless the pipe is a part of the roof drain system, in which case the minimum size of laterals and collector pipes is 4 inches.

(d) Street Drainage: Accomplish street drainage by the use of curb and gutter and curb inlets. Curb gaps can be considered in areas where roadside ditches are used. The center one-third of the street shall not convey runoff during the passing of the design storm. Do not use inverted crown sections for the streets without prior approval. Do not locate curb inlets in the radius of street intersections, at curb returns, or where pedestrian traffic is most likely to occur.

(e) POV Parking and Hardstands: Do not concentrate the flow of storm runoff on asphalt pavement. Convey storm runoff within POV parking areas to perimeter curbs by sheetflow. However, if it is necessary to concentrate flow within a parking area, provide concrete paving at the swale flowline. Concentrated flow will not be permitted to flow from POV parking or hardstand areas onto adjacent gravel areas or turfed slopes. Examine sheetflow from parking areas and hardstands onto adjacent gravel or turfed areas for possible erosive effects.

(f) Ditches and Swales: Use a minimum longitudinal ditch or swale gradient of 0.5% with an absolute minimum of 0.3% . Side slopes on ditches or swales shall be no steeper than 1 vertical on 2-1/2 horizontal. Pave steeper slopes. Use Turf Reinforcement Matting (TRM) in ditches that are subject to high velocity storm runoff. Use erosion control matting as necessary to control erosion on steeper slopes.

(g) Culverts: The recommended gradient of culverts shall be 0.5% with an absolute minimum of 0.3%. Provide concrete headwalls or end sections for all culverts. Design headwalls and end sections to reduce velocities to levels that are non-erosive for the soil types encountered.

6.3.3.2. Erosion and Sediment Control: Prepare and comply with Storm Water Pollution Prevention Plans (SWPPP) for the limits of the entire construction site. Include silt fences, mulch straw/hay bales around inlets, and sediment traps to control erosion during construction.

6.3.3.3. Vehicular Circulation.

(a) Geometric Features: Geometric design of all roads, streets, access drives, and parking areas shall conform to the requirements presented in AASHTO, a Policy of Geometric Design of Highways and Streets. Verify with the local installation that access for fire equipment is adequate. Radii, to back of curb, for intersections are standardized as follows:

Primary and Secondary Intersection - 30 feet
Tertiary intersections - 20 feet
Access drives at end parking space - 5 feet

(b) Parking: Provide perimeter concrete curbs and gutters for all parking areas and access drives in developed areas. In remote or little used areas, use concrete curbs and gutters only when required to control drainage. Where flexible pavements are used, removable prefabricated reinforced concrete wheel stops, as approved, may be used.

(c) Service Drives: Widths of drives to unloading ramps or docks for usual types of trucks or tractor trailers are:

Trucks, Single-Unit - 12 feet

Semi-trailers - 16 feet

6.4. SITE ENGINEERING

6.4.1. Existing Topographical Conditions: The government furnished survey Horizontal and Vertical control complies with EM 1110-1-8005, Table 2-1, Military Construction, Building or Structure Design.

6.4.2. Existing Geotechnical conditions: See Appendix A for a preliminary geotechnical report.

6.4.2.1. Existing Subsurface Conditions: A Government Preliminary Geotechnical Report has been prepared, and is appended to these specifications (Appendix A). The Government Geotechnical Report provides a general overview of the areal geologic conditions with detailed descriptions of the subsurface strata encountered during the Government geotechnical field investigation. Based on the results of the field investigation, laboratory testing program, and engineering analyses, the Government Geotechnical Report further provides parameters and minimum foundation design requirements. However, as stated in the Government Geotechnical Report, the Contractor is responsible for drilling additional borings at the site, and performing additional laboratory testing (specified in the Government Geotechnical Report). The Contractor's additional geotechnical field investigations shall be ONLY for the purpose of supplementing the data regarding subsurface conditions provided by the Government geotechnical field investigation, as presented in the Government Geotechnical Report

6.4.3. Fire Flow Tests See Appendix D for results of fire flow tests to use for basis of design for fire flow and domestic water supply requirements.

6.4.4. Pavement Engineering and Traffic Estimates:

6.4.4.1. Pavements: Geometric design of roads and streets shall follow the guidance provided in AASHTO - A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS and GUIDELINES FOR GEOMETRIC DESIGN OF VERY LOW-VOLUME LOCAL ROADS (ADT≤400). Design pavement structures in accordance with criteria contained in AASHTO - GUIDE FOR DESIGN OF PAVEMENT STRUCTURES. Vehicle types expected to occupy the pavements and their frequency of use are as follows:

Paved access is required to mechanical rooms/yards. New curb and gutter shall be concrete paved.

6.4.4.2. Emergency Vehicle Access: Provide access drives to allow access for fire trucks and emergency vehicles in accordance with NFPA and UFC 3-600-1. Access to the emergency drive(s) shall be restricted by using removable bollards or metal pipe swing gates with a removable center bollard. Refer to the gate detail in the drawings.

6.4.4.3. Concrete Hardstands for Vehicle Parking and Storage Areas: Develop a joint pattern plan showing locations of each type of joint to be used. Spot elevations are required at the intersection of each joint to facilitate placement of forms during construction.

6.4.5. Traffic Signage and Pavement Markings

6.4.5.1. Permanent and construction roadway signs shall be as required by the FHWA MUTCD and FHWA Standard Highway Signs.

6.4.5.2. Pavement markings and striping shall be in accordance with state DOT standards and the Manual of Uniform Traffic Control Devices (MUTCD). Channelization and pavement markings shall be as required by the FHWA MUTCD and FHWA Standard Highway Signs.

6.4.6. Base Utility Information

(a) Do not place underground utility lines such as sanitary sewer, water, and gas under existing or proposed pavements. Place the utility between the back slope of a road ditch and building, or back of curb. Coordinate deviations to the aforementioned requirements with the COR. Do not locate above ground utility features in front of, or in such a manner as to detract from the facility, make landscaping more difficult, or restrict or negate close-in recreational areas. Do not locate high pressure gas lines closer than 100 feet from an occupied building without special protective provisions and COR approval.

(b) Coordinate and plan utility information with the Installation's DPW through the COR. The SDP provides existing utility routing and general orientation for points of connection. Specific connection locations not shown are noted hereinafter.

6.4.6.1. Connect all utilities from the building to the service connection points shown on the SDP or listed herein. Coordinate between the SDP and utility providers, as well as coordinating utility outages with the installation and service provider.

6.4.6.2. Water Distribution System: The water distribution system is shown on the SDP. Coordinate points of connection through the COR with the installation DPW. Design and construction of potable water service between the main line and the facility shall be the responsibility of the Contractor. Design and install the water system and meter in accordance with the requirements of the installation DPW through coordination of the COR. Install valves on the water service lines near the connection point and on each service line to the building. For water mains, provide 2 valves at tees and 3 valves at crosses. Velocities in water lines shall be less than 7 feet per second (fps) to prevent possible water hammer effects.

(a) Potable Water Disinfection – Verify water line disinfection per AWWA C651-05. Analyze the samples by an analytical lab that holds a current state license and certification. Repeating disinfection protocols per AWWA C651-05 is required until satisfactory results are obtained (two consecutive sets of acceptable samples taken 24 hours apart). Collect water samples in proper sterilized containers, and perform a bacterial examination in accordance with state approved methods. As a minimum, collect one water sample from each 1000 linear feet segment of disinfected water line. The water supply system disinfection is not approved for usage until each test result is negative for bacteriological examination. Provide the water sample analytical results to the DPW's Environmental Office for record keeping. The commercial laboratory shall be certified by the state's approving authority for examination of potable water.

6.4.6.3. Natural Gas Distribution: Natural Gas distribution lines are shown on the SDP. Coordinate points of connection to the facility with CPS Energy. CPS Energy will provide natural gas service to the face of the building and shall install the site gas distribution piping. CPS Energy shall install the gas meter and connect the meter to the building stub out. The contractor shall stub the gas feed out of the building. The Contractor is not responsible for costs incurred for services provided by CPS Energy Design and construct the natural gas service lines with ANSI B31.8, Gas Transmission Distribution and Piping Systems. Natural gas shall be provided to the building . Provide a meter/regulator assembly for the facility with a valved bypass.

6.4.6.4. Sanitary Sewer System: The sanitary sewer system is shown on the SDP. Coordinate points of connection through the COR with the DPW. Design and construct the sanitary sewer system in accordance with American Society of Civil Engineers (ASCE) and the Water Environment Federation (WEF), Gravity Sanitary Sewer Design and Construction, Second Edition (ASCE Manuals and Reports on Engineering Practice No. 60 / WEF Manual of Practice No. FD-5). Provide sanitary sewer service to the building. Install two-way cleanouts and all structures required by criteria, as well as, all piping between the designated point of connection and the building. Minimize the use of lift stations. If a lift station is required, provide a packaged unit assembled of coated materials that do not easily corrode. Provide an audible and visible alarm. Ensure location of lift station is accessible by service vehicles. Provide manholes at every change of direction and every 400 feet. Provide drop manholes if pipe elevations differ more than 18 inches. The minimum sewer main size shall be 8-inch. Provide 6-inch minimum sewer connections to buildings. Provide two-way cleanouts every 100 feet along a sewer branch connection from a building, and provide two-way cleanouts at the building connection. Construct manhole inlets of reinforced concrete or pre-cast reinforced concrete. Design structures in pavement to handle H-20 loading. Structures in turfed areas can be constructed for lighter weight loading. Profiles are required for underground sanitary sewer systems.

6.4.6.5. Oil-Water Separators: Provide oil-water separators for the pretreatment of wastewater containing free-floating oils and grease prior to discharge into sanitary sewers. Additionally, determine the pretreatment limits required by the receiving wastewater utility and select or design a system to meet these discharge limits and to resist buoyant forces acting on the structure.

(a) Prepackaged Separators: The design shall consider the anticipated flow rate and the quantity of dirt and grit contained in the wastewater. High-volume wastewater containing large amounts of solids will usually require design of a cast-in-place separator.

(b) Cast-in-Place Separators: Cast-in-place reinforced concrete separators are required for the pretreatment of wastewater generated at outdoor facilities such as washracks. Provide a grit chamber either upstream of the separator, or integrally with the separator at the upstream end of the separator when large quantities of sediments are expected. In all cases, when the flow rate resulting from storm runoff significantly exceeds the normal operating flow rate, include a bypass in order to divert the storm water into the storm drainage system instead of allowing it to flow into the treatment system. Design cast-in-place oil/water separators to conform to Chapters 5 and 6 of the American Petroleum Institute's Manual on Disposal of Refinery Wastes. This manual provides minimum detention times. Provide slotted, rotation-type or belt type oil skimmer and waste oil storage tanks in accordance with user requirements.

6.4.6.6. Cable TV (CATV): Cable TV is privatized and provided by others. Privatized utility will provide design and service to the building(s) and is not in this contract.

6.4.7. Cut and Fill

6.4.7.1. Strive to achieve a balanced cut and fill for earthwork. Do not waste excess soil within the SDP work area without the written approval of the Contracting Officer’s Representative (COR).

6.4.7.2. Grading Requirements:

(a) Finished Floor Elevations: A building's finished floor elevation shall be a minimum of 12 inches above the highest point of the adjacent outside finished grade, unless there is an overriding technical reason to deviate. Slope the finished grade a minimum of 5% for the first 10 feet away from the building.

(b) Turfed Areas Adjacent to Buildings: Slope outside finished grade away from the building at a 5% grade for the first 10 feet. Extend the 5% grade to 20 to 30 feet in areas with expansive soils. When site conditions require the use of steep slopes near buildings, provide a berm that is a minimum of 6 feet wide at a 5% grade adjacent to the building. Indicate these requirements on the grading plan with critical spot elevations.

(c) Lawn Areas: Lawn areas beyond the 5% finished grade stated above shall have a 1% minimum slope and a desirable maximum slope of 25%. If it becomes necessary to use slopes steeper than 25%, provide slope protection, but in no case shall the slope exceed 33%. Base the type and amount of slope protection provided on the soil type, slope length, and aesthetic, environmental, and economic considerations.

(d) Roads, Streets, and Access Drives: Gradients for roads, streets and access drives shall be as outlined in AASHTO, A Policy of Geometric Design of Highways and Streets. Accomplish grade changes in excess of 1% by means of vertical curves. Determine the length of vertical curves in accordance with the aforementioned AASHTO criteria. Profiles are mandatory for vertical control of centerline gradients. Show roads, streets and highways using of half-plan/half-profile type drawings.

(e) Parking Areas: Pavement grades shall provide positive surface drainage with a 1 percent minimum slope in the direction of drainage. Provide a maximum slope within a 90-degree parking space of 5 percent from front to rear end and 1-½ percent from side to side. Provide a maximum slope within a 45-degree or 60-degree parking space of 5 percent from front to rear end and 1 percent from side to side. Slope grade perpendicular to direction of parking 5 percent maximum for bituminous or concrete surfaces and 3 percent for other surfaces.

(f) Finish Grade Contours and Spot Elevations: Provide finish grade contours at 1-foot intervals and spot elevations to construct all site development features. Spot elevations on the drawings should be sufficient so that interpolation between contours is not required for structures, grading or paved areas. Provide spot elevations where grade changes a minimum of 1 percent and use at point of tangency for curbs on end islands and at corners of parking lots.

6.4.8. Borrow Material

6.4.9. Haul Routes and Staging Areas

6.4.9.1. See Appendix J, DRAWINGS for the project location and the location of haul routes and Contractor's staging area. Construction limits shall be confined to the construction site boundaries as shown on the Site Development Plan (SDP) within the Appendices.

6.4.9.2. The Contractor will be allotted an area as shown on the SDP for the placement of a construction trailer complex and storage for the Contractor and respective Subcontractors. Permanent Trailers are not permitted within the building envelope work areas. Trailers within the work area may be required to be relocated at no additional cost to the Government to accommodate site activities. The Contractor shall be responsible for the site preparation, fencing, access drives, and maintenance of the compound at all times. Upon completion of the project and after removal of trailers, materials, and equipment from within the fenced area, remove the fence. . Restore areas used by the Contractor for the storage of equipment or material, or other use, to the original or better condition. Remove gravel used to traverse grassed areas and restore the area to its original condition, including top soil and seeding as necessary.

6.4.9.3. For proposal purposes, assume Contractor will be responsible for providing temporary utilities (water, sewer, and electricity, etc.) during construction at the project site. A water fill point will be provided as indicated on the SDP. It may be necessary, initially, for the Contractor to truck water to the project site until new utilities are constructed. Contractor is responsible for installation and maintenance of the haul road from the water fill point to the entrance of the construction site.. Coordinate routing of haul roads with the COR.

6.4.10. Clearing and Grubbing:

6.4.11. Landscaping:

(a) Provide native or well adapted species of plants in the landscaping plan. Choose trees, shrubs, and ground covers from the preferred plant list included in Appendix I. Provide shade trees . Use flowering vegetation at focal points to provide visual interest. All landscaping within 33 feet of the facility shall adhere to force protection clear zone requirements as specified in UFC 4-010-01.

(b) The landscaping integrated design shall emphasize the goal to achieve energy efficiency and water conservation. Select t vegetation based on hardiness, availability, and drought tolerance, which aids in the conservation of water, as well as, maintenance resources. Locate the trees to optimize shading opportunities, which aids in energy efficiency of the buildings by cooling during the summer.

(c) Landscape Irrigation.

6.4.12. Turf: Turfing is required on all graded, unpaved and disturbed areas resulting from the Contractor's operations. Use sod in areas with steep slopes (≥ 3:1) or ditch linings to assist in establishing turf and to aid in erosion protection. Use Turf Reinforcement Matting (TRM) in ditches that are subject to high velocity storm runoff. Use erosion control matting as necessary to control erosion on steeper slopes.

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 . 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 Sam Houston'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 Sam Houston'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:

comply with the METC Architectural theme.

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 Sam Houston. 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) The wall and ceiling/roof will have a continuous insulative/vapor barrier connection with no air gaps.

(c) Screen mechanical equipment by parapets at flat or low slope roofs.

(d) Roof shapes may be gabled or hip roofs or a combination of these roof shapes with flat roofs concealed by a parapet wall.

6.5.3. Programmable Electronic Key Card Access Systems:

Refer to chapter 3.4.1 c for Programmable Key Card information.

6.5.4. INTERIOR DESIGN

Interior building signage requirements:

6.6. STRUCTURAL DESIGN

6.6.1. General

Place floor mounted mechanical and electrical equipment on a 4" minimum concrete pad.

6.6.2. Project Specific Design Loads:

6.6.2.1. Ground Snow: 5 psf

6.6.2.2. Wind Speed: 90 mph

6.6.2.3. Seismic Design Data: The mapped maximum considered earthquake (MCE) spectral response accelerations for site class B are:

Ss (at short periods) = 11% g
S_1 (at 1-second period) = 3% g.

The acceleration values identified are for the general location of the facility. Verify and use site specific criteria based on the final site location of the facility. Adjust site class per IBC to match specific site information in geotechnical report.

6.6.2.4. For design of structural components subjected to dynamic loads, the U.S. Army Corps of Engineers Protective Design Center (PDC) developed SBEDS, Single-Degree-of-Freedom Blast Effects Design Spreadsheets (SBEDS). SBEDS is available at the software tab of the PDC website, https://pdc.usace.army.mil/.

6.6.3. Foundation

Use a vapor barrier system with a minimum 10-mil polyethylene membrane under all slabs-on-grade.

6.6.4. Site Features – Retaining Walls/Bridges/etc.

Design site features, e.g. retaining walls, culverts, bridges, in accordance with the appropriate American Association of State Highway and Transportation Officials (AASHTO) criteria including AASHTO LRFD Bridge Design Specifications, AASHTO Standard Specifications for Highway Bridges, and AASHTO Guide Specifications for Design of Pedestrian Bridges. Consider operation and maintenance requirements, e.g. painting, mowing, inspecting, routine maintenance. Design site features to drain properly in order to meet loading assumptions.

6.7. THERMAL PERFORMANCE

Consider moisture protection. Consider protection from damage to flooring and wall finishes when designing floor slabs and walls. This could be as simple as placing a vapor barrier under the floor slab, building wrap, or vapor barrier on the walls.

6.8. PLUMBING

6.8.1. The storm drainage system will consist of gutters and downspouts on each building. Direct all drainage to the existing storm sewer system.

6.8.2. Consider the use of tankless domestic water heaters.

6.8.3. General Plumbing Requirements:

6.8.3.1. Each building will have a domestic water service entrance with a floor drain for backflow preventer testing and discharge.

6.8.3.2. Wall Hydrants: Provide a minimum of 4 exterior wall hydrants, at least one per face of the building. These shall have a removable key and freeze protection. Mount wall hydrants 2 feet above finished grade and spaced around the building perimeter to allow watering of all grass areas with no greater than 100 feet of garden hose. Provide a minimum of one (1) hose-bib in each mechanical room, mechanical area, or utility area.

6.8.3.3. Install all backflow preventers in mechanical rooms for accessibility and comply with the requirements of Texas Commission on Environmental Quality, International Building Code, and International Plumbing Code. Backflow preventers shall pass certification testing for compliance with Title 30 Texas Administrative Code Rule 290.44(h). State licensed plumbers shall install and/or test backflow preventers, and cross connection devices.

Initial testing and certification of new backflow devices needs to be performed, and submitted for approval prior to domestic water usage.

6.8.3.4. Water Meters: Locate the water meter inside the building. Meters shall have a pulse generator with each pulse representing an adjustable volume of water. The meter shall be capable of operating up to speeds of 500 pulses per minute with no false pulses. Pulse generators shall provide the maximum number of pulses up to five hundred (500) per minute that is obtainable from the manufacturer. Connect meters to the building control system. Provide meters with isolation valves upstream and downstream of the meter and with a building piping drain valve downstream of the meter. Connect meters to the Post wide Utility Control System (UCS).

6.8.3.5. Water Service Utility Provider (WSUP) Coordination: Provide separate service for the fire water and domestic water services. The domestic water service shall include a meter inside the building and fire water service line shall have a backflow preventer with a post indicator valve.

6.8.3.6. Exterior Water Piping Freeze Protection: Detail and install seasonally (not used in winter) utilized water supply piping for complete drain down and provide an interior or below grade isolation valve. Insulate, heat trace and protect exposed water piping that is utilized year round with pipe jacketing to ensure that the piping will not freeze.

6.8.3.7. Irrigation: Potable water irrigation is generally prohibited due to water reduction best management practices. Use gray (re-use) water (where available) for all outdoor irrigation unless building purpose is health related for treatment of patients where gray water would be considered a risk factor.

6.8.4. Natural Gas Meters for Buildings Only:

6.8.4.1. Install a shutoff valve, meter set assembly, and service regulator set assembly on the service line outside each building, eighteen (18) inches above the ground on the building gas service riser.

6.8.4.2. Install an insulating joint on the inlet side of the meter set assembly and service regulator and construct to prevent flow of electrical current. A 3/8 inch tapped fitting equipped with a plug shall be provided on both sides of the service regulator, downstream of the gas shutoff valve; for installation of pressure gages for adjusting the regulator.

6.8.4.3. Terminate all service regulator vents and relief vents in the outside air in rain and insect resistant fittings. Locate the open end of the vent where gas can escape freely into the atmosphere, away from any openings into the building and above areas subject to flooding.

6.8.4.4. Meters shall have a pulse generator with each pulse representing an adjustable volume of gas. The meter shall be capable of operating up to speeds of five hundred (500) pulses per minute with no false pulses. Pulse generators shall provide the maximum number of pulses up to five hundred (500) per minute that is obtainable from the manufacturer. Connect meters to the Post wide Utility Control System (UCS).

6.8.4.5. Include a seismic shutoff valve.on the gas service entrance to each building.

6.8.4.6. Normally utilize the standard gas pressure from utility provider’s building regulator of 5.3 ounces. If higher pressures are needed, coordinate those requirements with the utility provider. Additionally, provide the utility provider with their required flow rate and expected gas usage diversity. Provide an allowance of $25,000.00 for the costs associated with the installation and design that will be required by CPS Energy for the new natural service extension to the site. The Contractor is responsible for all costs associated with the natural gas service to the site in accordance with the requirements of CPS Energy. Do not contact CPS Energy for pricing during the bidding process..

6.9. SITE ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

6.9.1. Power

Primary electrical power is privatized and owned by City Public Service (CPS). Both temporary and permanent power for buildings will be provided by CPS Energy. The solicitation drawings show a suggested route for distribution based on CPS Energy standards. A separate bid item is included in this request for proposal with CPS

Energy's preliminary connection charge. CPS will perform electrical field surveys at the D/B Contractor's expense. There will be a charge for any upgrades to the primary distribution system (both overhead and underground). For complete design and connection details

6.9.2. Lighting:

6.9.3. Telecommunications

6.10. FACILITY ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

6.10.1. Power

6.10.1.1. Connect the pulse initiator on the electric meter to the building's Direct Digital Control System. Connect meters to the Post wide Utility Control System (UCS).

6.10.1.2. Provide an exterior entrance to the main electrical room containing service equipment.

6.10.1.3. Locate panelboards in designated electrical rooms or non public areas. Do not install panel-boards in hallways or general access areas.

6.10.2. Telecommunications

6.10.2.1. Coordinate with the Directorate of Information Management (DOIM) during the design process. The POC for DOIM is Ms. Erma Brown at (210) 221-4546 or email at Erma.M.Brown@us.army.mil.

6.10.2.2. In waiting areas and courtyards (if applicable) provide one 8-pin modular jack in a single gang outlet faceplate with mounting lugs labeled "voice". In the mechanical room provide two 8-pin modular jacks (in addition to UFC requirement) in an outlet box with one labeled "voice" and the other "DDC".

6.10.2.3. Provide LC-LC patch cord for fiber patch panel.

6.10.2.4. Install pull wires in conduits which have spare capacity.

6.10.2.5. Provide fiber patch panels with LC connectors.

6.10.2.6. Coordinate with EMCS/UMCS paragraphs in section 01 10 00 to provide two 8-pin modular jacks adjacent to the Building Point of Connection hardware for connection to Fort SAM's existing EMCS.

6.10.2.7. Provide sufficient space on one of the walls in the main telecommunications room for a customer provided locked cabinet. Clear area for cabinet will be minimum 48 inches wide and 24 inces deep.

6.10.3. Cable TV (CATV)

See Appendix CC, Special Project Procedures for Fort Sam for additional requirements.

6.10.3.1. Route all CATV conduits and cables in accordance with specifications provided by local CATV provider. Provide 10' of slack for cables at the designated CATV box location.

6.10.4. Elevators (if applicable) shall have a dedicated "hot" telecommunications line to the fire department for emergency situations. Provide a 1" conduit with pull wire from the elevator machine room to the nearest telecommunications room.

6.11. HEATING, VENTILATING, AND AIR CONDITIONING

6.11.1. General: Integrate the control system to the installation's existing UMCS. The existing UMCS is FSH Industrial Grade Direct Digital Control System (IGDDCS) using Rockwell RSView Front End Operating Software.

6.11.2. System Selection:

6.11.2.1. HVAC System for Communications Room: All Communication Rooms shall have air-conditioning provided for cooling 365 days per year, regardless of outdoor air temperature.

6.11.2.2. HVAC System for Mechanical Room and other Service, Storage and Utility spaces: Mechanical, fire protection, electrical, and storage spaces shall be automatically ventilated to limit space temperatures to 10 degrees F above design outdoor air temperature.

6.11.3. EMCS

6.11.3.1. EMCS/UMCS at Fort Sam Houston: Fort Sam Houston does have a central utility monitoring and control system. The basewide UMCS system uses front end software RS View, Version 3.2 by Rockwell, to the individual buildings via a VLAN provided by ITBC. All heating, ventilating, and air-conditioning (HVAC) controls shall use a programmable logic control (PLC) based FSH Industrial Grade DDC System (IGDDCS). The PLC system shall be compatible with the Fort Sam Houston UMCS. PLC's shall be networked. All LAN equipment shall fully comply with IEEE 802.3 (10 BASE 2 or 10 Base T) Ethernet networks. See Specification 23 09 10.00 44 PROGRAMMABLE LOGIC CONTROL FOR HVAC (FORT SAM HOUSTON) in the Appendix for further requirements.

6.11.3.2. Integration of new facilities into the existing UMCS database and monitoring and controls software (such as the post-wide demand limiting) will require generation of custom graphics matching the style and complexity of the existing graphics. Integration of new facilities shall also include programming of alarm handling and demand load limiting which will require Directorate of Public Works (DPW) input for critical alarm lists and priority of building for demand load limiting. This will have to be done at the existing UMCS "front-end". Integration will be limited to experienced companies and personnel.

6.11.4. Water Quality Analysis and Treatment: Water quality for the installation and surrounding area is 'hard'. Treatment will be required for use as make-up water in HVAC equipment. Water analysis data from water treatment contractor and as given below:

- Chlorides: 20 ppm
- Total Alkalinity: 264 ppm
- Total Hardness: 292 ppm ($CaCO_3$)
- Calcium: 81 ppm
- Magnesium: 23 ppm
- Total Dissolved Solids: 321 ppm

Coordinate with water treatment contractor to confirm water data and current water treatment methods to obtain the required quantity and types of chemicals to be initially introduced into the closed loop heating and condensing water systems.

6.11.5. Mandatory Equipment Requirements: All mechanical equipment shall automatically restart after a power outage. Provide equipment such as low water boiler cut-offs and controls that can restart in a normal mode after power is restored. Protect all mechanical equipment and controls against power surges and low and high supply voltage situations. Power loss, surges or low or high voltage shall not in any way effect HVAC or plumbing equipment or controls, set points, controls bindings etc.

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:

6.12.2. Minimize roof penetrations.

6.13. FIRE PROTECTION

6.13.1. The Fire Alarm Control Panel shall be fully compatible with the existing Monaco presently in use at Fort Sam Houston.

6.13.1.1. The RF transceiver shall be a Monaco BT-X2 or approved equal.

6.13.1.2. The Fire alarm receiving system is a Monaco D-21 system.

6.13.1.3. Provide a remote enunciator panel for the fire alarm system.

6.13.1.4. Key all fire alarm equipment. Keys shall be per Fort Sam Houston requirements.

6.13.1.5. All tamper devices shall be supervised with supervisory signals sent to the Fort Sam Houston monitoring station.

6.13.1.6. Mark aire lanes in accordance with Fort Sam Houston requirements.

6.13.1.7. All FA tampers (PIV, valves, etc.) shall have cover tampers.

6.13.1.8. Provide a list of special tools and spare parts for the fire alarm and fire sprinkler systems. List shall include cost and source of supply for each item. In addition, provide a copy of computer software and technical data for the fire alarm system. Computer software shall include any special hardware required to operate the system.

6.13.2. Fire Sprinkler System

6.13.2.1. The water flow data given in this RFP is historical water flow data taken near this project site. Refer to Appendix D for the water flow test data. Verify this water flow data with a Contractor performed flow test. If the test indicates that the available flow or pressure has deteriorated from the data given in this RFP, bring this to the attention of the Government. If the test indicates that the available water flow or pressure has not deteriorated, use the water flow test data given in this RFP as the basis of design for the fire extinguishing systems.

6.13.2.2. Perform the water flow test at hydrants near to this project site. Perform flow testin accordance with the procedures contained in NFPA 291 to determine the available water supply. Report the flow test using a form containing all the data and having the same format as on the Sample Report of a Hydrant Flow Test found in NFPA 291. A fire protection engineer or an engineer experienced in water flow testing shall perform or witness the required flow tests prior to the first sprinkler system design submittal. Submit the qualifications of the engineer performing or witnessing the test. The Government won't concur with the sprinkler system design before the Government concurs with the water flow tests.

6.13.2.3. Identify and locate the test hydrants on the sprinkler system submittal drawings.

6.13.2.4. Install a double detector check assembly on the fire water service line for the building. Systems utilizing antifreeze require reduced pressure principle backflow preventers. Backflow preventers shall pass certification testing for compliance with Title 30 Texas Administrative Code Rule 290.44(h).

6.13.2.5. Install fire risers in dedicated space or mechanical room with external access for fire department.

6.13.3. Fire Alarm System

The fire alarm system shall send a trouble signal to the Installation's central fire receiving station for the Post Indicator Valve. Central receiving station is a radio based Monaco system.

6.13.4. Mass Notification System (MNS)

Program the MNS with standard Fort Sam Houston prerecorded messages. Ft. Sam personnel will provide messages thru the Contracting Officer's Representative.

6.14. SUSTAINABLE DESIGN

6.14.1. LEED Rating Tool Version. This project shall be executed using LEED-NC Version 2.2.

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: None..

6.14.3. Credit Validation: The project is a standard design building(s) portion of a multiple contractor Combined Project. 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 Government. Administration/team management of the online project will be by the Contractor. See Appendix LEED Requirements for Multiple Contractor Combined Projects for information about registered standard designs. 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 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.

MR Credit 2 Construction Waste Management.

The Installation does not have an on-post recycling facility available for Contractor's use.

See LEED Multiple Contractor Responsibilities Table(s) for additional information.

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. Multiple Contractor Combined Project. When site work and building(s) are accomplished by separate contractors, it is a Multiple Contractor Combined Project for purposes of LEED scoring and documentation. This project is part of a Multiple Contractor Combined Project that includes site work and building(s) accomplished by separate contractors. See Appendix LEED Requirements for Multiple Contractor Combined Projects and Appendix LEED Multiple Contractor Responsibilities Table(s) for special requirements for this project.

6.14.8. Additional Information

None.

6.15. ENVIRONMENTAL

CPS Energy may offers rebate programs. Check their website for additional information at: http://www.cpsenergy.com.

6.16. PERMITS

See Appendix BB, CPS Connections, and Appendix CC Section 01 35 13.00 44, Special Project Procedures for Fort Sam Houston for information regarding permitting requirements.

6.17. DEMOLITION

None.

6.18. ADDITIONAL FACILITIES

None.

End of Section 01 10 00

SECTION 01 32 01.00 10
PROJECT SCHEDULE

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.

- U.S. ARMY CORPS OF ENGINEERS (USACE) ER 1-1-11 (1995) Progress, Schedules, and Network Analysis Systems http://www.usace.army.mil/publications/eng-regs/er1-1-11/entire.pdf

1.2. QUALIFICATIONS

Designate an authorized representative who shall be responsible for the preparation of the schedule and all required updating (statusing) and preparation of reports. The authorized representative shall be experienced in scheduling projects similar in nature to this project and shall be experienced in the use of the scheduling software that meets the requirements of this specification.

2.0 PRODUCTS (Not Applicable)

3.0 EXECUTION

3.1. GENERAL REQUIREMENTS

3.1.1. Submit a project schedule as specified herein for approval showing the sequence in which the Contractor proposes to perform the work and dates on which the Contractor contemplates starting and completing all schedule activities. The scheduling of the entire project, including the design and construction sequences is required. Contractor management personnel shall actively participate in its development. Designers, subcontractors and suppliers working on the project shall also contribute in developing an accurate project schedule. The schedule must be a forward planning as well as a project monitoring tool. The approved project schedule shall be used to measure the progress of the work and to aid in evaluating requests for excusable time extensions. The schedule shall be cost loaded and activity coded as specified herein. The schedule will provide the basis for all progress payments. If the Contractor fails to submit any schedule within the time prescribed, the Contracting Officer may withhold approval of progress payments until the Contractor submits the required schedule

3.1.2. Status the schedule on at least a monthly basis, as specified herein. If in the opinion of the Contracting Officer, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress including those that may be required by the Contracting Officer, without additional cost to the Government. In this circumstance, the Contracting Officer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained. See paragraph 3.7.4.

3.1.3. Failure of the Contractor to comply with the requirements of the Contracting Officer shall be grounds for a determination by the Contracting Officer that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the Contracting Officer may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of the contract.

3.2. BASIS FOR PAYMENT AND COST LOADING

The schedule shall be the basis for determining contract earnings during each update period and therefore the amount of each progress payment. Lack of an approved schedule update or qualified scheduling personnel will result in an inability of the Contracting Officer to evaluate contract earned value for the purposes of payment. Failure of the Contractor to provide all information, as specified herein will result in the disapproval of the preliminary, initial and subsequent schedule updates. In the event schedule revisions are directed by the Contracting Officer and those revisions have not been included in subsequent revisions or updates, the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until such revisions to the project schedule have been made. Activity cost loading shall be reasonable as determined by the Contracting Officer. The aggregate value of all activities coded to a contract CLIN as specified herein shall equal the value of the CLIN on the Schedule.

3.3. PROJECT SCHEDULE DETAILED REQUIREMENTS

The computer software system utilized to produce and update the project schedule shall be capable of meeting all requirements of this specification. Failure of the Contractor to meet the requirements of this specification will result in the disapproval of the schedule. Scheduling software that meets the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER-1-1-11(1995) referenced herein are Primavera Project Planner (P3) by Primavera, and Open Plan by Deltek.

3.3.1. Use of the Critical Path Method

Use the Critical Path Method (CPM) of network calculation to generate the project schedule. Prepare the project schedule using the Precedence Diagram Method (PDM).

3.3.2. Level of Detail Required

Develop the project schedule to an appropriate level of detail. Failure to develop the project schedule to an appropriate level of detail, as determined by the Contracting Officer, will result in its disapproval. The Contracting Officer will consider, but is not limited to, the following characteristics and requirements to determine appropriate level of detail:

3.3.2.1. Activity Durations

Reasonable activity durations are those that allow the progress of ongoing activities to be accurately determined between update periods. Less than 2 percent of all non-procurement activities shall have Original Durations (OD) greater than 20 work days or 30 calendar days. Procurement activities are defined herein.

3.3.2.2. Design and Permit Activities

Include design and permit activities, including necessary conferences and follow-up actions and design package submission activities. Include the design schedule in the project schedule, showing the sequence of events involved in carrying out the project design tasks within the specific contract period. This shall be at a detailed level of scheduling sufficient to identify all major design tasks, including those that control the flow of work. Include review and correction periods associated with each item.

3.3.2.3. Procurement Activities

Include activities associated with the submittal, approval, procurement, fabrication and delivery of long lead materials, equipment, fabricated assemblies and supplies. Long lead procurement activities are those with an anticipated procurement sequence of over 90 calendar days. A typical procurement sequence includes the string of activities: submit, approve/review, procure, fabricate, and deliver.

3.3.2.4. Mandatory Tasks

Include and properly schedule the following tasks (See also the Sample Preliminary Submittal Register Input Form):

3.3.2.4.1. Submission, review and acceptance of design packages, including BIM

3.3.2.4.2. Submission of mechanical/electrical/information systems layout drawings

3.3.2.4.3. Submission and approval of O & M manuals

3.3.2.4.4. Submission and approval of as-built drawings

3.3.2.4.5. Submission and approval of 1354 data and installed equipment lists

3.3.2.4.6. Submission and approval of testing and air balance (TAB)

3.3.2.4.7. Submission of TAB specialist design review report

3.3.2.4.8. Submission and approval of fire protection specialist

3.3.2.4.9. Submission and approval of testing and balancing of HVAC plus commissioning plans and data. Develop the schedule logic associated with testing and commissioning of mechanical systems to a level of detail consistent with the contract commissioning requirements.

3.3.2.4.10. Air and water balancing

3.3.2.4.11. HVAC commissioning

3.3.2.4.12. Controls testing plan submission

3.3.2.4.13. Controls testing

3.3.2.4.14. Performance Verification testing

3.3.2.4.15. Other systems testing, if required

3.3.2.4.16. Contractor’s pre-final inspection

3.3.2.4.17. Correction of punch list from Contractor’s pre-final inspection

3.3.2.4.18. Government’s pre-final inspection

3.3.2.4.19. Correction of punch list from Government’s pre-final inspection

3.3.2.4.20. Final Inspection

3.3.2.5. Government Activities. Show Government and other agency activities that could impact progress. These activities include but are not limited to: approvals, design reviews, review conferences, release for construction of design package(s), environmental permit approvals by State regulators, inspections, utility tie-ins, Government Furnished Property/Equipment (GFP) and Notice to Proceed for phasing requirements, if any.

3.3.2.6. Activity Responsibility Coding (RESP)

Assign Responsibility Code for all activities to the Prime Contractor, Subcontractor or Government agency responsible for performing the activity. Activities coded with a Government Responsibility code include, but are not limited to: Government approvals, Government design reviews, environmental permit approvals by State regulators, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements. Code all activities not coded with a Government Responsibility Code to the Prime Contractor or Subcontractor responsible to perform the work. Activities shall not have more than one Responsibility Code. Examples of acceptable activity code values are: DOR (for the designer of record); ELEC (for the electrical subcontractor); MECH (for the mechanical subcontractor); and GOVT (for USACE). Unacceptable code values are abbreviations of the names of subcontractors.

3.3.2.7. Activity Work Area Coding (AREA)

Assign Work Area code to activities based upon the work area in which the activity occurs. Define work areas based on resource constraints or space constraints that would preclude a resource, such as a particular trade or craft work crew from working in more than one work area at a time due to restraints on resources or space. Examples of Work Area Coding include different areas within a floor of a building, different floors within a building, and different buildings within a complex of buildings. Activities shall not have more than one Work Area Code. Not all activities are required to be Work Area coded. A lack of Work Area coding will indicate the activity is not resource or space constrained.

3.3.2.8. Contract Changes/Requests for Equitable Adjustment (REA) Coding (MODF)

Assign Activity code to any activity or sequence of activities added to the schedule as a result of a Contract Modification, when approved by Contracting Officer, with a Contract Changes/REA Code. Key all Code values to the Government's modification numbering system. Any activity or sequence of activities added to the schedule as a result of alleged constructive changes made by the Government may be added to a copy of the current schedule, subject to the approval of the Contracting Officer. Assign Activity codes for these activities with a Contract Changes/REA Code. Key the code values to the Contractor's numbering system. Approval to add these activities does not necessarily mean the Government accepts responsibility and therefore liability for such activities and any associated impacts to the schedule, but rather the Government recognizes such activities are appropriately added to the schedule for the purposes of maintaining a realistic and meaningful schedule. Such activities shall not be Responsibility Coded to the Government unless approved. An activity shall not have more than one Contract Changes/REA Code

3.3.2.9. Contract Line Item (CLIN) Coding (BIDI)

Code all activities to the CLIN on the Contract Line Item Schedule to which the activity belongs. An activity shall not contain more than one CLIN Item Code. CLIN Item code all activities, even when an activity is not cost loaded.

3.3.2.10. Phase of Work Coding (PHAS)

Assign Phase of Work Code to all activities, based upon the phase of work in which the activity occurs. Code activities to either a Design Phase or a Construction Phase. Code fast track design and construction phases proposed by the Contractor to allow filtering and organizing the schedule by fast track design and construction packages. If the contract specifies construction phasing with separately defined performance periods, identify a Construction Phase Code to allow filtering and organizing the schedule accordingly. Each activity shall have only one Phase of Work code.

3.3.2.11. Category of Work Coding (CATW)

Assign Category of Work code to all Activities based upon the category of work which the activity belongs. Category of Work Code must include, but is not limited to: Design, Design Submittal, design reviews, review conferences, Construction Submittal, Approvals (if any), Acceptance, Procurement, Fabrication, Delivery, Weather Sensitive Installation, Non-Weather Sensitive Installation, Start Up, Test, and Turnover. Assign a Category of Work code to each activity. Each activity shall have only one Category of Work Code.

3.3.2.12. Definable Features of Work Coding (FOW1, FOW2, FOW3)

Assign a Definable Feature of Work Code to appropriate activities based on the definable feature of work to which the activity belongs. Definable Feature of Work is defined in Specification Section 01 45 04.00 10, Contractor Quality Control. An activity shall not have more than one Definable Feature of Work Code. Not all activities are required to be Definable Feature of Work Coded.

3.3.3. Scheduled Project Completion and Activity Calendars

The schedule interval shall extend from NTP date to the required contract completion date. The contract completion activity (End Project) shall finish based on the required contract duration, as adjusted for any approved contract time extensions. The first scheduled work period shall be the day after NTP is acknowledged by the Contractor. Schedule activities on a calendar to which the activity logically belongs. Activities may be assigned to a 7 day calendar when the contract assigns calendar day durations for the activity such as a Government Acceptance activity. If the Contractor intends to perform physical work less than seven days per week, schedule the associated activities on a calendar with non-work periods identified including weekends and holidays. Assign the Category of Work Code - Weather Sensitive Installation to those activities that are weather sensitive. Original durations must account for anticipated normal adverse weather. The Government will interpret all work periods not identified as non-work periods on each calendar as meaning the Contractor intends to perform work during those periods.

3.3.3.1. Project Start Date

The schedule shall start no earlier than the date on which the NTP was acknowledged. Include as the first activity in the project schedule an activity called "Start Project" or "NTP". The "Start Project" activity shall have an "ES" constraint date equal to the date that the NTP was acknowledged, with a zero day duration.

3.3.3.2. Schedule Constraints and Open Ended Logic

Constrain completion of the last activity in the schedule by the contract completion date. Schedule calculations shall result in negative float when the calculated early finish date of the last activity is later than the contract completion date. Include as the last activity in the project schedule an activity called "End Project". The "End Project" activity shall have an "LF" constraint date equal to the contract completion date for the project, and with a zero day duration or by using the “project must finish by” date in the scheduling software. The schedule shall have no constrained dates other than those specified in the contract. The use of artificial float constraints such as “zero fee float” or “zero total float” are typically prohibited. There shall only be 2 open ended activities: Start Project (or NTP) with no predecessor logic and End Project with no successor logic.

3.3.3.3. Early Project Completion

In the event the Preliminary or Initial project schedule calculates an early completion date of the last activity prior to the contract completion date, the Contractor shall identify those activities that it intends to accelerate and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. The last activity shall have a late finish constraint equal to the contract completion date and the schedule will calculate positive float. The Government will not approve an early completion schedule with zero float on the longest path. The Government is under no obligation to accelerate activities for which it is responsible to support a proposed early contract completion.

3.3.4. Interim Completion Dates

Constrain contractually specified interim completion dates to show negative float when the calculated early finish date of the last activity in that phase is later than the specified interim completion date.

3.3.4.1. Start Phase

Include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work. The “Start Phase X" activity shall have an "ES" constraint date equal to the date on which the NTP was acknowledged, and a zero day duration.

3.3.4.2. End Phase

Include as the last activity for a project phase an activity called "End Phase X" where "X" refers to the phase of work. The "End Phase X" activity shall have an "LF" constraint date equal to the specified completion date for that phase and a zero day duration.

3.3.4.3. Phase “X” Hammock

Include a hammock type activity for each project phase called "Phase X" where "X" refers to the phase of work. The "Phase X" hammock activity shall be logically tied to the earliest and latest activities in the phase.

3.3.5. Default Progress Data Disallowed

Do not automatically update Actual Start and Finish dates with default mechanisms that may be included in the scheduling software. Activity Actual Start (AS) and Actual Finish (AF) dates assigned during the updating process shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the AS and AF dates on the Daily Quality Control report for every in-progress or completed activity, and failure to ensure that the data contained on the Daily Quality Control reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's updated schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. Updating of the percent complete and the remaining duration of any activity shall be independent functions. Disable program features which calculate one of these parameters from the other.

3.3.6. Out-of-Sequence Progress

Activities that have progressed before all preceding logic has been satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case basis subject to approval by the Contracting Officer. Propose logic corrections to eliminate all out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule. Correct out of sequence progress that continues for more than two update cycles by logic revision, as approved by the Contracting Officer.

3.3.7. Negative Lags and Start to Finish Relationships

Lag durations contained in the project schedule shall not have a negative value. Do not use Start to Finish relationships (SF).

3.3.8. Calculation Mode

Schedule calculations shall retain the logic between predecessors and successors even when the successor activity starts and the predecessor activity has not finished. Software features that in effect sever the tie between predecessor and successor activities when the successor has started and the predecessor logic is not satisfied (“progress override”) will not be allowed.

3.3.9. Milestones

Include milestone activities for each significant project event including but not limited to: milestone activities for each fast track design package released for construction; design complete; foundation/substructure construction complete; superstructure construction complete; building dry-in or enclosure complete to allow the initiation of finish activities; permanent power complete; and building systems commissioning complete.

3.4. PROJECT SCHEDULE SUBMISSIONS

Provide the submissions as described below. The data CD, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

3.4.1. Preliminary Project Schedule Submission

Submit the Preliminary Project Schedule, defining the Contractor's planned operations for the first 90 calendar days for approval within 15 calendar days after the NTP is acknowledged. The approved Preliminary Project Schedule will be used for payment purposes not to exceed 90 calendar days after NTP. Completely cost load the Preliminary Project Schedule to balance the contract award CLINS shown on the Price Schedule. Detail it for the first 90 calendar days. It may be summary in nature for the remaining performance period. It must be early start and late finish constrained and logically tied as previously specified. The Preliminary Project Schedule forms the basis for the Initial Project Schedule specified herein and must include all of the required Plan and Program preparations, submissions and approvals identified in the contract (for example, Quality Control Plan, Safety Plan, and Environmental Protection Plan) as well as design activities, the planned submissions of all early design packages, permitting activities, design review conference activities and other non-construction activities intended to occur within the first 90 calendar days. Schedule any construction activities planned for the first 90 calendar days after NTP. Constrain planned construction activities by Government acceptance of the associated design package(s) and all other specified Program and Plan approvals. Activity code any activities that are summary in nature after the first 90 calendar days with Responsibility Code (RESP) and Feature of Work code (FOW1, FOW2, FOW3)

3.4.2. Initial Project Schedule Submission

Submit the Initial Project Schedule for approval within 42 calendar days after NTP. The schedule shall demonstrate a reasonable and realistic sequence of activities which represent all work through the entire contract performance period. The Initial Schedule shall be at a reasonable level of detail as determined by the Contracting Officer. Include detailed design and permitting activities, including but not limited to identification of individual design packages, design submission, reviews and conferences; permit submissions and any required Government actions; and long lead procurement activities required prior to design completion. The Initial Project Schedule shall include the entire construction sequence and all fast track construction activities, with as much detail as is known at the time but, as a minimum, shall include all construction start and completion milestone activities, and detailed construction activities through the dry-in milestone, including all activity coding and cost loading. Include the remaining construction, including cost loading, but it may be scheduled summary in nature. As the design proceeds and design packages are developed, fully detail the remaining construction activities concurrent with the monthly schedule updating process. Constrain construction activities by Government acceptance of associated designs. When the design is complete, incorporate into the then approved schedule update all remaining detailed construction activities that are planned to occur after the dry-in milestone.

3.4.3. Design Package Schedule Submission:

With each design package submitted to the Government, submit a frag-net schedule extracted from the then current Preliminary, Initial or Updated schedule which covers the activities associated with that Design Package including construction, procurement and permitting activities.

3.4.4. Periodic Schedule Updates

Based on the result of the meeting specified in PERIODIC SCHEDULE UPDATE MEETINGS, submit periodic schedule updates. These submissions shall enable the Contracting Officer to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgment of the Contracting Officer or authorized representative is necessary for verifying the Contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made. Update the schedule to include detailed lower WBS activities procurement and construction activities as the design progresses, but not later than the submission of the final, un-reviewed design submission for each separate design package. The Contracting Officer may require submission of detailed schedule activities for any distinct construction that is started prior to submission of a final design submission, if such activity is authorized.

3.4.5. Standard Activity Coding Dictionary

Use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11, Appendix A. This exact structure is mandatory, even if some fields are not used. A template SDEF compatible schedule backup file (sdef.prx) is available on the QCS website: www.rmssupport.com. The SDEF format is as follows:

Field	Activity Code	Length	Description
1	WRKP	3	Workers per Day
2	RESP	4	Responsible Party (e.g. GC, subcontractor, USACE)
3	AREA	4	Area of Work
4	MODF	6	Modification or REA number
5	BIDI	6	Bid Item (CLIN)
6	PHAS	2	Phase of Work
7	CATW	1	Category of Work
8	FOW1	10	Feature of Work (used up to 10 characters in length)
9	FOW2	10	Feature of Work (used up to 20 characters in length)
10	FOW3	10	Feature of Work (used up to 30 characters in length)

3.5. SUBMISSION REQUIREMENTS

Submit the following items for the Preliminary Schedule, Initial Schedule, and every Periodic Schedule Update throughout the life of the project:

3.5.1. Data CD's

Provide two sets of data CD's containing the project schedule in the backup format. Each CD shall also contain all previous update backup files. File medium shall be CD. Label each CD, indicating the type of schedule (Preliminary, Initial, Update), full contract number, Data Date and file names. Each schedule shall have a unique file name as determined by the Contractor.

3.5.2. Narrative Report

Provide a Narrative Report with the Preliminary, Initial, and each Periodic Update of the project schedule, as the basis of the progress payment request. The Narrative Report shall include: a description of activities along the 2 most critical paths where the total float is less than or equal to 20 work days, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken or required to be taken. The narrative report is expected to communicate to the Government, the Contractor's thorough analysis of the schedule output and its plans to compensate for any problems, either current or potential, which are revealed through its analysis. Identify and explain why any activities that, based their calculated late dates, should have either started or finished during the update period but did not.

3.5.3. Approved Changes Verification

Include only those project schedule changes in the schedule submission that have been previously approved by the Contracting Officer. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

3.5.4. Schedule Reports

The format, filtering, organizing and sorting for each schedule report shall be as directed by the Contracting Officer. Typically reports shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date Total Float, Actual Start Date, Actual Finish Date, and Percent Complete. The following lists typical reports that will be requested. One or all of these reports may be requested for each schedule submission.

3.5.4.1. Activity Report

A list of all activities sorted according to activity number.

3.5.4.2. Logic Report

A list of detailed predecessor and successor activities for every activity in ascending order sorted by activity number.

3.5.4.3. Total Float Report

A list of all incomplete activities sorted in ascending order of total float. List activities which have the same amount of total float in ascending order of Early Start Dates. Do not show completed activities on this report.

3.5.4.4. Earnings Report by CLIN

A compilation of the Contractor's Total Earnings on the project from the NTP to the data date. This report shall reflect the earnings of specific activities based on the agreements made in the schedule update meeting defined herein. Provided that the Contractor has provided a complete schedule update, this report shall serve as the basis of determining progress payments. Group activities by CLIN Item number and sort by activity number. This report shall: sum all activities coded to a particular CLIN and provide a CLIN Item percent earned value; and complete and sum CLIN items to provide a total project percent complete. The printed report shall contain, for each activity: the Activity Number, Activity Description, Original Budgeted Amount, Quantity to Date, Percent Complete (based on cost), and Earnings to Date.

3.5.5. Network Diagram

The network diagram is required for the Preliminary, Initial and Periodic Updates. Depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.5.1. Continuous Flow

Show a continuous flow from left to right with no arrows from right to left. Show the activity number, description, duration, and estimated earned value on the diagram.

3.5.5.2. Project Milestone Dates

Show dates on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.5.3. Critical Path

Clearly show the critical path.

3.5.5.4. Banding

Organize activities as directed to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

3.5.5.5. S-Curves

Earnings curves showing projected early and late earnings and earnings to date.

3.6. PERIODIC SCHEDULE UPDATE MEETINGS

Conduct periodic schedule update meetings for the purposes of reviewing the Contractor’s proposed out of sequence corrections, determining causes for delay, correcting logic, maintaining schedule accuracy and determining earned value. Meetings shall occur at least monthly within five days of the proposed schedule data date and after the Contractor has updated the schedule with Government concurrence respecting actual start dates, actual finish dates, remaining durations and percent complete for each activity it intend to status. Match the acutal start and finish dates with the dates exported, as described in paragraph 3.3.5. Provide a computer with the scheduling software loaded and a projector during the meeting which allows all meeting participants to view the proposed schedule update during the meeting. The meeting and resultant approvable schedule update shall be a condition precedent to a formal submission of the update as described in SUBMISSION REQUIREMENTS and to the submission of an invoice for payment. The meeting will be a working interactive exchange which will allow the Government and the Contractor the opportunity review the updated schedule on a real time and interactive basis. The Contractor’s authorized scheduling representative will organize, sort, filter and schedule the update as requested by the Government. The meeting will last no longer than 8 hours. A rough draft of the proposed activity logic corrections and narrative report shall be provided to the Government 48 hours in advance of the meeting. The Contractor's Project Manager and Authorized Scheduler shall attend the meeting with the Authorized Representative of the Contracting Officer.

3.6.1. Update Submission Following Progress Meeting

Submit a complete update of the project schedule containing all approved progress, revisions, and adjustments, pursuant to paragraph SUBMISSION REQUIREMENTS not later than 4 working days after the periodic schedule update meeting, reflecting only those changes made during the previous update meeting.

3.6.2. Staus of Activities

Update statusing information, including Actual Start Dates (AS), Actual Finish Dates (AF), Remaining Durations (RD) and Percent Complete shall be subject to the approval of the Government prior to the meeting. As a minimum, address the following items on an activity by activity basis during each progress meeting:

3.6.2.1. Actual Start and Finish Dates

Accurately status the AS and/or AF dates for each activity currently in-progress or completed since the last update The Government may allow an AF date to be assigned with the percent complete less than 100% to account for the value of work remaining but not restraining successor activities. Only assign AS dates when actual progress occurs on an activity.

3.6.2.2. Remaining Duration

Update the estimated RD for all incomplete activities independent of Percent Complete. Remaining durations may exceed the activity OD or may exceed the activity's prior update RD if the Government considers the current OD or RD to be understated based on current progress, insufficient work crews actually manning the job, unrealistic OD or deficiencies that must be corrected that restrain successor activities.

3.6.2.3. Percent Complete

Update the percent complete for each activity started, based on the realistic assessment of earned value. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be statused 100 percent complete. To allow for proper schedule management, cost load the correction of punch list from Government pre-final inspection activity(ies) not less than 1% of the total contract value, which activity(ies) may be declared 100 percent complete upon completion and correction of all punch list work identified during Government pre-final inspection(s).

3.6.2.4. Logic Changes

Specifically identify and discuss all logic changes pertaining to NTP on change orders, change orders to be incorporated into the schedule, contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, and other changes that have been made pursuant to contract provisions. The Government will only approve logic revisions for the purpose of keeping the schedule valid in terms of its usefulness in calculating a realistic completion date, correcting erroneous logic ties, and accurately sequencing the work.

3.6.2.5. Other Changes

Other changes required due to delays in completion of any activity or group of activities include: 1) delays beyond the Contractor's control, such as strikes and unusual weather. 2) delays encountered due to submittals, Government Activities, deliveries or work stoppages which make re-planning the work necessary. 3) Changes required to correct a schedule that does not represent the actual or planned prosecution and progress of the work.

3.7. REQUESTS FOR TIME EXTENSIONS

In the event the Contractor believes it is entitled to an extension of the contract performance period, completion date, or any interim milestone date, furnish the following for a determination by the Contracting Officer: justification, project schedule data, and supporting evidence as the Contracting Officer may deem necessary. Submission of proof of excusable delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is a condition precedent to any approvals by the Government. In response to each Request For Proposal issued by the Government, the Contractor shall submit a schedule impact analysis demonstrating whether or not the change contemplated by the Government impacts the critical path.

3.7.1. Justification of Delay

The project schedule shall clearly display that the Contractor has used, in full, all the float time available for the work involved with its request. The Contracting Officer's determination as to the number of allowable days of contract extension shall be based upon the project schedule updates in effect for the time period in question, and other factual information.

Actual delays that are found to be caused by the Contractor's own actions, which result in a calculated schedule delay, will not be a cause for an extension to the performance period, completion date, or any interim milestone date.

3.7.2. Submission Requirements

Submit a justification for each request for a change in the contract completion date of less than 2 weeks based upon the most recent schedule update at the time of the NTP or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

3.7.2.1. A list of affected activities, with their associated project schedule activity number.

3.7.2.2. A brief explanation of the causes of the change

3.7.2.3. An analysis of the overall impact of the changes proposed.

3.7.2.4. A sub-network of the affected area

Identify activities impacted in each justification for change by a unique activity code contained in the required data file.

3.7.3. Additional Submission Requirements

The Contracting Officer may request an interim update with revised activities for any requested time extension of over 2 weeks. Provide this disk within 4 days of the Contracting Officer's request.

3.7.4. If Progress Falls Behind the Approved Project Schedule

3.7.4.1. Should progress fall behind the approved schedule (more than 20 work days of negative float) due to Contractor generated problems, promptly provide a supplemental recovery or completion schedule that illustrates its efforts to regain time to assure a completion by the required contract completion date.

3.7.4.2. The supplemental recovery or completion schedule will not replace the original, approved schedule as the official contract schedule. Continue to update the original, approved schedule on at least a monthly basis. In addition, the Contractor and the Contracting Officer will monitor the supplemental recovery or completion schedule on at least a bi-weekly basis to determine its effect on regaining the rate of progress to assure project completion by the contractually required completion date.

3.7.4.3. Do not artificially improve progress by simply revising the schedule logic, modifying or adding constraints, or shortening future work activity durations. Resource and manpower load the supplemental recovery schedule or completion schedule with crew size and productivity for each remaining activity, indicating overtime, weekend work, and/or double shifts needed to regain the schedule, in accordance with FAR 52.236.15, without additional cost to the Government. Indicate assumptions made and the basis for any logic, constraint, or duration changes used in the creation of the supplemental recovery or completion schedule in a narrative submitted for the Contracting Officer's approval. Any additional resources or manpower must be evident at the work site. Do not modify the official contract schedule to include these assumptions.

3.7.4.4. Failure to perform work and maintain progress in accordance with the supplemental recovery or completion schedule may result in an interim and final unsatisfactory performance rating and/or may result in corrective action by the Contracting Officer in accordance with FAR 52.236-15.

3.8. DIRECTED CHANGES

If the NTP is issued for changes prior to settlement of price and/or time, submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The Contracting Officer will approve proposed revisions to the schedule prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor with suggested revisions to the project schedule. The Contractor shall include these revisions in the project schedule until revisions are submitted and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor shall continue to update the schedule with the Contracting Officer's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

3.9. WEEKLY PROGRESS MEETINGS

3.9.1. The Government and the Contractor shall meet weekly (or as otherwise mutually agreed to) between the meetings described in paragraph PERIODIC SCHEDULE UPDATE MEETINGS for the purpose of jointly reviewing the actual progress of the project as compared to the as planned progress and to review planned activities for the upcoming two weeks. The then current and approved schedule update shall be used for the purposes of this meeting and for the production and review of reports. The Contractor's Project Manager and the Authorized Representative of the Contracting Officer shall attend. The weekly progress meeting will address the status of RFI's, RFP's and Submittals.

3.9.2. Provide a bar chart produced by the scheduling software, organized by Total Float and Sorted by Early Start Date, and a two week "look-ahead" schedule by filtering all schedule activities to show only current ongoing activities and activities schedule to start during the upcoming two weeks, organized by Work Area Code (AREA) and sorted by Early Start Date.

3.9.3. The Government and the Contractor shall jointly review the reports. If it appears that activities on the longest path(s) which are currently driving the calculated completion date (driving activities), are not progressing satisfactorily and therefore could jeopardize timely project completion, corrective action must be taken immediately. Corrective action includes but is not limited to: increasing the number of work crews; increasing the number of work shifts; increasing the number of hours worked per shift; and determining if Government responsibility coded activities require Government corrective action.

3.10. OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

3.11. TRANSFER OF SCHEDULE DATA INTO RMS/QCS

Download and upload the schedule data into the Resident Management System (RMS) prior to RMS databases being transferred to the Government and is considered to be additional supporting data in a form and detail required by the Contracting Officer pursuant to FAR 52.232-5 - Payments under Fixed-Price Construction Contracts. The receipt of a proper payment request pursuant to FAR 52.232-27 - Prompt Payment for Construction Contracts is contingent upon the Government receiving both acceptable and approvable hard copies and electronic export from QCS of the application for progress payment.

End of Section 01 32 01.00 10

SECTION 01 33 00
SUBMITTAL PROCEDURES

1.0 GENERAL

1.1. DEFINITIONS

1.1.1. Submittal

Contract Clauses "FAR 52.236-5, Material and Workmanship," paragraph (b) and "FAR 52.236-21, Specifications and Drawings for Construction," paragraphs (d), (e), and (f) apply to all "submittals."

1.1.2. Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by SD numbers and titles as follows.

SD-01 Preconstruction Submittals

- Certificates of insurance.
- Surety bonds.
- List of proposed subcontractors.
- List of proposed products.
- Construction Progress Schedule.
- Submittal register.
- Schedule of prices.
- Accident Prevention Plan.
- Work plan.
- Quality control plan.
- Environmental protection plan.

SD-02 Shop Drawings

- Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.
- Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.
- Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

SD-03 Product Data

- Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials or equipment for some portion of the work.
- Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

- Physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.
- Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.
- Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies that are to be incorporated into the project and those which will be removed at conclusion of the work.

SD-05 Design Data

- Calculations, mix designs, analyses or other data pertaining to a part of work.
- Design submittals, design substantiation submittals and extensions of design submittals.

SD-06 Test Reports

- Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)

- Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.
- Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.
- Investigation reports.
- Daily checklists.
- Final acceptance test and operational test procedure.

SD-07 Certificates

- Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.
- Document required of Contractor, or of a supplier, installer or subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.
- Confined space entry permits.
- Text of posted operating instructions.

SD-08 Manufacturer's Instructions

- Preprinted material describing installation of a product, system or material, including special notices and Material Safety Data sheets concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

- Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- Factory test reports.

SD-10 Operation and Maintenance Data

- Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

SD-11 Closeout Submittals

- Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

1.1.3. Approving Authority

Office authorized to approve submittal.

1.1.4. Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.2. NOT USED

1.3. SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.3.1. Designer of Record Approved (DA)

1.3.1.1. Designer of Record (DOR) approval is required for all extensions of design, critical materials, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction", they are considered to be "shop drawings". Provide the Government the number of copies designated hereinafter of all DOR approved submittals, after the DOR has taken appropriate action. The DOR shall ensure that submittals conform to the Solicitation, the Accepted Proposal and the completed design, however see below for those submittals proposing a deviation to the contract or a substitution of a material, system, or piece of equipment that was identified by manufacturer, brand name or model description in the accepted contract proposal.

1.3.1.2. The DOR shall ensure that the submittals comply with all applicable Buy American Act and Trade Agreement Act clauses in the contract. The DOR may confer with the Contracting Officer's Representative for advice and interpretation of those clauses, as necessary.

1.3.1.3. The Government may, but is not required to, review any or all DOR approved submittals for conformance to the solicitation, accepted proposal and the completed design. Except for submittals designated as deviating from the Solicitation, the Accepted Proposal or completed design, the Contractor may proceed with acquisition and installation upon DOR approval. Government Approved (GA)

1.3.2. Government Approved (GA)

Government approval is required for any item specifically designated as requiring Government approval in the Solicitation, for internal and external color finish selections and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," they are considered to be "shop drawings."

1.3.3. Government Conformance Review of Design (CR)

The Government will review all intermediate and final design submittals for conformance with the technical requirements of the solicitation. Section 01 33 16 **DESIGN AFTER AWARD** covers the design submittal and review process in detail. Review will be only for conformance with the applicable codes, standards and contract requirements. Design data includes the design documents described in Section 01 33 16 **DESIGN AFTER AWARD**. Generally, design submittals should be identified as SD-05 Design Data submittals.

1.3.4. Designer of Record Approved/Government Conformance Review (DA/CR)

1.3.4.1. Deviations to the Accepted Design. Designer of Record approval and the Government's concurrence are required for any proposed deviation from the accepted design which still complies with the contract (the Solicitation and Accepted Proposal) before the Contractor is authorized to proceed with material acquisition or installation. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction", they are considered to be "shop drawings." If necessary to facilitate the project schedule, the Contractor and the DOR may discuss a submittal proposing a deviation with the Contracting Officer's Representative prior to officially submitting it to the Government. However, the Government reserves the right to review the submittal before providing an opinion, if it deems it necessary. In any case, the Government will not formally agree to or provide a preliminary opinion on any deviation without the DOR's approval or recommended approval. The Government reserves the right to non-concur with any deviation from the design, which may impact furniture, furnishings, equipment selections or operations decisions that were made, based on the reviewed and concurred design.

1.3.4.2. Substitutions. Unless prohibited or provided for otherwise elsewhere in the Contract, where the accepted contract proposal named products, systems, materials or equipment by manufacturer, brand name and/or by model number or other specific identification, and the Contractor desires to substitute manufacturer or model after award, submit a requested substitution for Government concurrence. Include substantiation, identifying information and the DOR's approval, as meeting the contract requirements and that it is equal in function, performance, quality and salient features to that in the accepted contract proposal.

1.3.5. Designer of Record Approved/Government Approved (DA/GA)

Any proposed deviation to the solicitation and/or the accepted proposal constitutes a change to the contract. In addition to the above stated requirements for proposed deviations to the accepted design, both Designer of Record and Government Approval and, where applicable, a contract modification are required before the Contractor is authorized to proceed with material acquisition or installation for any proposed deviation to the contract. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction", they are considered to be "shop drawings". The Government reserves the right to accept or reject any such proposed deviation at its discretion.

1.3.6. Information Only

All submittals not requiring Designer of Record or Government approval will be for information only. Provide the Government “For Information Only” copies of all submittals not requiring Government approval or concurrence, after the Designer of Record has taken the appropriate action.

1.4. APPROVED OR CONCURRED WITH SUBMITTALS

Do not construe the Contracting Officer's approval of or concurrence with submittals as a complete check, but only that design, general method of construction, materials, detailing and other information appear to meet the Solicitation and Accepted Proposal. Approval or concurrence will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for design, dimensions, all design extensions, such as the design of adequate connections and details, etc., and the satisfactory construction of all work. The Government won’t consider re-submittals for the purpose of substituting previously approved materials or equipment unless accompanied by an explanation of why a substitution is necessary.

1.5. DISAPPROVED SUBMITTALS

Make all corrections required by the Contracting Officer, obtain the Designer of Record's approval when applicable, and promptly furnish a corrected submittal in the form and number of copies specified for the initial submittal. Resubmit any "information only" submittal found to contain errors or unapproved deviations from the Solicitation or Accepted Proposal as one requiring "approval" action, requiring both Designer of Record and Government approval. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, provide prompt notice in accordance with the Contract Clause "Changes" to the Contracting Officer.

1.6. WITHHOLDING OF PAYMENT

No payment for materials incorporated in the work will be made if all required Designer of Record or required Government approvals have not been obtained. No payment will be made for any materials incorporated into the work for any conformance review submittals or information only submittals found to contain errors or deviations from the Solicitation or Accepted Proposal.

1.7. GENERAL

Make submittals as required by the specifications. The Contracting Officer may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections. Units of weights and measures used on all submittals shall be the same as those used in the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. Prior to submittal, the Contractor’s Quality Control (CQC) System Manager and the Designer of Record, if applicable, shall check, approve, sign, and stamp all items, indicating action taken. Clearly idenify proposed deviations from the contract requirements. Include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals. Schedule and make submittals requiring Government approval prior to the acquisition of the material or equipment covered thereby. Pick up and dispose of samples remaining upon completion of the work in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

1.8. SUBMITTAL REGISTER (GA)

Develop a complete list of submittals, including each separate design package submittal. Submit the initial submittal register within 15 days after Notice to Proceed, including, as a minimum, the design packages and other initial submittals required elsewhere in the contract. The Designer of Record shall identify required submittals in the specifications, and use the list to prepare the Submittal Register, utilizing the government-provided software, QCS (see Section 01 45 01.10), to create the ENG Form 4288. Appendix Ris a preliminary submittal register input form for use with the Quality Management System and the Resident Office Management System (QCS and RMS). The Government will provide the Contractor the actual Excel Spreadsheet version of this sample input form after award to modify and to use for input into QCS. The Excel Spreadsheet is not totally inputable into QCS, so additional keystroke input will be necessary. The sample input form is not all-inclusive. In addition, additional submittals may be required by other parts of the contract. After award, the parties will meet to discuss contract specific (or task order specific for a task order contract) distribution for the submittals all-inclusive and additional submittals may be required by other parts of the contract. Develop and complete the submittal register as the design is completed. Submit it to the Contracting Officer with the un-reviewed final design package submission or as soon as the design specifications are completed, if before the final design submission. When applicable, if the Contractor elects to fast track design and construction, using multiple design package submissions,update the submittal register to reflect the submittals associated with each design submission, clearly denoting all revisions to the previous submission. The submittal register serves as a scheduling document for submittals and for control of submittal actions throughout the contract period. Coordinate the submit dates and need dates used in the submittal register with dates in the Contractor prepared progress schedule. Submit montly updates to the submittal register showing the Contractor action codes and actual dates with Government action codes and actual dates or until all submittals have been satisfactorily completed. Revise and submit the submittal register when revising the progress schedule.

1.9. SCHEDULING

Schedule submittals covering component items forming a system or items that are interrelated to be coordinated and submitted concurrently. Schedule certifications to be submitted with the pertinent drawings. Allow adequate time (a minimum of 15 calendar days exclusive of mailing time) and show on the register for those items requiring Government approval or concurrence. No delay damages or time extensions will be allowed for time lost in late submittals by the Contractor.

1.10. TRANSMITTAL FORM (ENG FORM 4025)

Use the transmittal form (ENG Form 4025) for submitting submittals in accordance with the instructions on the reverse side of the form. These forms will be furnished to the Contractor or are included in the QCS software if the Contractor is required to use QCS for this contract. Use a separate transmittal form for each specification section Complete this form by filling out all the heading blank spaces and identify each item submitted. Exercise special care to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.

1.11. SUBMITTAL PROCEDURES

Make submittals as follows:

1.11.1. Procedures

The Government will further discuss detailed submittal procedures with the Contractor at the Post-Award Conference.

1.11.2. Deviations

For submittals which include proposed deviations requested by the Contractor, check the column "variation" of ENG Form 4025. Set forth in writing the reason for any deviations and annotate such deviations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations.

1.12. CONTROL OF SUBMITTALS

Carefully control his procurement operations to ensure that each individual submittal is made on or before the scheduled submittal date shown on the approved "Submittal Register."

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 six (6) copies of the submittal and return zero(0) 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 zero(0) copies of information only submittals.

1.15. STAMPS

Use stamps similar to the following on the submittal data to certify that the submittal meets contract requirements:

CONTRACTOR

(FIRM NAME)

__________ Approved

__________ Approved with corrections as noted on submittal data and/or attached sheet(s)

Signature: ______________________________

Title: ______________________________

Date: ______________________________

For design-build construction, both the Contractor Quality Control System Manager and the Designer of Record shall stamp and sign to certify that the submittal meets contract requirements.

SECTION 01 33 16
DESIGN AFTER AWARD

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 shall be accounted for by a listed. 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. 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.

3.5.3. 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 90.1-2004 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 (use only one source) such as MASTERSPEC from the American Institute of Architects, SPECTEXT from Construction Specification Institute or Unified Facility Guide Specifications (UFGS using MASTERFORMAT 2004 numbering system), etc. (including specifications from these sources). 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).

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

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

(a) Outside Plant (OSP) Cabling - Campus or Site Plans - Exterior Pathways and Inter-Building Backbones

(a) 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.

(b) Layout of complete building per floor - Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways including Serving Zones Drawings - Drop Locations and Cable ID's

(c) 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** Full Sets/ *Partial Sets	Design Analyses & Specs Full Sets/ *Partial Sets	Drawing Size (Half Size) **Half size** 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 **[Not Supplied - DistrictInfoGeneral : CONSTRUCTION_DISTRICT]**	1/0	1/0	1/0	1	1	1	1
Commander, U.S.Army Engineer District, Center of Standardization **Fort Worth**	1/0	1/0	1/0	6	N/A	1	1
Installation	2/0	11/0	11/0	5	2	2	2
U.S.Army Corps of Engineers Construction Area Office	1/0	5/0	5/0	5	1	1	1
Information Systems Engineering Command (ISEC)	0/0	0/0	0/0	1	N/A	N/A	1
Other Offices	0/0	0/0	0/0	0	N/A	0	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

Except for full or half-sized drawings for Installation personnel, as designated in the Table above, 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 six (6) 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 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) Manufacturer, Product name and Product model number or National Stock Number (NSN)

(f) Finish name and number (code to finish samples)

(g) Fabric name and number, minimum Wyzenbeek Abrasion Test double rubs (code to fabric samples)

(h) Dimensions

(i) Item location by room number and room name

(j) Quantity per room

(k) Total quantity

(l) Special instructions for procurement ordering and/or installation (if applicable)

(m) 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. Alternate Manufacturer List

Provide a table consisting of major furniture items that lists the manufacturers products specified on the Order Form and two alternate manufacturers. Major furniture items include, but are not limited to, casegoods, furniture systems, seating, and tables. Organize matrix by item code and item name. Supply alternates that are available on GSA Schedule and meet the requirements of the Furniture Order Form. One of the two alternates must be from UNICOR if possible. Provide manufacturer name address, telephone number, product series and product name for each alternate manufacturer.

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.

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 use 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, elevations or 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, elevation or 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. Specify workstations and storage of steel construction. Provide worksurface tops constructed to prevent warpage. 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 industrial shelving, workbenches, 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 industrial shelving, workbenches, 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 (except worksurfaces) with mitered solid wood edge of same wood type. Provide worksurface plastic laminate that closely matches adjacent wood veneer. 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. Universal casters that are appropriate for both hard surface flooring and carpet are preferred. All seating shall support up to a minimum of 250 lbs.

1.11.2. Desk and Guest Seating

Select ergonomic desk chairs with casters, non-upholstered adjustable arms, 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.

1.11.6. Lounge, Waiting and Reception Furniture.

Design for end and coffee tables with plastic laminate tops that are compatible in style finish and color with the seating.

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.

Don’t use plastic laminate self edge. Training tables shall be reconfigurable, moveable and storable; lighter weight folding with dollies or castered as necessary. Specify dollies if 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
Desks - 10 year minimum
Seating, unless otherwise noted - 10 year minimum
Seating Mechanisms and Pneumatic Cylinders - 10 years
Fabric - 3 years minimum
Filing and Storage - 10 year minimum
Tables, unless otherwise noted - 10 year minimum
Table Mechanisms – 5 year
Table Ganging Device - 1 year
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 reviewers enter design review comments into DrChecks. Designers of Record shall annotate comments timely and specifically to indicate exactly what action will be taken or why the action is not required. 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 agreed to by the designers and reviewers prior to the next submittal. The DrChecks comments and responses shall be printed and included in the design analysis for record.

2.1. 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.

2.2. The Designers of Record shall answer each comment in DrChecks with a formal response prior to the next submittal, clearly indicating what action will be taken and what drawing/spec will change. 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 design conference, reviewers will back-check answers to the comments against the submittal, in addition to reviewing additional design work.

2.3. Comments that, in the DB Contractor's opinion, require effort outside the scope of the contract shall be clearly indicated as such in DrChecks. The DB Contractor shall 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 designers 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

The role of the designers of record is to evaluate and respond to the comments entered by the Government reviewers and by the DB Contractor. 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 (concur, non-concur, for information only, or check and resolve) and add the response.

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 Back-check

At the following design conference, participants will back-check comment annotations against newly presented documents to verify that the designers' responses are acceptable and completed. The Contractor and Government reviewers shall either enter additional back-check comments, as necessary or close those that are resolved as a result of the design conferences:

6.1. Log into DrChecks.

6.2. Click on the appropriate project.

6.3. Under “My Backcheck” click on the number under “Pending”.

6.4. If you agree with the designer’s response select “Close Comment” and add a closing response if desired.

6.5. 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.

6.6. Click on the Add button. The back-check will be added to the database and a fresh screen will appear with the next comment.

6.7. 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 v2.2 Submittals (OCT09REV)**		Provide for Credit Audit Only		Date Submitted (to be filled in by Contractor)	Government Reviewer's Use (OCT09REV)
PAR		**FEATURE**	**DUE AT**		**REQUIRED DOCUMENTATION**	**DATE**	**REV**
GENERAL							
	GENERAL - All calculations shall be in accordance with LEED 2.2 Reference Guide.						
	GENERAL: Obtain excel version of this spreadsheet at http://en.sas.usace.army.mil/enWeb, "Engineering Criteria". OCT09REV						
	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. OCT09REV						
	OCT09REV 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
OCT09REV			**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
OCT09REV			**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
OCT09REV			**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
OCT09REV			**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
OCT09REV			**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
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
OCT09REV			**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

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PAR		FEATURE	DUE AT		REQUIRED DOCUMENTATION	DATE	REV
			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
OCT09REV			**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
OCT09REV			**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
OCT09REV			**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
OCT09REV			**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
OCT09REV			**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
OCT09REV			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
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

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			Final Design OCT09REV		Option 1: List of specified roof materials indicating, for each, product type, manufacturer, product name and identification if known, SRI value and roof slope. OCT09REV		ARC
			**Closeout OCT09REV		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 OCT09REV		Option 3: List of specified roof materials indicating, for each, product type, manufacturer, product name and identification if known, SRI value and roof slope. OCT09REV		
			**Closeout OCT09REV		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 that turn off non-essential lighting during non-business hours.		ELEC
OCT09REV			**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							
WE1.1		Water Efficient Landscaping: Reduce by 50%	Final Design		Statement indicating which option for compliance applies.		CIV
OCT09REV			**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

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			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
WE3.1		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
			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
WE3.2		Water Use Reduction: 30% Reduction	Same as WE3.1		Same as WE3.1		MEC
CATEGORY 3 – ENERGY AND ATMOSPHERE							
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

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			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
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 2.2 Reference Guide Example Calculations		MEC
			Final Design		Narrative describing any special circumstances or explanatory remarks OCT09REV		
			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		PE
			Closeout		**Scope of work for post-occupancy implementation of M&V 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 75% 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 95% of Existing Walls, Floors & Roof	Same as MR1.1		Same as MR1.1		ARC
MR1.3		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
					OCT09REV		
			**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. OCT09REV		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 OCT09REV		**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal. OCT09REV		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 OCT09REV		**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal. OCT09REV		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. OCT09REV		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
CATEGORY 5 – 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
			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

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			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: Carpet Systems	Closeout		Spreadsheet indicating, for each indoor carpet 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 CRI 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 OCT09REV		Spreadsheet indicating, for each permanent entryway system used, the manufacturer, product name/model number and description of system. Roll-up and carpet systems requiring weekly cleaning to earn this credit are not a permitted option for Army projects.		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
			Closeout OCT09REV		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

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	LEED-NC v2.2 Submittals (OCT09REV)		Provide for Credit Audit Only		Date Submitted (to be filled in by Contractor)	Government Reviewer's Use (OCT09REV)
PAR		FEATURE	DUE AT		REQUIRED DOCUMENTATION	DATE	REV
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
EQ8.1		Daylight & Views: Daylight 75% of Spaces	Final Design		Option 1: Table indicating all regularly occupied spaces with space area and space area with 2% daylighting factor. Sum of regularly occupied areas and regularly occupied areas with 2% daylighting factor. Percentage calculation of areas with 2% daylighting factor to total regularly occupied areas.		ARC
			Final Design		Option 1: Glazing factor calculation table		ARC
			Final Design		Option 2: Simulation model method, software and output data		ARC
			Final Design		Option 2: 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.		ARC
			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 and glazing performance properties.		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
CATEGORY 6 – FACILITY DELIVERY PROCESS							
IDc1.1		Innovation in Design	Final Design OCT09REV		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 OCT09REV				
IDc1.3		Innovation in Design	Final Design OCT09REV				
IDc1.4		Innovation in Design	Final Design OCT09REV				
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 07-07-2010

BUILDING INFORMATION MODELING REQUIREMENTS

1.0 Section 1 - Submittal Format

1.1. Design Deliverables. Develop all designs using Building Information Modeling (BIM) and Computer Aided Design (CAD) software. Design submittal drawings shall be Full size, suitable for half-size scaled reproduction.

2.0 Section 2 – Design Requirements

2.1. BIM Model and Facility Data. Contractor shall use BIM application(s) and software(s) to develop project designs. "Facility Data" is defined as associated intelligent attribute data. The "Model" is defined as 3D graphics that includes Facility Data and output as described in the paragraph 'Output' below. Contractors will use the Model to produce accurate Construction Documents. For each Center of Standardization (CoS) facility type included in this project, all BIM Models and associated Facility Data shall be submitted in Bentley Systems BIM [Not Supplied - SubmittalReqCADDSystem : BENTLEY_VERSION] with associated USACE Bentley BIM Workspace (which includes specific standard BIM libraries and definitions). This Workspace can be downloaded from the CAD/BIM Technology Center. [Where available, the workspace will be specific to this CoS Facility Standard Design. The Contractor will be provided a baseline multi-discipline BIM Project Model for the CoS Facility Standard Design type, where such a model exists (for the purposes of site adaptation).] The USACE Bentley BIM Workspace is dependent on specific versions of the Bentley BIM suite of products and only the versions of the software that are listed in the Contractor instructions included with the USACE BIM Workspace are permitted to be used.

2.1.1. 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.

2.2. Drawings. Deliver CAD files used for the creation of the Construction Documents Drawings per requirements in Section 01 33 16, the criteria of the USACE [Not Supplied - DistrictInfoGeneral : ISSUING_DISTRICT] District, and as noted herein. Specification of a CAD file format for these Drawings does not limit which BIM application(s) or software(s) may be used for project development and execution.

2.2.1. IFC Support. The Contractor's selected BIM application(s) and software(s) must support the IFC (Industry Foundation Class - see www.iai-tech.org). Submit any deviations from or additions to the IFC property sets for any new spaces, systems, and equipment for Government approval.

2.2.2. Submittal Requirements. BIM submittals shall be fully interoperable, compatible, and editable with the Bentley BIM tools. Use the specified version of the USACE Bentley BIM Workspace and conform to the requirements of **Sections 3 and 4 below**.

2.2.3. BIM Project Execution Plan.

2.2.3.1. Develop a BIM Project Execution Plan ("Plan" or "PxP") documenting the BIM and analysis technologies selected for the Project Model (integrated with the AEC CAD Standard) from concept development through As-Builts as a design, production, coordination, construction, and documentation tool and the collaborative process by which it shall be executed. See Section 7 for additional guidance on developing the Plan.

2.2.4. BIM Requirements..

2.2.4.1. Facility Data. Develop the Facility Data consisting of a set of intelligent elements for the Model (e.g., doors, air handlers, electrical panels). This Facility Data shall include all material definitions and attributes that are necessary for the Project facility design and construction. Additional data in support of Section 6 Contractor Electives is encouraged.

2.2.4.2. Model Content. The Model and Facility Data shall include, at a minimum, the requirements of Section 4 below.

2.2.4.3. Model Granularity. Models may vary in level of detail for individual elements within a 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 appropriately scaled civil drawings.

2.2.4.4. Output. Submitted CAD drawings (e.g., plans, elevations, sections, schedules, details, etc.) shall be derived (commonly known as extractions, views or sheets) and maintained from the submitted Model and Facility Data.

2.3. Quality Control. Implement quality control (QC) parameters for the Model, including:

2.3.1. Model Standards Checks. QC validation used to ensure that the Project Facility Data set has no undefined, incorrectly defined or duplicated elements. Report non-compliant elements and corrective action plan to correct non-compliant elements. Provide the government with detailed justification and request government approval for any non-compliant element which the contractor proposes to be allowed to remain in the Model.

2.3.2. CAD Standards Checks. QC checking performed to ensure that the fonts, dimensions, line styles, levels and other construction document formatting issues are followed per the A/E/C CADD Standard.

2.3.3. Other Parameters. Develop such other QC parameters as Contractor deems appropriate for the Project and provide to the Government for concurrence.

2.4. Design and Construction Reviews. Perform design and construction reviews at each submittal stage under Section 3 to test the Model, including:

2.4.1. Visual Checks. Checking to ensure the design intent has been followed and that there are no unintended elements in the Model.

2.4.2. 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) in a written report and resolve.

2.4.3. 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.

2.4.4. Other Parameters. Develop such other Review parameters as the Contractor deems appropriate for the Project and provide to the Government for concurrence..

3.0 Section 3 – Design Stage Submittal Requirements

3.1. General Submittal Requirements.

3.1.1. Provide submittals in compliance with BIM Project Execution Plan deliverables at stages as described hereinafter.

3.1.2. At each Stage in Paragraphs 3.3 through 3.6, provide a Contractor-certified written report confirming that consistency checks as identified in Paragraphs 2.3 and 2.4 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 Stage in Paragraphs 3.3 through 3.6, provide the Government with:

- The Model, Facility Data, Workspace and CAD Data files in native Bentley BIM/CAD.

- A 3-D interactive review format of the Model in Bentley Navigator, Autodesk Navisworks, Adobe 3D PDF 7.0 (or later), Google Earth KMZ or other format per Plan requirements. The file format for reviews can change between submittals.

- A list of all submitted files. The list should include a description, directory, and file name for each file submitted. For all CAD sheets, include the sheet title and sheet number. Identify files that have been produced from the submitted Model and Facility Data.

3.1.4. The Government will confirm acceptability of all submittals identified in Section 3 in coordination with the USACE [Not Supplied - DistrictInfoGeneral : ISSUING_DISTRICT] BIM Manager

3.2. Initial Design Conference Submittal.

3.2.1. Submit a digital copy of the Plan 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.

3.2.2. Within thirty (30) days after the approval of the Plan, conduct a demonstration to review the Plan for clarification, and to verify the functionality of Model technology workflow and processes. If modifications are required, the Contractor shall complete the modifications and resubmit the Plan and perform subsequent demonstration for Government acceptance. There will be no payment for design or construction until the Plan is acceptable to the Government. The Government may also withhold payment for design and construction for unacceptable performance in executing the approved Plan.

3.3. Interim Design Submittals.

3.3.1. BIM and CAD Data. The Model shall include the requirements identified in Paragraph 2.2.4 as applicable to the Interim Design package(s).

3.4. Final Design Submissions and Design Complete Submittals.

3.4.1. BIM and CAD Data. The Model shall include the requirements identified in Paragraph 2.2.4. 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-Builts BIM and CAD Data Submittal. Submit the final Model, Facility Data, and CAD files reflecting as-built conditions for Government Approval, 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 deliverable Model shall be developed to include the systems described below as they would be built and the processes of installing them, and to reflect final as-built 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 accurate net square footage and net volume, and holding data for the room finish schedule for including room names and numbers. Include Programmatic Information provided by the Government or validated program 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 shall be developed in the structural Model and then referenced by the architectural Model for each floor of the Project building.

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 generic 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 and Woodwork. All architectural specialties (i.e., toilet room accessories, toilet partitions, grab bars, lockers, and display cases) and woodwork (i.e., cabinetry and counters) shall be accurately depicted with the necessary intelligence to produce accurate plans, elevations and sections 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 systems Model may vary in level of detail for individual elements within a Model, 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 within a Model. Equipment shall be depicted to meet layout requirements with the necessary intelligence to produce accurate plans and minimum schedules depicting their configuration. 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, including 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 and related building/wall sections.

4.5.4. Cast-in-Place Concrete. All walls, columns, and 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. The structural Model shall include all necessary openings and 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. The structural Model shall include all necessary shafts, pits, and openings, including necessary intelligence to produce accurate plans and building/wall sections depicting these design elements.

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 in the model. Additional minimum Model requirements include:

4.6.1. HVAC. All necessary heating, ventilating, air-conditioning and specialty equipment, including air distribution ducts for supply, return, and ventilation and exhaust ducts, including control system, 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 HVAC and Plumbing equipment clearances shall be modeled for use in interference management and maintenance access requirements.

4.6.4. Elevator Equipment. The Model shall include the necessary equipment and control system, including necessary intelligence to produce accurate plans, sections and elevations depicting these design elements.

4.7. Electrical/Telecommunications. The electrical 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 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 Systems. All necessary special electrical components (i.e., security, Mass Notification, Public Address, nurse call and other special occupancies, and control systems), including necessary intelligence to produce accurate plans, details and schedules.

4.7.3. Grounding Systems. Grounding Systems. All necessary grounding components (i.e., lightning protection systems, static grounding systems, communications grounding systems, bonding), including necessary intelligence to produce accurate plans, details and schedules.

4.7.4. Communications. All existing and new communications 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 with necessary intelligence to produce accurate plans, elevations and schedules. The exterior building lighting Model shall include all necessary lighting, relevant existing and proposed support utility lines and equipment required with necessary intelligence to produce accurate plans, details and schedules.

4.7.6. Equipment Clearances. The model shall incorporate and define all electrical and communications working spaces, clearances, and required access

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, on the Project site with necessary connections to mains or other distribution points as appropriate, including necessary intelligence to produce accurate plans and profiles for the Project site.

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 and parking lots or 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 during the source selection, as described in the proposal submission requirements and evaluation criteria, the following criteria are requirements, as applicable to those elective feature(s).

6.2. COBIE Compliance. The Model and Facility Data for the Project shall fulfill Construction Operations Building Information Exchange (COBIE) requirements as defined by the Whole Building Design Guide organization, including all requirements for the indexing and submission of Portable Document Format (PDF) and other appropriate file formats 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 BIM Execution Plan and during the Preliminary BIM Execution Plan Review, 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 Submittal stages, the Contractor shall deliver the construction schedule with information 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 BIM Execution Plan and during the Preliminary BIM Execution Plan Review, provide an overview of the use of BIM in the development and support of cost estimating requirements, or other applications such as cost analysis and estimate validation.

6.4.1. Submittal Requirements. During the Submittal stages, the Contractor shall deliver cost estimating information derived from the Model.

6.4.2. Project completion. At project completion, the Contractor shall provide an MII (Micro Computer Aided Cost Estimating System Generation II) Cost Estimate which 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 BIM output to the maximum extent possible, though other "Gap" quantity information will be included as necessary for a complete and accurate cost estimate.

6.4.2.1. Sub system level extracted quantities from the BIM 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. Therefore, when developing a BIM, the designer shall be cognizant of what tasks need to be separated appropriately at the beginning stages of model development, such as tasks done 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 BIM shall be broken done by their location (proximity in the structure) as well as the complexity of its installation.

6.4.2.2. At all design stages it shall be understood that BIM output as described in this document 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. An example of this would be plumbing that is less than 1.5" diameter and therefore not expected to be modeled due to granularity; this information is commonly referred to as The Gap. Quantities from The Gap and their associated costs shall be included in the final project actual cost estimates as well.

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.

7.0 Section 7 – BIM Project Execution Plan Template

7.1. Contractors will utilize the latest version of the USACE BIM PROJECT EXECUTION PLAN (USACE PxP) Template to develop an acceptable Plan. The template can be downloaded from the CAD/BIM Technology Center website.

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).	

SECTION 01 45 01.10
QUALITY CONTROL SYSTEM (QCS)

1.0 GENERAL

The Government will use the Resident Management System for Windows (RMS) to assist in its monitoring and administration of this contract. The Contractor shall use the Government-furnished Construction Contractor Module of RMS, referred to as QCS, to record, maintain, and submit various information throughout the contract period. The Contractor module, user manuals, updates, and training information can be downloaded from the RMS web site. This joint Government-Contractor use of RMS and QCS will facilitate electronic exchange of information and overall management of the contract. QCS provides the means for the Contractor to input, track, and electronically share information with the Government in the following areas:

- Administration
- Finances
- Quality Control
- Submittal Monitoring
- Scheduling
- Import/Export of Data
- Request for Information
- Accident Reporting
- Safety Exposure Manhours

1.1. CORRESPONDENCE AND ELECTRONIC COMMUNICATIONS

For ease and speed of communications, both Government and Contractor will exchange correspondence and other documents in electronic format. Correspondence, pay requests and other documents comprising the official contract record shall also be provided in paper format, with signatures and dates where necessary. Paper documents will govern, in the event of discrepancy with the electronic version.

1.2. OTHER FACTORS

Particular attention is directed to Contract Clause, "Schedules for Construction Contracts", Contract Clause, "Payments", Section 01 32 01.00 10, PROJECT SCHEDULE, Section 01 33 00, SUBMITTAL PROCEDURES, and Section 01 45 04.00 10, CONTRACTOR QUALITY CONTROL, which have a direct relationship to the reporting to be accomplished through QCS. Also, there is no separate payment for establishing and maintaining the QCS database; all costs associated therewith shall be included in the contract pricing for the work.

1.3. QCS SOFTWARE

QCS is a Windows-based program that can be run on a stand-alone personal computer or on a network. The Government will make available the QCS software to the Contractor after award of the construction contract. Prior to the Pre-Construction Conference, the Contractor shall be responsible to download, install and use the latest version of the QCS software from the Government's RMS Internet Website. Upon specific justification and request by the Contractor, the Government can provide QCS on CD-ROM. Any program updates of QCS will be made available to the Contractor via the Government RMS Website as they become available.

1.4. SYSTEM REQUIREMENTS

The following listed hardware and software is the minimum system configuration that the Contractor shall have to run QCS:

(a) Hardware

- IBM-compatible PC with 1000 MHz Pentium or higher processor
- 256 MB RAM for workstation / 512+ MB RAM for server
- 1 GB hard drive disk space for sole use by the QCS system
- Compact disk (CD) Reader, 8x speed or higher
- SVGA or higher resolution monitor (1024 x 768, 256 colors)
- Mouse or other pointing devise
- Windows compatible printer (Laser printer must have 4+ MB of RAM)
- Connection to the Internet, minimum 56K BPS

(b) Software

- MS Windows 2000 or higher
- MS Word 2000 or newer
- Latest version of : Netscape Navigator, Microsoft Internet Explorer, or other browser that supports HTML 4.0 or higher
- Electronic mail (E-mail), MAPI compatible
- Virus protection software that is regularly upgraded with all issued manufacturer's updates

1.5. RELATED INFORMATION

1.5.1. QCS USER GUIDE

After contract award, the Contractor shall download instructions for the installation and use of QCS from the Government RMS Internet Website. In case of justifiable difficulties, the Government will provide the Contractor with a CD-ROM containing these instructions.

1.5.2. CONTRACTOR QUALITY CONTROL (CQC) TRAINING

The use of QCS will be discussed with the Contractor's QC System Manager during the mandatory CQC Training class.

1.6. CONTRACT DATABASE

Prior to the pre-construction conference, the Government will provide the Contractor with basic contract award data to use for QCS. The Government will provide data updates to the Contractor as needed, generally by using the government's SFTP repository built into QCS import/export function. These updates will generally consist of submittal reviews, correspondence status, QA comments, and other administrative and QA data.

1.7. DATABASE MAINTENANCE

The Contractor shall establish, maintain, and update data for the contract in the QCS database throughout the duration of the contract. The Contractor shall establish and maintain the QCS database at the Contractor's site office. Data updates to the Government, e.g., daily reports, submittals, RFI's, schedule updates, payment requests, etc. shall be submitted using the government's SFTP repository built into QCS export function. If permitted by the Contracting Officer, email or CD-ROM may be used instead (see Paragraph DATA SUBMISSION VIA CD-ROM). The QCS database typically shall include current data on the following items:

1.7.1. ADMINISTRATION

1.7.1.1. Contractor Information

The database shall contain the Contractor's name, address, telephone numbers, management staff, and other required items. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver Contractor administrative data in electronic format.

1.7.1.2. Subcontractor Information

The database shall contain the name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor must be listed separately for each trade to be performed. Each subcontractor/trade shall be assigned a unique Responsibility Code, provided in QCS. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver subcontractor administrative data in electronic format.

1.7.1.3. Correspondence

All Contractor correspondence to the Government shall be identified with a serial number. Correspondence initiated by the Contractor's site office shall be prefixed with "S". Letters initiated by the Contractor's home (main) office shall be prefixed with "H". Letters shall be numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C".

All Requests For Information (RFI) shall be exchanged using the Built-in RFI generator and tracker in QCS.

1.7.1.4. Equipment

The Contractor's QCS database shall contain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.7.1.5. Management Reporting

QCS includes a number of reports that Contractor management can use to track the status of the project. The value of these reports is reflective of the quality of the data input, and is maintained in the various sections of QCS. Among these reports are: Progress Payment Request worksheet, QA/QC comments, Submittal Register Status, Three-Phase Inspection checklists.

1.7.2. FINANCES

1.7.2.1. Pay Activity Data

The QCS database shall include a list of pay activities that the Contractor shall develop in conjunction with the design and construction schedule. The sum of all pay activities shall be equal to the total contract amount, including modifications. Pay activities shall be grouped by Contract Line Item Number (CLIN), and the sum of the activities shall equal the amount of each CLIN. The total of all CLINs equals the Contract Amount.

1.7.2.2. Payment Requests

All progress payment requests shall be prepared using QCS. The Contractor shall complete the payment request worksheet prompt payment certification, and payment invoice in QCS. The work completed under the contract, measured as percent or as specific quantities, shall be updated at least monthly. After the update, the Contractor shall generate a payment request report using QCS. The Contractor shall submit the payment request, prompt payment certification, and payment invoice with supporting data by using the government's SFTP repository built into QCS export function. If permitted by the Contracting Officer, E-mail or a CD-ROM may be used. A signed paper copy of the approved payment request is also required, which shall govern in the event of discrepancy with the electronic version.

1.7.3. Quality Control (QC)

QCS provides a means to track implementation of the 3-phase QC Control System, prepare daily reports, identify and track deficiencies, document progress of work, and support other contractor QC requirements. The Contractor shall maintain this data on a daily basis. Entered data will automatically output to the QCS generated daily report. The Contractor shall provide the Government a Contractor Quality Control (CQC) Plan within the time required in Section 01 45 04.00 10, CONTRACTOR QUALITY CONTROL. Within seven calendar days of Government acceptance, the Contractor shall submit a QCS update reflecting the information contained in the accepted CQC Plan: schedule, pay activities, features of work, submittal register, QC requirements, and equipment list.

1.7.3.1. Daily Contractor Quality Control (CQC) Reports

QCS includes the means to produce the Daily CQC Report. The Contractor may use other formats to record basic QC data. However, the Daily CQC Report generated by QCS shall be the Contractor's official report. Data from any supplemental reports by the Contractor shall be summarized and consolidated onto the QCS-generated Daily CQC Report. Daily CQC Reports shall be submitted as required by Section 01 45 04.00 10, CONTRACTOR QUALITY CONTROL. Reports shall be submitted electronically to the Government within 24 hours after the date covered by the report. The Contractor shall also provide the Government a signed, printed copy of the daily CQC report.

1.7.3.2. Deficiency Tracking

The Contractor shall use QCS to track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using QC punch list items. The Contractor shall maintain a current log of its QC punch list items in the QCS database. The Government will log the deficiencies it has identified using its QA punch list items. The Government's QA punch list items will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of both QC and QA punch list items.

1.7.3.3. QC Requirements

The Contractor shall develop and maintain a complete list of QC testing and required structural and life safety special inspections required by the International Code Council (ICC), transferred and installed property, and user training requirements in QCS. The Contractor shall update all data on these QC requirements as work progresses, and shall promptly provide this information to the Government via QCS.

1.7.3.4. Three-Phase Control Meetings

The Contractor shall maintain scheduled and actual dates and times of preparatory and initial control meetings in QCS.

1.7.3.5. Labor and Equipment Hours

The Contractor shall log labor and equipment exposure hours on a daily basis. This data will be rolled up into a monthly exposure report.

1.7.3.6. Accident/Safety Tracking Reporting

The Government will issue safety comments, directions, or guidance whenever safety deficiencies are observed. The Government's safety comments will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of the safety comments. In addition, the Contractor shall utilize QCS to advise the Government of any accidents occurring on the jobsite. This supplemental entry is not to be considered as a substitute for completion of mandatory notification and reports, e.g., ENG Form 3394 and OSHA Form 300.

1.7.3.7. Features of Work

The Contractor shall include a complete list of the features of work in the QCS database. A feature of work may be associated with multiple pay activities. However, each pay activity (see subparagraph "Pay Activity Data" of paragraph "Finances") will only be linked to a single feature of work.

1.7.3.8. Hazard Analysis

The Contractor shall use QCS to develop a hazard analysis for each feature of work included in its CQC Plan. The hazard analysis shall address any hazards, or potential hazards, that may be associated with the work

1.7.4. Submittal Management

The Government will provide the submittal register form, ENG Form 4288, SUBMITTAL REGISTER, in electronic format. The Contractor and Designer of Record (DOR) shall develop and maintain a complete list of all submittals, including completion of all data columns and shall manage all submittals. Dates on which submittals are received and returned by the Government will be included in its export file to the Contractor. The Contractor shall use QCS to track and transmit all submittals. ENG Form 4025, submittal transmittal form, and the submittal register update, ENG Form 4288, shall be produced using QCS. QCS and RMS will be used to update, store and exchange submittal registers and transmittals, but will not be used for storage of actual submittals.

1.7.5. Schedule

The Contractor shall develop a design and construction schedule consisting of pay activities, in accordance with Section 01 32 01.00 10, PROJECT SCHEDULE, as applicable. This schedule shall be input and maintained in the QCS database either manually or by using the Standard Data Exchange Format (SDEF) (see Section 01 32 01.00 10 PROJECT SCHEDULE). The updated schedule data shall be included with each pay request submitted by the Contractor.

1.7.5.1. Import/Export of Data

QCS includes the ability to export Contractor data to the Government and to import submittal register and other Government-provided data from RMS, and schedule data using SDEF.

1.8. IMPLEMENTATION

Contractor use of QCS as described in the preceding paragraphs is mandatory. The Contractor shall ensure that sufficient resources are available to maintain its QCS database, and to provide the Government with regular database updates. QCS shall be an integral part of the Contractor's management of quality control.

1.9. DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM

The Government-preferred method for Contractor's submission of QCS data is by using the government's SFTP repository built into QCS export function.. Other data should be submitted using E-mail with file attachment(s). For locations where this is not feasible, the Contracting Officer may permit use of CD-ROM for data transfer. Data on CDs shall be exported using the QCS built-in export function. If used, CD-ROMs will be submitted in accordance with the following:

1.9.1. File Medium

The Contractor shall submit required data on CD-ROMs. They shall conform to industry standards used in the United States. All data shall be provided in English.

1.9.2. Disk Or Cd-Rom Labels

The Contractor shall affix a permanent exterior label to each diskette and CD-ROM submitted. The label shall indicate in English, the QCS file name, full contract number, contract name, project location, data date, name and telephone number of person responsible for the data.

1.9.3. File Names

The files will be automatically named by the QCS software. The naming convention established by the QCS software shall not be altered in any way by the Contractor.

1.10. MONTHLY COORDINATION MEETING

The Contractor shall update the QCS database each workday. At least monthly, the Contractor shall generate and submit an export file to the Government with schedule update and progress payment request. As required in Contract Clause "Payments", at least one week prior to submittal, the Contractor shall meet with the Government representative to review the planned progress payment data submission for errors and omissions.

The Contractor shall make all required corrections prior to Government acceptance of the export file and progress payment request. Payment requests accompanied by incomplete or incorrect data submittals will be returned. The Government will not process progress payments until an acceptable QCS export file is received.

1.11. NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the requirements of this specification. 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.

End of Section 01 45 01.10

SECTION 01 45 04.00 10
CONTRACTOR QUALITY CONTROL

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 responsible for the overall construction activities at the site, including 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.

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.

3.2.3. 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 [Not Supplied - ConstructionReqQC : COURSE_LOCATION]. 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:

  COR will designate lab.

  [Not Supplied - ConstructionReqQC : LAB_ATTN]

  [Not Supplied - ConstructionReqQC : LAB_MAIL]

  [Not Supplied - ConstructionReqQC : LAB_STATE]
- For other deliveries:

  COR will designate lab.

[Not Supplied - ConstructionReqQC : LAB_ATTN_OTHER]

[Not Supplied - ConstructionReqQC : LAB_MAIL_OTHER]

[Not Supplied - ConstructionReqQC : LAB_STATE_OTHER]

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
TEMPORARY CONSTRUCTION FACILITIES

1.0 OVERVIEW

1.0 OVERVIEW

1.1. GENERAL REQUIREMENTS

1.1.1. Site Plan

Prepare a site plan indicating the proposed location and dimensions of any area to be fenced and used by the Contractor, the number of trailers to be used, avenues of ingress/egress to the fenced area and details of the fence installation. Identify any areas which may have to be graveled to prevent the tracking of mud. Also indicate if the use of a supplemental or other staging area is desired.

1.2. AVAILABILITY AND USE OF UTILITY SERVICES

1.2.1. See Section 00 72 00, Contract Clauses and Section 00 73 00, Special Contract Requirements, for Utility Availability requirements.

1.2.2. Sanitation

Provide and maintain within the construction area minimum field-type sanitary facilities approved by the Contracting Officer. Government toilet facilities will not be available to Contractor's personnel.

1.2.3. Telephone

Make arrangements and pay all costs for desired telephone facilities.

1.3. BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

1.3.1. Bulletin Board

Immediately upon beginning of onsite work, provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the Contracting Officer. Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, as approved by the Contracting Officer. Display legible copies of the aforementioned data until work is completed. Remove the bulletin board from the site upon completion of the project.

1.3.2. Project and Safety Signs

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.

1.4. PROTECTION AND MAINTENANCE OF TRAFFIC

Provide access and temporary relocated roads as necessary to maintain traffic. Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Take measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, as required by the State and local authorities having jurisdiction. Protect the traveling public from damage to person and property.

The Contractor's traffic on roads selected for hauling material to and from the site shall interfere as little as possible with public traffic. Investigate the adequacy of existing roads and the allowable load limit on these roads. Repair any damage to roads caused by construction operations.

1.4.1. Haul Roads

The Contractor shall, at its own expense, construct access and haul roads necessary for proper prosecution of the work under this contract. Construct haul roads with suitable grades and widths. Avoid sharp curves, blind corners, and dangerous cross traffic. Provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, shall be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads shall be subject to approval by the Contracting Officer. Provide adequate lighting to assure full and clear visibility for full width of haul road and work areas during any night work operations. Remove haul roads designated by the Contracting Officer upon completion of the work and restore those areas.

1.4.2. Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. Barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

1.5. MAINTENANCE OF CONSTRUCTION SITE

Mow grass and vegetation located within the boundaries of the construction site for the duration of the project, from NTP to contract completion. Edge or neatly trim grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers from NTP to contract completion.

End of Section 01 50 02

SECTION 01 57 20.00 10
ENVIRONMENTAL PROTECTION

1.0 GENERAL REQUIREMENTS

Minimize environmental pollution and damage that may occur as the result of construction operations. Protect the environmental resources within the project boundaries and those affected outside the limits of permanent work during the entire duration of this contract. Comply with all applicable environmental Federal, State, and local laws and regulations. The Contractor shall be responsible for any delays resulting from failure to comply with environmental laws and regulations

1.1. SUBCONTRACTORS

Ensure compliance with this section by subcontractors.

1.2. ENVIRONMENTAL PROTECTION PLAN

1.2.1. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Define issues of concern within the Environmental Protection Plan as outlined in this section. Address each topic in the plan at a level of detail commensurate with the environmental issue and required construction task(s). Identify and discuss topics or issues which are not identified in this section, but which the Contractor considers necessary, after those items formally identified in this section. Prior to commencing construction activities or delivery of materials to the site, submit the Plan for review and Government approval. The Contractor shall meet with the Government prior to implementation of the Environmental Protection Plan, for the purpose of discussing the implementation of the initial plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's Environmental Plans. Maintain and keep the Environmental Protection Plan current onsite.

1.2.2. Compliance

No requirement in this Section shall be construed as relieving the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During Construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

1.2.3. Contents

The plan shall include, but shall not be limited to, the following:

1.2.3.1. Name(s) of person(s) within the Contractor's organization who is(are) responsible for ensuring adherence to the Environmental Protection Plan.

1.2.3.2. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable

1.2.3.3. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel

1.2.3.4. Description of the Contractor's environmental protection personnel training program

1.2.3.5. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. Include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan.

1.2.3.6. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site

1.2.3.7. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.

1.2.3.8. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.

1.2.3.9. Drawing showing the location of on-installation borrow areas.

1.2.3.10. A spill control plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local laws and regulations. The spill control plan supplements the requirements of EM 385-1-1. This plan shall include as a minimum:

(a) The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual shall immediately notify the Government and the local Fire Department in addition to the legally required Federal, State, and local reporting channels (including the National Response Center 1-800-424-8802) if a reportable quantity is released to the environment. The plan shall contain a list of the required reporting channels and telephone numbers.

(b) The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup

(c) Training requirements for Contractor's personnel and methods of accomplishing the training

(d) A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.

(e) The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency

(f) The methods and procedures to be used for expeditious contaminant cleanup

1.2.3.11. A solid waste management plan identifying waste minimization, collection, and disposals methods, waste streams (type and quantity), and locations for solid waste diversion/disposal including clearing debris and C&D waste that is diverted (salvaged, reused, or recycled). Detail the contractor's actions to comply with, and to participate in, Federal, state, regional, local government, and installation sponsored recycling programs to reduce the volume of solid waste at the source. Identify any subcontractors responsible for the transportation, salvage and disposal of solid waste. Submit licenses or permits for solid waste disposal sites that are not a commercial operating facility. Attach evidence of the facility's ability to accept the solid waste to this plan. A construction and demolition waste management plan, similar to the plan specified in the UFGS 01 74 19 (formerly 01572) may be used as the non-hazardous solid waste management plan. Provide a Non-Hazardous Solid Waste Diversion Report. Submit the report on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted and each quarter thereafter (e.g. the first working day of January, April, July, and October) until the end of the project. Additionally, a summary report, with all data fields, is required at the end of the project. The report shall indicate the total type and amount of waste generated, total type and amount of waste diverted, type and amount of waste sent to waste-to-energy facility and alternative daily cover, in tons along with the percent that was diverted. Maintain, track and report construction and demolition waste data in a manner such that the installation can enter the data into the Army SWAR database, which separates data by type of material. A cumulative report in LEED Letter Template format may be used but must be modified to include the date disposed of/diverted and include the above stated diversion data. NOTE: The Solid Waste Diversion Reports are separate documentation than the LEED documentation.

1.2.3.12. DELETED.

1.2.3.13. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.

1.2.3.14. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. In accordance with EM 385-1-1, include a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be on site at any given time in the contaminant prevention plan. Update the plan as new hazardous materials are brought on site or removed from the site. Reference this plan in the storm water pollution prevention plan, as applicable.

1.2.3.15. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the waste water, include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented and any required permits. If surface discharge will be the method of disposal, include a copy of the permit and associated documents as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, include documentation that the waste water treatment plant Operator has approved the flow rate, volume, and type of discharge.

1.2.3.16. A historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on the project site: and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in the area are discovered during construction. Include methods to assure the protection of known or discovered resources and shall identify lines of communication between Contractor personnel and the Government.

1.2.3.17. A pesticide treatment plan, updated, as information becomes available. Include: sequence of treatment, dates, times, locations, pesticide trade name, EPA registration numbers, authorized uses, chemical composition, formulation, original and applied concentration, application rates of active ingredient (i.e. pounds of active ingredient applied), equipment used for application and calibration of equipment. The Contractor is responsible for Federal, State, Regional and Local pest management record keeping and reporting requirements as well as any additional Installation specific requirements. Follow AR 200-1, Chapter 5, Pest Management, Section 5-4, “Program Requirements” for data required to be reported to the Installation.

1.3. PROTECTION FEATURES

This paragraph supplements the Contract Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES AND IMPROVEMENTS. Prior to start of any onsite construction activities, the Contractor and the Government shall make a joint condition survey. Immediately following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. Both the Contractor and the Government will sign this survey, upon mutual agreement as to its accuracy and completeness. The Contractor develop a plan that depicts how it will protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the Contractor's work under the contract.

1.4. ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations, requested by the Contractor, from the drawings, plans and specifications which may have an environmental impact will be subject to approval by the Government and may require an extended review, processing, and approval time. The Government reserves the right to disapprove alternate methods, even if they are more cost effective, if the Government determines that the proposed alternate method will have an adverse environmental impact.

1.5. NOTIFICATION

The Government will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. The Contractor shall, after receipt of such notice, inform the Government of the proposed corrective action and take such action when approved by the Government. The Government may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor for any such suspensions. This is in addition to any other actions the Government may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

2.0 PRODUCTS (NOT USED)

3.0 EXECUTION

3.1. LAND RESOURCES

Confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, identify any land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. Do not attach or fasten any ropes, cables, or guys to any trees for anchorage unless specifically authorized. Provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Remove all stone, soil, or other materials displaced into uncleared areas..

3.1.1. Work Area Limits

Prior to commencing construction activities, mark the areas that need not be disturbed under this contract. Mark or fence isolated areas within the general work area which are not to be disturbed. Protect monuments and markers before construction operations commence. Where construction operations are to be conducted during darkness, any markers shall be visible in the dark. Personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

3.1.2. Landscape

Clearly identify trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved by marking, fencing, or wrapping with boards, or any other approved techniques. Restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

3.1.3. Erosion and Sediment Controls

Provide erosion and sediment control measures in accordance with Federal, State, and local laws and regulations. Coordinate with approving authorities (federal, state, etc.) for specific requirements to be included in the plan. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's construction activities. Keep the area of bare soil exposed at any one time by construction operations to a minimum necessary. Construct or install temporary and permanent erosion and sediment control best management practices (BMPs). BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection, diversion channels, and sedimentation basins. Remove any temporary measures after the area has been stabilized.

3.1.4. Contractor Facilities and Work Areas

Place field offices, staging areas, stockpile storage, and temporary buildings in areas designated on the drawings or as directed by the Government. Make only approved temporary movement or relocation of Contractor facilities. Provide erosion and sediment controls for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Control temporary excavation and embankments for plant and/or work areas to protect adjacent areas.

3.2. WATER RESOURCES

Monitor construction activities to prevent pollution of surface and ground waters. Do not apply toxic or hazardous chemicals to soil or vegetation unless otherwise indicated. Monitor all water areas affected by construction activities. For construction activities immediately adjacent to impaired surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that surface water when required by state or federally issued Clean Water Act permits.

3.2.1. Stream Crossings

Stream crossings shall allow movement of materials or equipment without violating water pollution control standards of the Federal, State, and local governments or impede state-designated flows.

3.2.2. Wetlands

Do not enter, disturb, destroy, or allow discharge of contaminants into any wetlands.

3.3. AIR RESOURCES

Comply with all Federal and State air emission and performance laws and standards for equipment operation, activities, or processes.

3.3.1. Particulates

Control dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from asphaltic batch plants, including weekends, holidays and hours when work is not in progress. Maintain excavations, stockpiles, haul roads, permanent and temporary access roads, plant sites, spoil areas, borrow areas, and other work areas within or outside the project boundaries free from particulates which would cause the Federal, State, and local air pollution standards to be exceeded or which would cause a hazard or a nuisance. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators or other methods are permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. Provide sufficient, competent equipment available to accomplish these tasks. Perform particulate control as the work proceeds and whenever a particulate nuisance or hazard occurs. Comply with all State and local visibility regulations.

3.3.2. Odors

Control odors from construction activities at all times. Odors shall not cause a health hazard and shall be in compliance with State regulations and/or local ordinances.

3.3.3. Sound Intrusions

Keep construction activities under surveillance and control to minimize environment damage by noise. Comply with the provisions of the state and Installation rules.

3.3.4. Burning

Burning is not allowed on the project site unless specified in other sections of the specifications or by written authorization. Specific times, locations, and manners of burning shall be subject to approval.

3.4. CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes shall be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.4.1. Solid Wastes

Place solid wastes (excluding clearing debris) in containers which are emptied on a regular schedule. Conduct handling, storage, and disposal to prevent contamination. Employ segregation measures so that no hazardous or toxic waste will become co-mingled with solid waste. Transport solid waste off Government property and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal. The minimum acceptable off-site solid waste disposal option is a Subtitle D RCRA permitted landfill. Verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate. Comply with Federal, State, and local laws and regulations pertaining to the use of landfill areas.

3.4.2. Chemicals and Chemical Wastes

Dispense chemicals, ensuring no spillage to the ground or water. Perform and document periodic inspections of dispensing areas to identify leakage and initiate corrective action. The Government may periodically review this documentation. Collect chemical waste in corrosion resistant, compatible containers. Monitor and remove collection drums to a staging or storage area when contents are within 6 inches of the top. Classify, manage, store, and dispose of wastes in accordance with Federal, State, and local laws and regulations.

3.4.3. Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable state and local regulations. Hazardous materials are defined in 49 CFR 171 - 178. At a minimum, manage and store hazardous waste in compliance with 40 CFR 262. Take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. Segregate hazardous waste from other materials and wastes; protect it from the weather by placing it in a safe covered location and take precautionary measures, such as berming or other appropriate measures, against accidental spillage. Store, describe, package, label, mark, and placard hazardous waste and hazardous material in accordance with 49 CFR 171 - 178, state, and local laws and regulations. Transport Contractor generated hazardous waste off Government property in accordance with the Environmental Protection Agency and the Department of Transportation laws and regulations. Dispose of hazardous waste in compliance with Federal, State and local laws and regulations. Immediately report spills of hazardous or toxic materials to the Government and the Facility Environmental Office. Contractor will be responsible for cleanup and cleanup costs due to spills. Contractor is responsible for the disposition of Contractor generated hazardous waste and excess hazardous materials.

3.4.4. Fuel and Lubricants

Conduct storage, fueling and lubrication of equipment and motor vehicles in a manner that affords the maximum protection against spill and evaporation. Manage and store fuel, lubricants and oil in accordance with all Federal, State, Regional, and local laws and regulations.

3.5. RECYCLING AND WASTE MINIMIZATION

Participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project. Line and berm fueling areas and establish storm water control structures at discharge points for site run-off. Keep a liquid containment clean-up kit available at the fueling area.

3.6. HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

Existing historical, archaeological, and cultural resources within the Contractor's work area are shown on the drawings. Protect and preserve these resources during the life of the Contract. Temporarily suspend all activities that may damage or alter such resources, if any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found during excavation or other construction activities. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, notify the Government so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. Cease all activities that may result in impact to or the destruction of these resources. Secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

3.7. BIOLOGICAL RESOURCES

Minimize interference with, disturbance to, and damage to fish, wildlife, and plants, including their habitat. Protect threatened and endangered animal and plant species including their habitat in accordance with Federal, State, Regional, and local laws and regulations.

3.8. INTEGRATED PEST MANAGEMENT

Coordinate, through the Government, with the Installation Pest Management Coordinator (IPMC) at the earliest possible time prior to pesticide application, in order to minimize impacts to existing fauna and flora. Discuss integrated pest management strategies with the IPMC and receive concurrence from the IPMC, through the COR, prior to the application of any pesticide associated with these specifications. Give IMPC personnel the opportunity to be present at all meetings concerning treatment measures for pest or disease control and during application of the pesticide. The use and management of pesticides are regulated under 40 CFR 152 - 186.

3.8.1. Pesticide Delivery and Storage

Deliver pesticides, approved for use on the Installation, to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

3.8.2. Qualifications

Use the services of a subcontractor for pesticide application whose principal business is pest control. The subcontractor shall be licensed and certified in the state where the work is to be performed.

3.8.3. Pesticide Handling Requirements

Formulate, treat with, and dispose of pesticides and associated containers in accordance with label directions.

3.8.4. Application

A state certified pesticide applicator shall apply pesticides in accordance with EPA label restrictions and recommendations.

3.9. PREVIOUSLY USED EQUIPMENT

Clean all previously used construction equipment prior to bringing it onto the project site. Ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. Consult with the USDA jurisdictional office for additional cleaning requirements.

3.10. MILITARY MUNITIONS

Immediately stop work in that area and immediately inform the Government, in the event military munitions, as defined in 40 CFR 260, are discovered or uncovered.

3.11. TRAINING OF CONTRACTOR PERSONNEL

Train personnel in all phases of environmental protection and pollution control. Conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Conduct additional meetings for new personnel and when site conditions change. The training and meeting agenda shall include methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.12. POST CONSTRUCTION CLEANUP

Clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". Unless otherwise instructed in writing , obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. Grade, fill and seed the entire disturbed area, unless otherwise indicated.

SECTION 01 62 35
RECYCLED/RECOVERED MATERIAL

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.

- U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
- 40 CFR 247 Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2. OBJECTIVES

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. The Contractor shall make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

1.3. EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials, when incorporated into the work under this contract, shall contain at least the minimum percentage of recycled or recovered materials indicated by EPA unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the designated item requirements apply only if the designated item is used in the work.

1.4. EPA PROPOSED ITEMS INCORPORATED IN THE WORK

Products other than those designated by EPA are still being researched and are being considered for future Comprehensive Procurement Guideline (CPG) designation. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

1.5. EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

There are many products listed in 40 CFR 247 which have been designated or proposed by EPA to include recycled or recovered materials that may be use by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

End of Section 01 62 35

SECTION 01 78 02.00 10
CLOSEOUT SUBMITTALS

1.0 OVERVIEW

1.1. SUBMITTALS

Government approval is required for any submittals with a "G" designation; submittals not having a "G" designation are for Designer of Record approval or for information only. Submit the following in accordance with Section 01 33 00 submittals*:*

SD-02 Shop Drawings

– As-Built Drawings - G

▪ Drawings showing final as-built conditions of the project. Provide electronic drawing files as specified in Section 01 33 16, 3 sets of blue-line prints and one set of the approved working as-built drawings.

SD-03 Product Data

– As-Built Record of Equipment and Materials

▪ Two copies of the record listing the as-built materials and equipment incorporated into the construction of the project.

– Construction Warranty Management Plan

▪ Three sets of the construction warranty management plan containing information relevant to the warranty of materials and equipment incorporated into the construction project, including the starting date of warranty of construction. Furnish with each warranty the name, address, and telephone number of each of the guarantor's representatives nearest to the project location.

– Warranty Tags

▪ Two record copies of the warranty tags showing the layout and design.

– Final Cleaning

▪ Two copies of the listing of completed final clean-up items.

1.2. PROJECT RECORD DOCUMENTS

1.2.1. As-Built Drawings – G

An as-built drawing is a construction drawing revised to reflect the final as-built conditions of the project as a result of modifications and corrections to the project design required during construction. The final as-built drawings shall not have the appearance of marked up drawings, but that of professionally prepared drawings as if they were the "as designed" drawings.

1.2.2. Maintenance of As-Built Drawings

1.2.2.1. The Configuration Management Plan shall describe how the Contractor will maintain up-to-date drawings, how it will control and designate revisions to the drawings and specifications (In accordance with Special Contract Requirement: ***Deviating from the Accepted Design*** and Section 01 33 16: ***Design after Award***, the Designer of Record's approval is necessary for any revisions to the accepted design).

1.2.2.2. Make timely updates, carefully maintaining a record set of working as-built drawings at the job site, marked in red, of all changes and corrections from the construction drawings. Enter changes and corrections on drawings promptly to reflect "Current Construction". Perform this update no less frequently than weekly for the blue line drawings and update no less frequently than quarterly for the CADD/CAD and BIM files, which were prepared previously in accordance with Section 01 33 16. Include a confirmation that the as-builts are up to date with the submission of the monthly project schedule.

1.2.2.3. If the DB Contractor fails to maintain the as-built drawings as required herein, the Government will retain from the monthly progress payment, an amount representing the estimated monthly cost of maintaining the as-built drawings. Final payment with respect to separately priced facilities or the contract as a whole will be withheld until the Contractor submits acceptable as-built drawings and the Government approves them.

1.2.2.4. The marked-up set of drawings shall reflect any changes, alterations, adjustments or modifications. Changes must be reflected on all sheets affected by the change. Changes shall include marking the drawings to reflect structural details, foundation layouts, equipment sizes, and other extensions of design.

1.2.2.5. Typically, room numbers shown on the drawings are selected for design convenience and do not represent the actual numbers intended for use by the end user. Final as-built drawings shall reflect actual room numbers adopted by the end user.

1.2.2.6. If there is no separate contract line item (CLIN) for as-built drawings, the Government will withhold the amount of $35,000, or 1% of the present construction value, whichever is the greater, until the final as-built drawing submittal has been approved by the Government.

1.2.3. Underground Utilities

The drawings shall indicate, in addition to all changes and corrections, the actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, the as-built drawings shall show, by offset dimensions to two permanently fixed surface features, the end of each run including each change in direction. Locate Valves, splice boxes and similar appurtenances by dimensioning along the utility run from a reference point. Record average elevation of the top of each run or underground structure..

1.2.4. Partial Occupancy

For projects where portions of construction are to be occupied or activated before overall project completion, including portions of utility systems, supply as-built drawings for those portions of the facility being occupied or activated at the time the facility is occupied or activated. Show this same as-built information previously furnished on the final set of as-built drawings.

1.2.5. As-Built Conditions That are Different From the construction Drawings

Accurately reflect all as-built conditions that are different, such as dimensions, road alignments and grades, and drainage and elevations, from the construction drawings on each drawing. If the as-built condition is accurately reflected on a shop drawing, then furnish that shop drawing in CADD format. Reference the final as-built construction drawing the shop drawing file that includes the as-built information. In turn, the shop drawing shall reference the applicable construction as-built drawing. Delete any options shown on drawings and not selected clearly reflect options selected on final as-built drawings.

1.2.6. Additional As-Built Information that Exceeds the Detail Shown on the construction Drawings:

These as-built conditions include those that reflect structural details, foundation layouts, equipment, sizes, mechanical and electrical room layouts and other extensions of design, that were not shown in the project design documents because the exact details were not known until after the time of approved shop drawings. It is recognized that these shop drawing submittals (revised showing as-built conditions) will serve as the as-built record without actual incorporation into the construction drawings, piping, and equipment drawings. Include locations of all explorations, logs of all explorations, and results of all laboratory testing, including those provided by the Government. Furnish all such shop drawings in CADD /CADformat. Include fire protection details, such as wiring, performed for the design of the project.

1.2.7. Final As-Built Drawings

Submit final as-built CADD/CAD and BIM Model(s) and Facility Data files at the time of Beneficial Occupancy of the project or at a designated phase of the project. In the event the Contractor accomplishes additional work after this submittal, which changes the as-built conditions, submit a new DVD with all drawing sheets and three blue-line copies of affected sheets which depict additional changes.

1.2.8. Title Blocks

In accordance with the configuration management plan, clearly mark title blocks to indicate final as-built drawings.

1.2.9. Other As-Built Documents

Provide scans of all other documents such as design analysis, catalog cuts, certification documents that are not available in native electronic format in an organized manner in Adobe.pdf format.

1.2.9.1. LEED Documentation

Update LEED documentation on at least a monthly basis and have it available for review by the Government on the jobsite at all times during construction. Submit the final LEED Project Checklist(s), final LEED submittals checklist and complete project documentation, verifying the final LEED score and establishing the final rating. Provide full support to the validation review process, including credit audits. See also the LEED documentation requirements in Section 01 33 16, DESIGN AFTER AWARD.

1.2.9.2. GIS Documentation

Provide final geo-referenced GIS database of the new building footprint along with any changes made to exterior of the building. The intent of capturing the final building footprint and exterior modifications in a GIS database is to provide the installation with a data set of the comprehensive changes made to the landscape as a result of the construction project. The Government will incorporate this data set into the installations existing GIS MasterPlan or Enterprise GIS system. The GIS database deliverable shall follow a standard template provided to the Contractor by the Government, adhere to detailed specifications outlined in ECB No 2006-15, and be documented using the Federal Geographic Data Committee (FGDC) metadata standard.

1.3. EQUIPMENT DATA

1.3.1. Real Property Equipment

Provide an Equipment-in-Place list of all installed equipment furnished under this contract. Include all information usually listed on manufacturer's name plate. Include the cost of each piece of installed property F.O.B. construction site. For each of the items which is specified herein to be guaranteed for a specified period from the date of acceptance thereof, provide the following information: The name, serial and model number address of equipment supplier, or manufacturer originating the guaranteed item. The Contractor's guarantee to the Government of these items will not be limited by the terms of any manufacturer's guarantee to the Contractor. Furnish the list as one (1) reproducible and three (3) copies thirty (30) calendar days before completion of any segment of the contract work which has an incremental completion date.

1.3.2. Maintenance and Parts Data

Furnish a brochure, catalog cut, parts list, manufacturer's data sheet or other publication showing detailed parts data on all other equipment subject to repair and maintenance procedures not otherwise required in Operations and Maintenance Manuals specified elsewhere in this contract. Distribution of directives shall follow the same requirements as listed in paragraph above.

1.3.3. Construction Specifications

Furnish permanent electronic files of final as-built construction specifications, including modifications thereto, with the as-built drawings.

1.4. CONSTRUCTION WARRANTY MANAGEMENT

1.4.1. Prior to the end of the one year warranty, the Government may conduct an infrared roof survey on any project involving a membrane roofing system. This survey will be conducted in accordance with ASTM C1153-90, "Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging". The Contractor shall replace all damaged materials and locate and repair sources of moisture penetration.

1.4.2. Management

1.4.2.1. Warranty Management Plan

Develop a warranty management plan containing information relevant to the clause ***Warranty of Construction*** in FAR 52.246-21. Submit the warranty management plan for Government approval at least 30 days before the planned pre-warranty conference. In the event of phased turn-over of the contract, update the Warranty Management Plan as necessary to include latest information required. Include all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan shall be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen, or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below shall include due date and whether item has been submitted or was accomplished. Submit warranty information made available during the construction phase prior to each monthly pay estimate. Assemble information in a binder and turn over to the Government upon acceptance of the work. The construction warranty period shall begin on the date of project acceptance and shall continue for the full product warranty period. The Contractor, Government, including the Customer Representative shall jointly conduct warranty inspections, 4 months and 9 months, after acceptance. The warranty management plan shall include, but shall not be limited to, the following information:

(1) Roles and responsibilities of all personnel associated with the warranty process, including points of contact and telephone numbers within the organizations of the contractors, subcontractors, manufacturers or suppliers involved.

(2) Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.

(3) A list for each warranted equipment, item, feature of construction or system indicating:

(i) Name of item.

(ii) Model and serial numbers.

(iii) Location where installed.

(iv) Name and phone numbers of manufacturers or suppliers.

(v) Names, addresses and telephone numbers of sources of spare parts.

(vi) Warranties and terms of warranty. Include one-year overall warranty of construction. Indicate those items, which have extended warranties with separate warranty expiration dates.

(vii) Cross-reference to warranty certificates as applicable.

(viii) Starting point and duration of warranty period.

(ix) Summary of maintenance procedures required to continue the warranty in force.

(x) Cross-reference to specific pertinent Operation and Maintenance manuals.

(xi) Organization, names and phone numbers of persons to call for warranty service.

(xii) Typical response time and repair time expected for various warranted equipment.

(4) The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

(5) Procedure and status of tagging of all equipment covered by extended warranties.

(6) Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.4.3. Performance Bond

1.4.3.1. The Contractor's Performance Bond will remain effective throughout the construction warranty period.

1.4.3.2. In the event the Contractor or his designated representative(s) fails to commence and diligently pursue any work required under this clause, and in a manner pursuant to the requirements thereof, the Government shall have a right to demand that said work be performed under the Performance Bond by making written notice on the surety. If the surety fails or refuses to perform the obligation it assumed under the Performance Bond, the Government shall have the work performed by others, and after completion of the work, may make demand for reimbursement of any or all expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

1.4.3.3. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Government will have the right to recoup expenses from the bonding company.

1.4.3.4. Following oral or written notification of required warranty repair work, the Contractor will respond as dictated by para. 1.4.5. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Government to proceed against the Contractor as outlined in the paragraph 1.4.5.5 and/or above.

1.4.4. Pre-Warranty Conference

Prior to contract completion, or completion of any phase or portion of contract to be turned over, and at a time designated by the Contracting Officer, the Contractor shall meet with the Government to develop a mutual understanding with respect to the requirements of this clause. Communication procedures for Contractor notification of warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Government for the execution of the construction warranty shall be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, the Contractor will furnish the name, telephone number and address of a licensed and bonded company which is authorized to initiate and pursue warranty work action on behalf of the Contractor. This point of contact will be located within the local service area of the warrantied construction, will be continuously available, and will be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of his responsibilities in connection with other portions of this provision.

1.4.5. Contractor's Response to Warranty Service Requirements.

Following Government oral or written notification, which may include authorized installation maintenance personnel, the Contractor shall respond to warranty service requirements in accordance with the "Warranty Service Priority List" and the three categories of priorities listed below. Submit a report on any warranty item that has been repaired during the warranty period. The report shall include the cause of the problem, date reported, corrective action taken, and when the repair was completed. If the Contractor does not perform the construction warranty within the timeframe specified, the Government will perform the work and backcharge the construction warranty payment item established.

1.4.5.1. First Priority Code 1 Perform onsite inspection to evaluate situation, and determine course of action within 4 hours, initiate work within 6 hours and work continuously to completion or relief.

1.4.5.2. Second Priority Code 2 Perform onsite inspection to evaluate situation, and determine course of action within 8 hours, initiate work within 24 hours and work continuously to completion or relief.

1.4.5.3. Third Priority Code 3 All other work to be initiated within 3 work days and work continuously to completion or relief.

1.4.5.4. The "Warranty Service Priority List" is as follows:

- Code 1 - Air Conditioning System

(a) Buildings with computer equipment.

(b) Barracks, mess halls (entire building down).

- Code 2 - Air Conditioning Systems

(a) Recreational support.

(b) Air conditioning leak in part of building, if causing damage.

(c) Air conditioning system not cooling properly

(d) Admin buildings with Automated Data Processing (ADP) equipment not on priority list.

- Code 1 - Doors

(a) Overhead doors not operational.

- Code 1 - Electrical

(a) Power failure (entire area or any building operational after 1600 hours).

(b) Traffic control devices.

(c) Security lights.

(d) Smoke detectors and fire alarm systems

(e) Power or lighting failure to an area, facility, portion of a facility, which may adversely impact health, safety, security, or the installation's mission requirement, or which may result in damage to property.

- Code 2 - Electrical

(a) Power failure (no power) for unoccupied buildings or portions thereof or branch circuits within occupied buildings, not listed as Code 1.

(a) Receptacle and lights, not listed as code 1.

- Code 3 - Electrical

(a) Street, parking area lights

- Code 1 - Gas

(a) Leaks and breaks.

(b) No gas to cantonment area.

- Code 1 - Heat

(a) Area power failure affecting heat.

(b) Heater in unit not working.

- Code 2 Heat

(a) All heating system failures not listed as Code 1.

- Code 3 - Interior

(a) Floor damage

(b) Paint chipping or peeling

- Code 1 - Intrusion Detection Systems - N/A.
- Code 2 - Intrusion Detection Systems other than those listed under Code 1
- Code 1 - Kitchen Equipment

(a) Dishwasher.

(b) All other equipment hampering preparation of a meal.

- Code 2 - Kitchen Equipment

(a) All other equipment not listed under Code 1.

- Code 2 - Plumbing

(a) Flush valves not operating properly

(b) Fixture drain, supply line commode, or water pipe leaking.

(c) Commode leaking at base.

- Code 3 - Plumbing

(a) Leaking faucets

- Code 1 - Refrigeration

(a) Mess Hall.

(b) Medical storage.

- Code 2 - Refrigeration

(a) Mess hall - other than walk-in refrigerators and freezers.

- Code 1 - Roof Leaks

(a) Temporary repairs will be made where major damage to property is occurring.

- Code 2 - Roof Leaks

(a) Where major damage to property is not occurring, check for location of leak during rain and complete repairs on a Code 2 basis.

- Code 1 - Sprinkler System

(a) All sprinkler systems, valves, manholes, deluge systems, and air systems to sprinklers.

- Code 1 - Tank Wash Racks (Bird Baths)

(a) All systems which prevent tank wash.

- Code 1 - Water (Exterior)

(a) Normal operation of water pump station.

- Code 2 - Water (Exterior)

(a) No water to facility.

- Code 1 - Water, Hot (and Steam)

(a) Barracks (entire building).

- Code 2 - Water, Hot

(a) No hot water in portion of building listed under Code 1

1.4.5.5. Should parts be required to complete the work and the parts are not immediately available, the Contractor shall have a maximum of 12 hours after arrival at the job site to provide the Government, with firm written proposals for emergency alternatives and temporary repairs for Government participation with the Contractor to provide emergency relief until the required parts are available on site for the Contractor to perform permanent warranty repair. The Contractors proposals shall include a firm date and time that the required parts shall be available on site to complete the permanent warranty repair. The Government will evaluate the proposed alternatives and negotiate the alternative considered to be in the best interest of the Government to reduce the impact of the emergency condition. Alternatives considered by the Government will include the alternative for the Contractor to "Do Nothing" while waiting until the required parts are available to perform permanent warranty repair. Negotiating a proposal which will require Government participation and the expenditure of Government funds shall constitute a separate procurement action by the using service.

1.4.6. Equipment Warranty Identification Tags

1.4.6.1. Provide warranty identification tags at the time of installation and prior to substantial completion shall provide warranty identification tags on all Contractor and Government furnished equipment which the Contractor has installed.

(a) The tags shall be suitable for interior and exterior locations, resistant to solvents, abrasion, and to fading caused by sunlight, precipitation, etc. These tags shall have a permanent pressure-sensitive adhesive back, and they shall be installed in a position that is easily (or most easily) noticeable. Tag each component of contractor furnished equipment that has differing warranties on its components.

(b) Submit sample tags, representing how the other tags will look, for Government review and approval.

(c) Tags for Warrantied Equipment: The tag for this equipment shall be similar to the following: Exact format and size will be as approved.

EQUIPMENT WARRANTY - CONTRACTOR FURNISHED EQUIPMENT

MFG NAME MODEL NO.

SERIAL NO.

CONTRACT NO.

CONTRACTOR NAME

CONTRACTOR WARRANTY EXPIRES

MFG WARRANTY(IES) EXPIRE

EQUIPMENT WARRANTY - GOVERNMENT FURNISHED EQUIPMENT

MFG NAME MODEL NO.

SERIAL NO.

CONTRACT NO.

DATE EQUIP PLACED IN SERVICE

MFG WARRANTY(IES) EXPIRE

(d) If the manufacturer's name (MFG), model number and serial number are on the manufacturer's equipment data plate and this data plate is easily found and fully legible, this information need not be duplicated on the equipment warranty tag

1.4.6.2. Execution: Complete the required information on each tag and install these tags on the equipment by the time of and as a condition of final acceptance of the equipment.

1.5. MECHANICAL TESTING, ADJUSTING, BALANCING, AND COMMISSIONING

Submit; all reports, statements, certificates, and completed checklists for testing, adjusting, balancing, and commissioning of mechanical systems prior to final inspection and transfer of the completed facility for approval, as specified in applicable technical specification sections.

1.6. OPERATION AND MAINTENANCE MANUALS

1.6.1. General Requirements

1.6.1.1. Inasmuch as the operations and maintenance manuals are required to operate and maintain the facility, the operations and maintenance (O&M) manuals will be considered a requirement prior to substantial completion of any facility to be turned over to the Government. Beneficial occupancy of all or portions of a facility prior to substantial completion will not relieve the Contractor of liquidated damages, if substantial completion exceeds the required completion date.

1.6.1.2. Provide one permanent electronic copy on CD-ROM and 2 hard copies of the Equipment Operating, Maintenance, and Repair Manuals. Provide separate manuals for each utility system as defined hereinafter. Submit Operations and Maintenance manuals for approval before field training or 90 days before substantial completion (whichever occurs earlier). If there is no separate CLIN for O&M Manuals, the Government will withhold an amount representing $20,000, as non-progressed work, until submittal and approval of all O&M manuals are complete.

1.6.2. Definitions

1.6.2.1. Equipment

A single piece of equipment operating alone or in conjunction with other equipment to accomplish a system function.

1.6.2.2. System

A combination of one or more pieces of equipment which function together to accomplish an intended purpose (i.e. HVAC system is composed of many individual pieces of equipment such as fans, motors, compressors, valves, sensors, relays, etc.)

1.6.3. Hard Cover Binders

The manuals shall be hard cover with posts, or 3-ring binders, so sheets may be easily substituted. Print the following identification on the cover: the words "EQUIPMENT OPERATING, MAINTENANCE, AND REPAIR MANUALS," the project name, building number, and an indication of utility or systems covered, the name of the Contractor, and the Contract number. Manuals shall be approximately 8-1/2 by 11-inches with large sheets folded in and capable of being easily pulled out for reference. All manuals for the project must be similar in appearance, and be of professional quality.

1.6.4. Warning Page

Provide a warning page to warn of potential dangers (if they exist, such as high voltage, toxic chemicals, flammable liquids, explosive materials, carcinogens, high pressures, etc.). Place the warning page inside the front cover and in front of the title page. Include any necessary Material Safety Data Sheets (MDSD) here.

1.6.5. Title Page

The title page shall include the same information shown on the cover and show the name of the preparing firm and the date of publication.

1.6.6. Table of Contents

Each volume of the set of manuals for this project shall include a table of contents, for the entire set, broken down by volume.

1.6.7. GENERAL

Organize manuals according to the following format, and include information for each item of equipment   Submit a draft outline and table of contents for approval at 50% contract completion.

TABLE OF CONTENTS

PART I: Introduction

- Equipment Description
- Functional Description
- Installation Description

PART II: Operating Principles

PART III: Safety

PART IV: Preventive Maintenance

- Preventive Maintenance Checklist, Lubrication
- Charts and Diagrams

PART V: Spare Parts Lists

- Troubleshooting Guide
- Adjustments
- Common Repairs and Parts Replacement

PART VI: Illustrations

1.6.7.1. Part I-Introduction

Part I shall provide an introduction, equipment or system description, functional description and theory of operation, and installation instructions for each piece of equipment. Include complete instructions for uncrating, assembly, connection to the power source and pre-operating lubrication in the installation instructions as applicable. Illustrations, including wiring and cabling diagrams, are required as appropriate in this section. Include halftone pictures of the equipment in the introduction and equipment description, as well as system layout drawings with each item of equipment located and marked.   Do not use copies of previously submitted shop drawings in these manuals.

1.6.7.2. Part II-Operating Principles

Part II shall provide complete instructions for operating the system, and each piece of equipment. Illustrations, halftone pictures, tables, charts, procedures, and diagrams are required when applicable. This will include step-by-step procedures for start-up and shutdown of both the system and each component piece of equipments, as well as adjustments required to obtain optimum equipment performance, and corrective actions for malfunctions. Show performance sheets and graphs showing capacity data, efficiencies, electrical characteristics, pressure drops, and flow rates here, also. Marked-up catalogs or catalog pages do not satisfy this requirement. Present performance information as concisely as possible with only data pertaining to equipment actually installed. Include actual test data collected for Contractor performance here.

1.6.7.3. Part III-Safety

Part III shall contain the general and specific safety requirements peculiar to each item of equipment. Repeat safety information as notes cautions and warnings in other sections where appropriate to operations described.

1.6.7.4. Part IV-Preventive Maintenance

Part IV shall contain a troubleshooting guide, including detailed instructions for all common adjustments and alignment procedures, including a detailed maintenance schedule. Also include a diagnostic chart showing symptoms and solutions to problems. Include test hookups to determine the cause, special tools and test equipment, and methods for returning the equipment to operating conditions. Information may be in chart form or in tabular format with appropriate headings. Include instructions for the removal, disassembly, repair, reassembly, and replacement of parts and assemblies where applicable and the task is not obvious.

1.6.7.5. Part V-Spare Parts List

Part V shall contain a tabulation of description data and parts location illustrations for all mechanical and electrical parts. The heading of the parts list shall clearly identify the supplier, purchase order number, and equipment. Include the unit price for each part. List parts by major assemblies, and arrange the listing in columnar form. Include names and addresses of the nearest manufacturer's representatives, as well as any special warranty information. Provide a list of spare parts that are recommended to be kept in stock by the Government installation.

1.6.7.6. Part VI-Illustrations

Part VI shall contain assembly drawings for the complete equipment or system and for all major components. Include complete wiring diagrams and schematics. Other illustrations, such as exploded views, block diagrams, and cutaway drawings, are required as appropriate.

1.6.8. Framed Instructions

Post framed instructions are required for substantial completion. Post framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, including equipment, ductwork, piping valves, dampers, and control sequence at a location near the equipment described. Prepare condensed operating instructions explaining preventive maintenance procedures methods of checking the system for normal safe operation, valve schedule and procedures for safely starting and stopping the system in type form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. Submit proposed diagrams, instructions, and other sheets prior to posting. Post the framed instructions before field training.

1.6.9. (Reserved. See 1.7 for Field Training)

1.6.10. System/Equipment Requirements

1.6.10.1. Facility Heating System

Provide information on the following equipment: boilers, water treatment, chemical feed pumps and tanks, converters, heat exchangers, pumps, unit heaters, fin-tube radiation, air handling units (both heating only and heating and cooling), and valves (associated with heating systems).

1.6.10.2. Air-Conditioning Systems

Provide information in chillers, packaged air-conditioning equipment, towers, water treatment, chemical feed pumps and tanks, air-cooled condensers, pumps, compressors, air handling units, and valves (associated with air-conditioning systems).

1.6.10.3. Temperature Control and HVAC Distribution Systems

Provide all information described for the following equipment: valves, fans, air handling units, pumps, boilers, converters and heat exchangers, chillers, water cooled condensers, cooling towers, and fin-tube radiation, control air compressors, control components (sensors, controllers, adapters and actuators), and flow measuring equipment.

1.6.10.4. Central Heating Plants

Provide the information described for the following equipment: boilers, converters, heat exchangers, pumps, fans, steam traps, pollution control equipment, chemical feed equipment, control systems, fuel handling equipment, de-aerators, tanks (flash, expansion, return waters, etc.), water softeners, and valves.

1.6.10.5. Heating Distribution Systems

Provide the information described for the following equipment: valves, fans, pumps, converters and heat exchangers, steam traps, tanks (expansion, flash, etc.), and piping systems.

1.6.10.6. Exterior Electrical Systems

Provide information on the following equipment: power transformers, relays, reclosers, breakers, and capacitor bank controls.

1.6.10.7. Interior Electrical Systems

Provide information on the following equipment: relays, motor control centers, switchgear, solid state circuit breakers, motor controller, EPS lighting systems, wiring diagrams and troubleshooting flow chart on control systems, and special grounding systems.

1.6.10.8. Energy Monitoring and Control Systems

The maintenance manual shall include descriptions of maintenance for all equipment, including inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective components.

1.6.10.9. Domestic Water Systems

Provide the identified information on the following equipment: tanks, unit process equipment, pumps, motors, control and monitoring instrumentation, laboratory test equipment, chemical feeders, valves, switching gear, and automatic controls.

1.6.10.10. Wastewater Treatment Systems

Provide the identified information on the following equipment: tanks, unit process equipment, pumps, motors, control and monitoring instrumentations, laboratory test equipment chemical feeders, valves, scrapers, skimmers, comminutors, blowers, switching gear, and automatic controls.

1.6.10.11. Fire Protection Systems

Provide information on the following equipment: alarm valves, manual valves, regulators, foam and gas storage tanks, piping materials, sprinkler heads, nozzles, pumps, and pump drivers.

1.6.10.12. Fire Alarm and Detection Systems

(1) The maintenance manual shall include description of maintenance for all equipment, including inspection, periodic preventive maintenance, fault diagnosis, and repair or replacement of defective components.

(2) Provide all software; database with complete identification of programmable portions of system equipment and devices, and all other system programming data on all modes of the system; connecting cables; and proprietary equipment necessary for the operation, maintenance, testing, repair and programming, etc. of the system and that may be required for implementation of future changes to the fire system (additional and/or relocated initiating devices, notification devices, etc.

(3) Provide all system and equipment technical data and computer software with the requisite rights to Government use, in accordance with the applicable contract clauses.

(4) Training shall include software and programming required for the effective operation, maintenance, testing, diagnostics and expansion of the system.

1.6.10.13. Plumbing Systems

Provide information on the following equipment: water heaters, valves, pressure regulators backflow preventors, piping materials, and plumbing fixtures.

1.6.10.14. Liquid Fuels Systems

Provide information on the following equipment: tanks, automatic valves manual valves, filter separators, pumps, mechanical loading arms, nozzles, meters, electronic controls, electrical switch gear, and fluidic controls.

1.6.10.15. Cathodic Protection Systems

Provide information on the following material and equipment: rectifiers, meters, anodes, anode backfill, anode lead wire, insulation material and wire size, automatic controls (if any), rheostats, switches, fuses and circuit breakers, type and size of rectifying elements, type of oil in oil-immersed rectifiers, and rating of shunts.

1.6.10.16. Generator Installations

Provide information on the following equipment: generator sets, automatic transfer panels, governors, exciters, regulators starting systems, switchgear, and protective devices.

1.6.10.17. Miscellaneous Systems

Provide information on the following: communication and ADP systems, security and intrusion alarm, elevators, material handling, active solar, photovoltaic, nurse call, paging, intercom, closed circuit TV, irrigation, sound and material delivery systems, kitchen, refrigeration, disposal, ice making equipment, and other similar type special systems not otherwise specified.

1.6.10.18. Laboratory, Environmental and Pollution Control Systems

Provide information on the following equipment: wet scrubbers, quench chambers, scrub tanks, liquid oil separators, and fume hoods.

1.7. FIELD TRAINING

Field Training is a requirement for substantial completion. Conduct a training course for the operating staff for each particular system. Conduct the training is to be conducted during hours of normal working time after the system is functionally complete. The field instructions shall cover all of the items contained in the Equipment Operating, Maintenance and Repair Manuals. The training will include both classroom and "hands-on" training. Submit a lesson plan outlining the information to be discussed during training periods. Submit this lesson plan for approval 90 days before contract completion before the field training occurs. Record training on DVD and furnish to the Government within ten (10) days following training. Document all training and furnish a list of all attendees.

1.8. PRICING OF CONTRACTOR-FURNISHED AND INSTALLED PROPERTY AND GOVERNMENT-FURNISHED CONTRACTOR-INSTALLED PROPERTY

Promptly furnish and require any sub-contractor or supplier to furnish, in like manner, unit prices and descriptive data required by the Government for Property Record purposes of fixtures and equipment furnished and/or installed by the Contractor or sub-contractor, except prices do not need to be provided for Government-Furnished Property.

1.9. LEED REVIEW MEETINGS

1.9.1. Pre-Closeout Meeting. Approximately 30 days before submittal of LEED closeout documentation, the Contractor and the Government's project delivery team (including Installation representative) will meet to review the documentation, determine which, if any, credits will be audited and identify any corrections/missing items prior to the closeout LEED documentation submittal.

1.9.2. Approximately 14 days after submittal of LEED closeout documentation, the Contractor and the Government's project delivery team (including Installation representative) will meet to review the LEED closeout documentation. The review conference will include discussion of and resolution of all review comments to ensure consensus on achievement of credits and satisfactory documentation. At the review conference a final score will be determined and endorsed in writing by all parties.

1.10. RED ZONE MEETING

At approximately 80% of contract completion or 60 days before the anticipated Beneficial Occupancy Date (BOD), whichever occurs first, the Contractor and the Government's project delivery team will conduct what is known as the Red Zone Meeting to discuss the close-out process, to schedule the events and review responsibilities for actions necessary to produce a timely physical, as well as fiscal, project close-out. The Red Zone meeting derives its name from the football term used to describe the team effort to move the ball the last 20 yards into the end zone. The close-out of a construction project sometimes can be equally as hard and most definitely requires the whole team's efforts. The ACO will chair the meeting. If not already provided, shortly before the meeting, the Contractor shall provide an electronic copy or access to the CADD as-built drawings, completed commensurate with the amount of work completed at the time of the Red Zone Meeting, as an indicator of the Contractors' understanding of and ability to meet the USACE CADD Standards and to ensure that the Contractor is making progress with CADD As-Built requirements. EXHIBIT 1 is a generic meeting checklist.

1.11. FINAL CLEANING

Clean the premises in accordance with FAR clause 52.236-12 and additional requirements stated here. Remove stains, foreign substances, and temporary labels from surfaces. Vacuum carpet and soft surfaces. Clean equipment and fixtures to a sanitary condition. Clean or replace filters of operating equipment if cleaning isn't possible or practicable. Remove debris from roofs, drainage systems, gutters, and downspouts. Sweep paved areas and rake clean landscaped areas. Remove waste, surplus materials, and rubbish from the site. Remove all temporary structures, barricades, project signs, fences and construction facilities. Submit a list of completed clean-up items on the day of final inspection.

1.12. INTERIM FORM DD1354 "TRANSFER AND ACCEPTANCE OF MILITARY REAL PROPERTY

Near the completion of Project, but a minimum of 60 days prior to final acceptance of the work, complete, update draft provided with the final design package(s) (see Section 01 33 16, paragraph 3.7.5) and submit an accounting of all installed property on Interim Form DD1354 "Transfer and Acceptance of Military Real Property." Include any additional assets/improvements/alterations and cost updates from the Draft DD Form 1354. Contact the COR for any project specific information necessary to complete the DD Form 1354. This form will be a topic for the Red Zone Meeting discussed above. For information purposes, a blank DD Form 1354 (fill-able) in ADOBE (PDF) may be obtained at the following web site: http://www.dtic.mil/whs/directives/infomgt/forms/eforms/dd1354.pdf Submit the completed Checklist for Form DD1354 of Government-Furnished and Contractor-Furnished/Contractor Installed items. Attach this list to the updated DD Form 1354. Instructions for completing the form and a blank checklist (fill-able) in ADOBE (PDF) may be obtained at the following web site:
http://www.wbdg.org/ccb/DOD/UFC/ufc_1_300_08.pdf

EXHIBIT 1

SAMPLE

Red Zone Meeting Checklist

Date:______________

Contract No.	
Description / Location	
Contractor	
Contracting Officer	

Action	Completion Milestone	√
Inspections		
Fire		
Safety		
Pre-final		
Mechanical Test & Balance		
Commissioning		
Landscaping Complete		
Erosion Control		
Beneficial Occupancy Date (BOD)		
Furniture Installation		
Comm Installation		
As-Built Drawings		
Provide all O&M manuals, tools, shop drawings, spare parts, etc. to customer		
Training of O&M Personnel		
Provide Warranty documents to Customer		
Contract completion		

Ribbon cutting		
Payroll Clearances		
DD Form 2626 - Construction Contractor Performance Evaluation		
DD Form 2631 – A-E Performance Rated after Construction		
Status of Pending Mods and REA's/Claims		
Final Payment Completed		
Release of Claims		
Return of Unobligated Funds		
Move Project from CIP to General Ledger		
Financial completion		

End of Section 01 78 02.00 10

FORT SAM HOUSTON, TEXAS

ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX

GOVERNMENT GEOTECHNICAL REPORT

FOR DESIGN-BUILD PROJECT RFP

PREPARED BY

U.S. ARMY CORPS OF ENGINEERS

FORT WORTH DISTRICT

ENGINEERING AND CONSTRUCTION DIVISION
ENGINEERING BRANCH

GEOTECHNICAL SECTION

CESWF-EC-DG

NOVEMBER 2008
(Amended OCTOBER 2010 for Battalion Headquarters RFP)

FORT SAM HOUSTON, TEXAS
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX

GOVERNMENT GEOTECHNICAL REPORT

1. General. The purpose of this report is to provide subsurface information, and foundation and pavement design considerations, guidance, and requirements for two new Barracks (Student Dormitories), a Battalion Headquarters, a Central Energy Plant, and associated pavement structures to be constructed as part of the new Advanced Individual Training Barracks Complex at Fort Sam Houston, Texas. The new Student Dormitories are each required to accommodate 1,200 enlisted personnel, and will be designed with a maximum total gross area of approximately 330,000 GSF, based on information available at the time of this report. The Student Dormitories are each anticipated to be four stories in height. In addition to sleeping rooms, the new Student Dormitories are anticipated to include administrative areas, day rooms, laundry rooms, storage rooms, computer rooms, and mechanical/ electrical/communications rooms. It is anticipated that the new building construction will match existing building architectural styles of the surrounding area. At the time of this report, it is anticipated that all new vehicular pavement structures shall be rigid pavement. New rigid pavement structures are anticipated to include a new concrete fire/emergency medical vehicle access lane and concrete aprons in front of trash dumpster pads. New rigid pavement structures are also anticipated to include privately-owned vehicle (POV) parking areas in the northern part of the site (north of Student Dormitory 1), and adjacent to the Battalion Headquarters, and service drives. A new ½-mile running track is also included in the project. Two earth-lined stormwater detention ponds, located at the northern and southern limits of the project site, area also included in the project; the detention ponds are anticipated to be 7 feet deep (maximum). Support features include a troop formation pad, sidewalks, new utilities, landscaping, and site improvements.

The AIT Barracks Complex project site is located in the northeast central part of Fort Sam Houston. Specifically, the majority of the project site (excluding the Central Energy Plant) is located within an existing athletic field immediately east of Williams Road at the intersections with Hardee Road and Koehler Road. This part of the project site is bounded to the north and east by perimeter trails separating the athletic field from an adjoining golf course, and to the south by an existing drainage ditch. The Central Energy Plant is anticipated to be located on a vacant parcel northeast of existing Building 1387 (located at the southwest corner of the intersection of Williams Road and Hardee Road). Based on project information available at the time of this report, the proposed building footprint for Student Dormitory 1 is centered slightly north of the intersection of Williams Road and Hardee Road, and the proposed building footprint for Student Dormitory 2 is centered slightly south of the intersection of Williams Road and Koehler Road. The proposed building footprint for the Battalion Headquarters is located immediately east of, and centered between the two Student Dormitories Topographically, the majority of the AIT Barracks Complex site east of Williams Road is very level, with the gradient increasing to the south and east (i.e., in the area of Student Dormitory 2). The existing gradient in the area of Student Dormitory 1 ranges from less than 1 percent to approximately 7 percent, sloping generally to the east. The existing gradient in the area of Student Dormitory 2 ranges from less than 1 percent to greater than 10 percent, sloping generally to the south and east. The existing gradient in the area of the Battalion Headquarters ranges from about 3 percent to greater than 10 percent. In the area of the Central Energy Plant, the existing gradient ranges from less than 1 percent to about 8 percent, sloping generally to the east. According to a recent survey, existing grades within the proposed Student Dormitory 1 building footprint range from approximately 673.0 feet to 678.0 feet National Geodetic Vertical Datum (NGVD). Existing grades within the proposed Student Dormitory 2 building footprint range from approximately 663.5 feet to 676.0 feet (NGVD). Existing grades within the proposed Battalion Headquarters range from approximately 667.0 feet to 672.0 feet (NGVD). Existing grades within the proposed Central Energy Plant range from approximately 677.0 feet to 680.5 feet (NGVD). Based on project information available at the time of this report, the following finish floor elevations have been assigned to the corresponding project facilities:

Building	Finish Floor Elevation, feet (NGVD)
Student Dormitory 1	677.0
Student Dormitory 2	674.0
Battalion Headquarters	675.0

A finish floor elevation for the Central Energy Plant was not known at the time of this report. Refer to the civil drawings provided elsewhere in this RFP Package for civil/site grading plans presenting the post-construction site grading.

2. Subsurface Investigation. The U.S. Army Corps of Engineers, Fort Worth District, drilled twenty-six (26) test holes at the AIT Barracks Complex project site between June and August 2008. Specifically, borings 10A-1272 through 8A4C-1297 were drilled at the AIT Barracks Complex project site to determine subsurface conditions and to obtain representative soil and rock samples for laboratory testing. Test hole advancement and sample recovery was performed at the AIT Barracks Complex project site using 4-, 6-, 7 $^{7}/_{8}$-, 8-, and 10-inch diameter short flight augers, 4-inch carboloy bit and diamond bit core barrel samplers, a 10-inch drag bit, and a nominal 3-inch diameter shelby tube sampler. Samples recovered from selective borings were sealed in airtight containers and taken to the laboratory of TEAM Consultants, Incorporated (Arlington, Texas) for testing. Borings were drilled to total depths ranging from 6.5 feet to 65.0 feet below existing grade.

The field investigation was performed using a Failing 1500 truck-mounted drill rig and conventional drilling attachments. Results of the field investigation are shown on the Boring Locations sheets, B101 through B103, and on the Logs of Borings Sheets, B201 through B207 (Appendix A).

a. Groundwater Conditions. Groundwater conditions were monitored during drilling operations, immediately upon completion of the test holes, and after an observation period of up to 24 hours. Static water levels were measured in ten of the twenty-six borings drilled at the AIT Barracks Complex project site, with depths ranging from 14.8 feet to 53.2 feet below existing grade. Tabulated below are the static levels measured at the time of the field investigation. It should be noted that groundwater conditions are relative to the time of drilling, annual precipitation, and drainage conditions at the site.

Boring	Static Level, feet
8A4C-1276	53.2
8A4C-1277	39.0
8A4C-1279	36.0
8A4C-1281	40.6
8A4C-1284	26.3
8A-1285	51.0
8A4C-1286	40.8
8A4C-1287	22.7
8A4C-1289	14.8
8A4C-1297	30.1

b. Dynamic Cone Penetrometer Testing. Dynamic Cone Penetrometer testing (DCP) was performed for pavement design considerations at the AIT Barracks Complex project site in borings 10A-1273, 10A-1278, 10A-1282, 6A-1283, 10A-1290, 10A-1292, and 6A-1294. Results of DCP testing are presented in Appendix D and discussed in paragraphs 4 and 5.

c. Soil Resistivity Testing. Soil resistivity testing was performed at two boring locations across the AIT Barracks Complex project site. One soil resistivity test was performed at the approximate location of boring 8A4C-1277; the resistivity value measured in the field at this location is 287 ohm-cm. A soil resistivity test was also performed at the approximate location of boring 8A4C-1287; the resistivity value measured in the field at this location is 958 ohm-cm. Soil resistivity test results are provided in the ‘Remarks’ column of the aforementioned logs of borings (Appendix A).

3. Subsurface Conditions.

a. General Geology. Fort Sam Houston lies within the Balcones fault zone which separates the Edwards plateau province to the northwest from the Gulf Coastal plain province to the southeast. The Balcones zone comprises an area approximately 15 miles wide, trending northeast-southwest through Bexar County. Single faults within this zone exhibit displacements up to 690 feet, with a total displacement across the zone of approximately 1,475 feet.

The primary geologic formation underlying the overburden is assigned to the Taylor Formation of Upper Cretaceous age. In this area, the Taylor Formation consists of a clay shale which is soft to moderately hard (rock classification), calcareous, slightly silty, with occasional hard, marly zones up to 3 feet thick. The clay shale is generally jointed and weathered to a depth of 50 to 60 feet below ground surface. The Taylor Formation has an estimated thickness of 210 feet in this area and is conformably underlain by the Anacacho Limestone Formation.

b. Site Conditions. As previously discussed, the majority of the AIT Barracks Complex project site (excluding the Central Energy Plant) is located within an existing athletic field. Hence, the part of the project site east of Williams Road is primarily an open, grass-covered parcel with scattered trees. Existing facilities that will require demolition for the new project construction include a running track and a metal fence. The area of the proposed Central Energy Plant building footprint is also a clear, grass-covered parcel that adjoins a drainage ditch (separating the proposed Central Energy Plant from existing Building 1387). Existing grades within the proposed Student Dormitory 1 building footprint range from approximately 673.0 feet to 678.0 feet (NGVD), with gradients ranging from approximately 1 percent to 7 percent, sloping generally to the east. Existing grades within the proposed Student Dormitory 2 building footprint range from approximately 663.5 feet to 676.0 feet (NGVD), with gradients ranging from less than 1 to greater than 10 percent, sloping generally to the south and east. Existing grades within the proposed Battalion Headquarters range from approximately 667.0 feet to 672.0 feet (NGVD), with gradients ranging from about 3 percent to greater than 10 percent. Existing grades within the proposed Central Energy Plant range from approximately 677.0 feet to 680.5 feet (NGVD), with gradients ranging from less than 1 percent to about 8 percent, sloping generally to the east.

Stratigraphically, the site is characterized by medium to high plasticity clay (CL to CH, respectively) and clayey gravel/cobble overburden strata, and deeper formations of weathered and unweathered clay shale primary. **NOTE: Stratigraphic contact depths referenced herein are measured with respect to the original (pre-site construction) existing grades (i.e., the grades existing at the time of the geotechnical field investigation).** The uppermost overburden stratum typically consists of medium to high plasticity clay. The uppermost clay (i.e., extending to 2.9 to 5.5 feet below existing grade, averaging 5 feet below existing grade) is high plasticity (CH), stiff to hard, dry to slightly moist, dark brown to black, slightly sandy to sandy, and slightly gravelly to gravelly (with seams). Below the upper dark brown to black CH clay overburden, the clay becomes yellow brown to gray to red to strong brown (remaining so to the contact with the underlying gravel/cobble stratum, as described below), medium to high plasticity, stiff to hard, dry to moist, slightly sandy to sandy, slightly gravelly to gravelly, and slightly limy to limy. Liquid limits measured from representative samples of the medium to high plasticity clays collected across the entire AIT Barracks Complex project site range from 39 to 82 percent, plastic limits vary from 15 to 26 percent (with plasticity indices ranging from 23 to 60 percent), and in situ moisture contents vary between 8 and 23 percent. In the area of Student Dormitory 1, liquid limits measured from representative samples of the medium to high plasticity clays range from 39 to 80 percent, plastic limits vary from 15 to 26 percent (with plasticity indices ranging from 23 to 55 percent), and in situ moisture contents vary between 14 and 22 percent. In the area of Student Dormitory 2, liquid limits measured from representative samples of the medium to high plasticity clays range from 39 to 72 percent, plastic limits vary from 15 to 25 percent (with plasticity indices ranging from 24 to 47 percent), and in situ moisture contents vary between 13 and 20 percent. In the area of the Battalion Headquarters, liquid limits measured from representative samples of the medium to high plasticity clays range from 50 to 70 percent, plastic limits vary from 17 to 24 percent (with plasticity indices ranging from 33 to 46 percent), and in situ moisture contents vary between 15 and 17 percent. In the area of the Central Energy Plant, liquid limits measured from representative samples of the medium to high plasticity clays range from 51 to 66 percent, plastic limits vary from 18 to 21 percent (with plasticity indices ranging from 32 to 45 percent), and in situ moisture contents vary between 8 and 21 percent.

A stratum of clayey and sandy gravel and cobble is present between the medium to high plasticity clay overburden and the underlying clay shale primary. The gravel and cobble was typically encountered at depths ranging from approximately 3.0 to 26.4 feet below existing grade at the boring locations, except at the location of boring 10A-1290, where the gravel/cobble stratum was encountered at the surface (i.e., the medium to high plasticity clay overburden was not encountered at that location). Also, the gravel/cobble was not penetrated within the following borings: 10A-1272, 10A-1273, 10A-1274, 10A-1278, 6A-1295, and 6A-1296; the deepest stratum penetrated in each of these borings (which were each drilled to 10.0 feet below existing grade) was the CH overburden, as described above. The gravel/cobble varies in thickness from approximately 2.0 to 15.6 feet at the locations of borings drilled across the entire AIT Barracks Complex project site, based on borings drilled through the grave/cobble into the underlying clay shale. The gravel/cobble is described as loose to very dense (but typically dense to very dense), coarse to fine, dry to wet, brown to yellow brown to gray (clay and sand matrix), sandy and clayey (with seams of each), limy, with cobbles up to at least 5.5 inches in diameter recovered during drilling (the maximum size that could be recovered by the augers used during the field investigation). Atterberg limits testing was conducted on specimens of the clayey, sandy gravel, and the sandy medium plasticity clay and clayey sand matrix (seams) within the gravel cobble. Liquid limits measured from representative samples of the clayey, sandy gravel and clayey, sandy matrix/seam materials range from 36 to 45 percent, plastic limits vary from 15 to 16 percent (with plasticity indices ranging from 21 to 31 percent), and in situ moisture contents vary between 12 and 16 percent. It should be noted that the gravel/cobble stratum is a known water-bearing stratum at Fort Sam Houston (as indicated by the water levels measured during and after completion of drilling in borings 8A4C-1284, 8A-1285, 8A4C-1287, 8A4C-1289, and 8A4C-1297).

Beneath the overburden materials are formations of weathered and unweathered clay shale primary which are present to the total depth investigated (65.0 feet). Across the entire AIT Barracks Complex project site, the highly (badly) weathered to weathered clay shale primary was encountered at depths ranging from 14.5 to 35.5 feet below existing grade at the boring locations. This correlates to upper contact elevations for the weathered clay shale ranging from approximately 641.7 feet to 656.2 feet (NGVD) at the boring locations. The clay shale is yellow brown and light gray to strong brown, soft (rock classification), massive, silty, sandy (with sandy zones), calcareous, limonitic seams, and slightly fossiliferous to fossiliferous, with blocky structure. The weathered clay shale is highly fractured throughout. The fractures observed range from moderate to high angle, with gypsum crystals noted in healed fractures typically below 30 to 40 feet. It should be noted that water from the overlying gravel/cobble stratum is known to be able to migrate through the fractures within the clay shale, as indicated by the borings drilled during the current field investigation. Liquid limits measured from representative samples of the weathered clay shale collected across the entire AIT Barracks Complex project site range from 47 to 78 percent, plastic limits vary from 16 to 26 percent (with plasticity indices ranging from 31 to 53 percent), and in situ moisture contents vary between 15 and 24 percent. In the area of Student Dormitory 1, liquid limits measured from representative samples of the weathered clay shale range from 47 to 65 percent, plastic limits vary from 16 to 22 percent (with plasticity indices ranging from 31 to 45 percent), and in situ moisture contents vary between 15 and 21 percent. In the area of Student Dormitory 2, liquid limits measured from representative samples of the weathered clay shale range from 58 to 78 percent, plastic limits vary from 20 to 26 percent (with plasticity indices ranging from 38 to 53 percent), and in situ moisture contents vary between 19 and 24 percent. In the area of the Battalion Headquarters, liquid limits measured from representative samples of the weathered clay shale range from 60 to 74 percent, plastic limits vary from 20 to 24 percent (with plasticity indices ranging from 40 to 50 percent), and in situ moisture contents vary between 17 and 21 percent. In the area of the Central Energy Plant, a liquid limit of 64 percent, a plastic limit of 21 percent (plasticity index = 43 percent), and an in situ moisture content of approximately 22 percent was measured from a representative sample of the weathered clay shale (boring 8A4C-1297, sample C-1).

Dark gray unweathered clay shale was encountered at depths ranging from 47.0 to 63.0 feet below existing grade at the boring locations across the entire AIT Barracks Complex project site. This correlates to upper contact elevations for the unweathered clay shale ranging from approximately 607.9 feet to 631 feet (NGVD) at the boring locations. For borings drilled in the area of Student Dormitory 1 (specifically, borings 8A-1275, 8A4C-1276, 8A4C-1277, 8A4C-1279, and 8A-1280), the unweathered clay shale was encountered at depths ranging from 47.0 to 56.0 feet below existing grade, with corresponding elevations of approximately 618.3 feet to 631.1 feet (NGVD). For borings drilled in the area of Student Dormitory 2 (specifically, borings 8A4C-1284, 8A-1285, 8A4C-1287, 8A-1288, and 8A4C-1289), the unweathered clay shale was encountered at depths ranging from 56.0 to 63.0 feet below existing grade, with corresponding elevations of approximately 607.9 feet to 617.2 feet (NGVD). It should be noted that the unweathered clay shale was not penetrated in boring 8A-1288 (Student Dormitory 2 area), which was drilled to a depth of 65.0 feet below existing grade (correlating to an approximate elevation of 608.7 feet (NGVD)); the clay shale within this boring appeared to be less weathered (transitioning to unweathered) below approximately 61.0 feet. The unweathered clay shale appears to be better cemented and unfractured compared to the overlying weathered clay shale. The unweathered clay shale is moderately hard (rock classification), unctuous, sandy, and slightly fossiliferous. Liquid limits measured from representative samples of the unweathered clay shale collected across the entire AIT Barracks Complex project site range from 36 to 69 percent, plastic limits vary from 15 to 23 percent (with plasticity indices ranging from 18 to 46 percent), and in situ moisture contents vary between 10 and 20 percent. In the area of Student Dormitory 1, liquid limits measured from representative samples of the unweathered clay shale range from 36 to 53 percent, plastic limits vary from 15 to 21 percent (with plasticity indices ranging from 18 to 32 percent), and in situ moisture contents vary between 10 and 16 percent. In the area of Student Dormitory 2, liquid limits measured from representative samples of the unweathered clay shale range from 38 to 69 percent, plastic limits vary from 18 to 23 percent (with plasticity indices ranging from 20 to 46 percent), and in situ moisture contents vary between 10 and 21 percent. Isopach maps depicting an interpretation of the upper contact elevations across the site for the gravel/cobble, weathered shale, and unweathered shale strata are presented on Sheets B104, B105, and B106, respectively.

Subsurface conditions representative of the project site are shown on the logs of borings, Sheets B201 through B207 (Appendix A). The legend on the individual boring logs show overburden materials as classified in the laboratory using procedures presented in ASTM D 2488. It should be noted that the actual interface between material types may be far more gradual or abrupt than presented; therefore, actual subsurface conditions in areas not sampled may differ from those predicted. The nature and extent of variations across the sites may not become evident until construction commences, and the actual construction process may alter subsurface conditions as well. If variations become evident at the time of construction, CESWF-EC-DG should be contacted to determine if the recommendations presented in this report need to be reevaluated.

4. Testing.

a. Laboratory Testing. Representative soil and rock samples recovered from selective test holes were subjected to laboratory testing for identification, moisture content, grain-size distribution, Atterberg limits, density, strength, and controlled expansion-consolidation. The accumulative test results are tabulated and presented in Appendix C. Results of identification and moisture content testing are shown on the individual boring logs, Appendix A.

Results of laboratory testing performed on samples obtained from the AIT Barracks Complex site are presented graphically in Appendix B as follows: Plasticity characteristics are shown on Plate 1, Plasticity Chart. Moisture content values of representative samples are shown with respect to depth on Plate 2. Atterberg limits test results are shown with respect to depth on Plate 3. Dry density values of representative undisturbed samples and their corresponding moisture contents are shown with respect to depth on Plate 4. Ultimate compressive strengths of the clay shale primary are shown with respect to depth on Plate 5.

(1) Shear Strength Testing. Shear strength characteristics of the high plasticity clay overburden and the clay shale primary were analyzed in the laboratory using one-point unconsolidated-undrained triaxial compression testing, confining the specimens to overburden pressure and then loading to failure. Specimens denoted with a "(UC)" were subjected to unconfined compression strength testing, as the strength of the sample was anticipated to exceed the rated capacity of the triaxial test equipment. Tabulated below are the ultimate compressive strengths and respective dry densities of the overburden clay and clay shale primary specimens. Shear strength test results are also presented in Appendix C at the end of this report.

Boring	Depth, feet	γ_d, pcf	Q_u, tsf	Material Type
8A4C-1276	34.5	107.3	10.53	Weathered Shale
8A4C-1276	43.5	108.7	9.83	Weathered Shale
8A4C-1276	49.6	113.2	13.96	Weathered Shale
8A4C-1276	56.6	133.5	72.84 (UC)	Unweathered Shale
8A4C-1276	62.6	133.5	59.56 (UC)	Unweathered Shale
8A4C-1277	27.5	112.4	10.92	Weathered Shale
8A4C-1277	34.5	108.0	4.99	Weathered Shale
8A4C-1277	40.5	110.8	7.91	Weathered Shale
8A4C-1277	46.5	109.7	9.75	Weathered Shale
8A4C-1277	52.5	117.5	16.96	Unweathered Shale
8A4C-1277	59.5	133.7	52.88 (UC)	Unweathered Shale
8A4C-1279	34.5	110.4	7.88	Weathered Shale
8A4C-1279	42.5	107.2	8.19	Weathered Shale
8A4C-1279	48.5	110.2	8.48	Weathered Shale
8A4C-1279	54.5	118.4	22.77 (UC)	Unweathered Shale
8A4C-1279	61.5	119.7	21.32 (UC)	Unweathered Shale
8A4C-1281	8.0	119.5	13.69	CH Clay Overburden
8A4C-1281	23.5	107.4	7.51	Weathered Shale
8A4C-1281	29.5	112.7	13.88	Weathered Shale
8A4C-1281	35.5	113.6	5.12	Weathered Shale
8A4C-1281	42.5	108.9	10.12	Weathered Shale
8A4C-1284	33.5	100.6	4.68	Weathered Shale
8A4C-1284	41.6	109.2	10.19	Weathered Shale
8A4C-1284	50.6	107.3	7.33	Weathered Shale
8A4C-1284	56.5	109.1	12.24	Weathered Shale
8A4C-1284	63.5	120.8	26.15	Unweathered Shale
8A4C-1286	25.0	106.8	4.84	Weathered Shale
8A4C-1286	31.5	102.7	5.60	Weathered Shale
8A4C-1286	37.5	115.9	9.19	Weathered Shale

Boring	Depth, feet	γ_d, pcf	Q_u, tsf	Material Type
8A4C-1286	43.5	105.0	5.55	Weathered Shale
8A4C-1287	36.0	101.2	4.92	Weathered Shale
8A4C-1287	43.6	108.7	18.87	Weathered Shale
8A4C-1287	49.5	107.3	8.90	Weathered Shale
8A4C-1287	55.5	108.8	9.33	Weathered Shale
8A4C-1287	63.5	133.4	43.04 (UC)	Unweathered Shale
8A4C-1289	25.5	103.9	4.91	Weathered Shale
8A4C-1289	32.5	104.2	5.22	Weathered Shale
8A4C-1289	39.5	103.6	11.52	Weathered Shale
8A4C-1289	47.5	111.5	19.80	Weathered Shale
8A4C-1289	53.5	106.6	16.83	Weathered Shale
8A4C-1289	60.5	107.9	14.62	Unweathered Shale
8A4C-1297	9.0	111.5	9.04	CH Clay Overburden
8A4C-1297	16.0	108.0	6.55	CH Clay Overburden
8A4C-1297	24.0	110.8	8.25	CH Clay Overburden
8A4C-1297	42.5	106.1	5.45	Weathered Shale

(2) Controlled Expansion-Consolidation Testing and Swell Pressure Testing. Controlled expansion-consolidation (CEC) testing was performed on one specimen of high plasticity (CH) clay overburden, one specimen of medium plasticity clay overburden, two specimens of weathered clay shale, and two specimens of unweathered clay shale collected at the AIT Barracks Complex site.

A specimen of high plasticity (CH) clay overburden collected at a depth of 3.0 feet within boring 8A4C-1277 was subjected to controlled expansion-consolidation testing. This high plasticity clay specimen has a liquid limit of 72 percent, a plastic limit of 25 percent (PI = 47 percent), and natural moisture content of approximately 18 percent. An expansion pressure (p_{exp}) of approximately 5.0 tsf was recorded during CEC testing of the high plasticity clay specimen. Based on CEC test results, the high plasticity clay specimen collected at a depth of 3.0 feet within boring 8A4C-1277 has a very high expansion potential (C_s = 0.084; p_{exp}/p_0 = 28.9) and a moderate to high consolidation potential (C_c = 0.222). A specimen of medium plasticity (CL) clay overburden collected at a depth of 20.0 feet within boring 8A4C-1278 also was subjected to controlled expansion-consolidation testing. This medium plasticity clay specimen has a liquid limit of 39 percent, a plastic limit of 15 percent (PI = 24 percent), and natural moisture content of approximately 15 percent. An expansion pressure (p_{exp}) of approximately 1.5 tsf was recorded during CEC testing of the medium plasticity clay specimen. Based on CEC test results, the medium plasticity clay specimen collected at a depth of 20.0 feet within boring 8A4C-1278 has a moderate expansion potential (C_s = 0.029; p_{exp}/p_0 = 1.2) and a low to moderate consolidation potential (C_c = 0.096).

Controlled expansion-consolidation was performed on two specimens of the weathered clay shale primary. A weathered clay shale primary specimen collected at a depth of 27.5 feet within boring 8A4C-1277 was subjected to controlled expansion-consolidation testing. This weathered clay shale primary specimen has a liquid limit of 57 percent, a plastic limit of 20 percent (PI = 37 percent), and a natural moisture content of approximately 18 percent. An expansion pressure (p_{exp}) of approximately 2.0 tsf was recorded during CEC testing on this weathered shale primary specimen. Based on CEC test results, the weathered clay shale specimen collected at a depth of 27.5 feet within boring 8A4C-1277 has a moderate expansion potential (C_s = 0.037; p_{exp}/p_0 = 1.2) and a low consolidation potential (C_c = 0.071). Controlled expansion-consolidation testing also was performed on a weathered clay shale primary specimen collected at a depth of 49.5 feet within boring 8A4C-1287. This weathered clay shale primary specimen has a liquid limit of 63 percent, a plastic limit of 20 percent (PI = 43 percent), and a natural moisture content of approximately 21 percent. An expansion pressure (p_{exp}) of approximately 3.0 tsf was recorded during CEC testing on this weathered shale primary specimen. Based on CEC test results, the weathered clay shale specimen collected at a depth of 49.5 feet within boring 8A4C-1287 has a moderate to high expansion potential (C_s = 0.061; p_{exp}/p_0 = 1.0) and a low to moderate consolidation potential (C_c = 0.103).

Controlled expansion-consolidation testing was performed on two specimens of the unweathered clay shale primary. An unweathered clay shale primary specimen collected at a depth of 52.5 feet within boring 8A4C-1277 was subjected to controlled expansion-consolidation testing. This unweathered clay shale primary specimen has a liquid limit of 53 percent, a plastic limit of 21 percent (PI = 32 percent), and a natural moisture content of approximately 16 percent. An expansion pressure (p_{exp}) of approximately 3.2 tsf was recorded during CEC testing on this unweathered shale primary specimen. Based on CEC test results, the unweathered clay shale specimen collected at a depth of 52.5 feet within boring 8A4C-1277 has a moderate expansion potential (C_s = 0.026; p_{exp}/p_0 = 0.9) and a very low consolidation potential (C_c = 0.045). Controlled expansion-consolidation testing also was performed on a specimen of cemented unweathered clay shale primary collected at a depth of 59.5 feet within boring 8A4C-1277. This cemented unweathered clay shale primary specimen has a liquid limit of 42 percent, a plastic limit of 19 percent (PI = 23 percent), and a natural moisture content of approximately 10 percent. An expansion pressure (p_{exp}) of approximately 1.0 tsf was recorded during CEC testing on this cemented unweathered shale primary specimen. Based on CEC test results, the cemented unweathered clay shale specimen collected at a depth of 59.5 feet within boring 8A4C-1277 has a low expansion potential (C_s = 0.007; p_{exp}/p_0 = 0.3) and a low consolidation potential (C_c = 0.057). Controlled expansion-consolidation test results are summarized in the table below and presented in Appendix C at the end of this report.

Controlled Expansion-Consolidation Tests

Boring	Depth, feet	LL	PI	P_{exp}/P_o	C_s	C_c	Material Type
8A4C-1277	27.5	57	37	1.2	0.037	0.071	Weathered Shale
8A4C-1277	52.5	53	32	0.9	0.026	0.045	Unweathered Shale
8A4C-1277	59.5	42	23	0.3	0.007	0.057	Unweathered Shale
8A4C-1287	3.0	72	47	28.9	0.084	0.222	CH Clay Overburden
8A4C-1287	20.0	39	24	1.2	0.029	0.096	CL Clay Overburden
8A4C-1287	49.5	63	43	1.0	0.061	0.103	Weathered Shale

b. Field Testing. Dynamic Cone Penetrometer (DCP) testing was performed in borings 10A-1273, 10A-1278, 10A-1282, 6A-1283, 10A-1290, 10A-1292, and 6A-1294 at the AIT Barracks Complex site for pavement design considerations. A DCP consists of a steel rod with a steel cone attached to one end and a sliding single-mass hammer. For this project, the DCP test was performed by driving the steel cone into the soil using a 10.1-pound sliding hammer dropped from a height of 22.6 inches (574 millimeters). The number of blows required for each 0.4 inch (10-mm) or higher of penetration was recorded as the "penetration per blow set"; therefore, the more penetration achieved per blow indicates that a "weaker" soil layer was encountered. Typically, penetration measurements are taken to a depth of 39.4 inches (1,000 millimeters) or when refusal is achieved. Refusal is defined as the point when the cone cannot penetrate the soil more than 0.4 inches (10 millimeters). Presented below are the average in situ strength parameters derived from the DCP tests. DCP test results are also presented in Appendix D at the end of this report.

Depth, in	CBR, %	k, pci
0 – 6	18 - 55	259 - 282
6 – 12	12 - 45	226 - 377
>12	8	180

5. <u>Discussions.</u> The following discussions are provided in support of the foundation and pavement design recommendations and requirements made herein for the proposed AIT Barracks Complex and appurtenant pavement structures. It should be noted that the discussions presented herein are based on the results of the Government geotechnical field investigation and laboratory testing program conducted at the site, as described previously in this report, as well as engineering studies, and previous engineering experience with similar structures at Fort Sam Houston. The Design-Build Contractor shall heed the information provided in this report and comply with the requirements and recommendations presented herein when developing his foundation and pavement designs. **<u>The Design-Build Contractor's foundation and pavement designs are required to comply with and to meet or exceed the minimum foundation and pavement design requirements and recommendations presented herein.</u>** The bidders for this design-build contract project may use the subsurface boring log and lab testing data as a basis to formulate their foundation and pavement designs for the purposes of developing a bid for the project Request for Proposal (RFP) solicitation. The successful Design-Build Contractor bidder may supplement the information provided herein by his own geotechnical field investigation and laboratory testing program for the purpose of supplementing and comparing with the data provided in this report, and to serve as a basis for the development of his final foundation and pavement designs. **<u>Supplemental geotechnical field investigations conducted by the Design-Build Contractor shall be ONLY for the purpose of</u>**

supplementing the data regarding the subsurface conditions provided by the Government geotechnical field investigation. These supplemental efforts shall include conducting testing on soil and rock (clay shale) specimens as described in Section 4 (Testing). Additional test holes shall each be drilled to a minimum depth of 65 feet below existing grade. **All borings, test holes, and drilled excavations created as part of the construction (e.g., elevator jack holes) shall be grouted full depth with a lean grout mixture to seal holes and excavations from water penetration.** Tests on disturbed specimens of overburden soils shall include classification (ASTM D 2488), moisture content (ASTM D 2216), grain size analysis (ASTM D 422), and Atterberg limits (ASTM D 4318). Undisturbed (shelby tube) specimens of the overburden soils shall also be collected; tests on undisturbed specimens of the overburden soil shall include the tests listed for disturbed specimens, as well as controlled expansion-consolidation testing (ASTM D 2435 and ASTM D 4546 (Method C)), density (Corps of Engineers Engineer Manual (EM) 1110-2-1906, Appendix II, Par. 4, Displacement Method), and strength testing (ASTM D 2850). Core specimens of at least 4-inch diameter of the clay shale primary shall be collected and subjected to testing to include moisture content (ASTM D 2216), Atterberg limits (ASTM D 4318), density (Corps of Engineers EM 1110-2-1906, Appendix II, Par. 4, Displacement Method), controlled expansion-consolidation (at least four specimens) (ASTM D 2435 and ASTM D 4546 (Method C)), and strength (ASTM D 2464).

Development of the final foundation and pavement designs is the responsibility of the Design-Build Contractor; however, the Design-Build Contractor's final foundation and pavement designs shall be in full compliance with the requirements prescribed herein (including foundation type, foundation design parameters, and minimum pavement sections and pavement design criteria and parameters). The Design-Build Contractor shall provide to the Government engineering studies and design calculations that support the foundation and pavement design recommendations they or their associates propose. The Design-Build Contractor's foundation and pavement design recommendations shall be reviewed for technical adequacy and compliance with the requirements and criteria established herein and in the

Request for Proposal (RFP). Specific requirements for the Design-Build Contractor's foundation and pavement design analysis are provided in section 6.c.

a. Soil Activity Considerations. The AIT Barracks Complex site is characterized by a medium to high plasticity clay overburden stratum, underlain by a clayey and sandy gravel/cobble stratum of variable thickness that is further underlain by formations of weathered and unweathered clay shale primary. The high plasticity overburden clay is typically present to depths ranging from 3.0 feet to 26.4 feet below existing grade across the entire AIT Barracks Complex site. The underlying clayey and sandy gravel/cobble stratum ranges form 2.0 to 15.6 feet in thickness. The weathered clay shale was encountered at depths ranging from 14.5 feet to 35.5 feet below existing grade at the test hole locations drilled across the entire AIT Barracks Complex project site. The unweathered clay shale was encountered at depths ranging from 47.0 feet to 63.0 feet below existing grade at the test hole locations drilled across the entire AIT Barracks Complex project site (except boring 8A-1288, which was drilled to 65.0 feet below existing grade and did not penetrate into the uniformly dark gray unweathered shale). The plasticity characteristics and in situ moisture contents of the medium to high plasticity clay overburden, clayey and sandy gravel/cobble, and the weathered and unweathered clay shale primary have been discussed in detail in paragraph 3.b., above, and are summarized in the tables below.

Range of Atterberg Limits and In Situ Moisture Contents Measured Across the Entire AIT Barracks Complex Project Site

Stratum	LL, %	PL, %	PI, %	w, %
High Plasticity Clay Overburden	39 – 82	15 – 26	23 – 60	8 – 23
Clayey, Sandy Gravel/Cobble	36 – 45	15 – 16	21 – 30	12 – 16
Weathered Clay Shale	47 – 78	16 – 26	31 – 53	15 – 24
Unweathered Clay Shale	36 – 69	15 – 23	18 – 46	10 – 21

Moisture content and Atterberg limits test results indicate that these materials are potentially moisture deficient throughout the entire depth investigated (65.0 feet).

The results of controlled expansion-consolidation testing conducted on specimens collected during the geotechnical field investigation at the AIT Barracks Complex site are discussed in paragraph 4.a.(2), above. Based on the results of controlled expansion-consolidation testing conducted on the selected shelby tube and core specimens, the clay overburden has a moderate to very high potential for expansion, the weathered clay shale primary has a moderate to high potential for expansion, and the unweathered clay shale has a low to moderate potential for expansion. Also, based on the cited testing data, the clay overburden has a low to high potential for consolidation, the weathered clay shale has a low to moderate potential for consolidation, and the unweathered clay shale has a very low to low potential for consolidation. It should be noted that during controlled expansion-consolidation testing conducted recently on these strata for the nearby Medical Education and Training Campus (METC) program and San Antonio Military Medical Center (SAMMC) – North Campus projects, the clay overburden has been determined to possess a high to very high potential for expansion, the weathered clay shale primary a high to very high potential for expansion, and the unweathered clay shale a moderate to high potential for expansion. Also, based on the CEC test data conducted for the neighboring projects, the clay overburden has a moderate to high potential for consolidation and the clay shale (both weathered and unweathered) has a low to moderate potential for consolidation.

An expansive soils analysis was performed to quantify the response of the active clay overburden and clay shale primary when subjected to increased load conditions during periods of seasonal moisture fluctuations. In the analysis, the plastic overburden soils and clay shale primary are assumed to be in a saturated condition, and initially, surcharge loads (fill and building) were neglected. Due to the fractured nature of the clay shale primary, particularly in the weathered zone, and the results of the previously discussed Atterberg limits, moisture content, and controlled expansion-consolidation testing, the active zone is considered to potentially extend well into the unweathered clay shale. Hence, an active zone of 65.0 feet was used for the expansive soils analysis. As has been previously discussed, there is considerable variation in the contact depths of the strata across this site. The expansive soils analysis considers the following idealized stratigraphy: 0.0 feet to 5.0 feet – high plasticity (CH) clay; 5.0 feet to 15.0 feet – medium to high plasticity clay (CL to CH); 15.0 feet to 20.0 feet – clayey and sandy gravel/cobble; 20.0 feet to 55.0 feet – yellow brown and gray weathered clay shale; 55.0 feet to 65.0 feet – uniformly dark gray unweathered clay shale. The expansive soils analysis is based on the following material properties, by layer/depth interval:

Depth, feet	LL	PI	P_{exp}, tsf	P_{exp}/P_o	C_s	C_c	Material Type
0.0 – 5.0	72	47	5.0	28.9	0.084	0.222	CH Clay Overburden[1]
5.0 – 15.0	39	24	1.5	1.2	0.029	0.096	CL Clay Overburden [2]
15.0 – 20.0	36	22	0.7	0.9	0.020	0.170	Clayey Gravel/Cobble[3]
20.0 – 40.0	57	37	2.0	1.2	0.037	0.071	Weathered Shale[4]
40.0 – 55.0	63	43	3.0	1.0	0.061	0.103	Weathered Shale[5]
55.0 – 65.0	53	32	3.2	0.9	0.026	0.045	Unweathered Shale[6]

1. Boring 8A4C-1287, specimen ST-1 (sample depth = 3.0 feet) – this investigation;
2. Boring 8A4C-1287, specimen ST-3 (sample depth = 20.0 feet) – this investigation;
3. Boring 6DC-660, specimen DB-5 (sample depth = 12.0 feet) – BAMC site investigation (historical data);
4. Boring 8A4C-1277, specimen C-1 (sample depth = 27.5 feet) – this investigation;
5. Boring 8A4C-1287, specimen C-3 (sample depth = 49.5 feet) – this investigation;
6. Boring 8A4C-1277, specimen C-5 (sample depth = 52.5 feet) – this investigation.

Based on these conditions, the heave potential of the overburden and primary materials within the active zone was determined to be approximately 6.1 inches. However, apart from the uppermost CH clay specimen, the samples from this field investigation subjected to CEC testing generally exhibit lower-end expansive characteristics as compared to the total data set for this site as well as historical values for these strata at Fort Sam Houston. Therefore, an additional range of expansion pressures for the overburden clay, and the weathered and unweathered clay shale formations were also considered based on data from the current site investigation and also on extensive controlled expansion-consolidation testing conducted previously on similar materials at the nearby Brooke Army Medical Center (BAMC) site and the Medical Education and Training Campus projects. The additional range of expansion pressures considered in the analysis is based on the following material properties, by layer/depth interval:

Depth, feet	LL	& PI	P_{exp}, tsf	P_{exp}/P_o	C_s	& C_c	Material Type
0.0 – 5.0	72	47	5.0	28.9	0.084	0.222	CH Clay Overburden[1]
5.0 – 15.0	52	35	2.2	2.2	0.035	0.191	CH Clay Overburden [2]
15.0 – 20.0	36	22	0.7	0.9	0.020	0.170	Clayey Gravel/Cobble[3]
20.0 – 55.0	75	54	3.3	1.9	0.070	0.105	Weathered Shale[4]
55.0 – 65.0	73	55	5.0	1.3	0.045	0.046	Unweathered Shale[5]

1. Boring 8A4C-1287, specimen ST-1 (sample depth = 3.0 feet) – this investigation;
2. Boring 8A4C-1178, specimen ST-3 (sample depth =16.0 feet) - METC Student Dormitories site investigation;
3. Boring 6DC-660, specimen DB-5 (sample depth = 12.0 feet) – BAMC site investigation (historical data);
4. Boring 6DC-658, specimen C-1 (sample depth = 28.4 feet) – BAMC site investigation (historical data);
5. Boring 6DC-659, specimen C-9 (sample depth = 57.5 feet) – BAMC site investigation (historical data);

Although the highly plastic overburden soils contribute the greater portion of heave potential, the contribution to total heave of the clay shale is also significant, despite the overburden pressure of the overlying strata. The expansive soils analyses determined that if the active zone extended to a depth of 20 feet below existing grade (approximate average contact between the overburden soils and the weathered clay shale), a heave potential ranging from approximately 5.7 to 6.2 inches is anticipated. A residual heave potential ranging from approximately 5.1 to 5.6 inches is also anticipated even with a building surcharge of 100 psf. The expansive soils analyses determined that if the active zone extended to the contact between the weathered and unweathered shale, a depth of approximately 55 feet below existing grade, a heave potential ranging from 6.1 to 9.2 inches is anticipated. A residual heave potential ranging from 5.4 to 8.4 inches is also anticipated even with a building surcharge of 100 psf. And, if the unweathered clay shale is activated, either through water penetrating the stratum via fractures occurring naturally in the deposit or created as a result of drilled pier construction (or a combination of these pathways), a heave potential ranging from 6.1 to 9.4 inches is anticipated (considering that the clay shale becomes activated to a depth of no greater than 65 feet below existing grade). A residual heave potential ranging from 5.4 to 8.6 inches is anticipated considering a building surcharge of 100 psf.

The settlement potential of the overburden clay and clay shale primary is anticipated to be about 1 inch considering a building surcharge of 100 psf. Considering fill surcharges (in addition to the building surcharge) ranging from 1 to 5 feet in thickness, the settlement potential of the overburden clay and clay shale primary is anticipated to range from approximately 1.6 inches to 3.6 inches. Considering fill surcharges (in addition to the building surcharge) ranging from 6 to 10 feet in thickness, the settlement potential of the overburden clay and clay shale primary is anticipated to range from approximately 4.0 inches to 5.2 inches. Fill surcharges exceeding 10 feet are not anticipated, however, settlement potentials for greater fill surcharges can be provided by CESWF-EC-DG upon request.

The expansive soils analysis demonstrates the very high expansion potential of the overburden clay and the clay shale primary. Due to the high potential volumetric changes that may be expected of the high plasticity clay overburden and clay shale primary, it is required that ground level floor slabs for the Student Dormitories be structurally-supported. Special foundation and subgrade preparation requirements for the smaller (and comparatively lightly-loaded) Battalion Headquarters and Central Energy Plant are provided herein to withstand the effects of the highly expansive subsurface conditions.

b. Foundation Design Considerations. The foundation design recommendations and requirements presented in this report are based on criteria contained in *UFC 3-220-03FA, UFC 3-220-07*, and engineering judgment.

(1) Student Dormitories. The foundations for the proposed facilities must meet several criteria. The foundation must be compatible with the superstructure it supports, its movements must be within acceptable tolerances, it must meet functional requirements of the facility (such as a crawlspace), and it must be economical. Due to the potentially moderate to large anticipated column loads, the anticipated building geometry, the requirement for a crawl space, the anticipated differential heave and settlement potential of the high plasticity clay and the relatively low allowable bearing capacity that can be assigned to this stratum, the varying topography, the variable elevation, thickness, and consistency of the underlying gravel stratum,

the heave potential of the underlying clay shale, and the cost of framework construction, shallow foundations such as a mat slab and dug and formed spot and continuous spread footings are not considered viable foundation systems for the Student Dormitories. However, a deep foundation system consisting of drilled and underreamed piers has historically performed very well at Fort Sam Houston, can be assigned a larger allowable end-bearing value (while also meeting the other criteria stated above), and can be constructed economically compared to a shallow footing system. Therefore a reinforced concrete drilled and underreamed pier foundation is considered to be the optimum foundation system for the Student Dormitories.

There are two potential bearing strata for the drilled and underreamed piers, namely the weathered clay shale and the unweathered clay shale. The gravel/coble would normally be considered as a preferable founding material since it can be assigned a substantial allowable bearing capacity, is above the highly expansive clay shale, and will not experience unacceptable settlements. Unfortunately, there are two problems associated with the gravel/cobble at this site. The first is that the anticipated contact depth of the gravel/cobble stratum is considered too shallow (less than 10 feet at many of the test hole locations across the site) for adequately formed underreamed piers. Second, and more importantly, the gravel/cobble stratum at the AIT Barracks Complex site is typically less than 10 feet in thickness and at variable depths. This is considered an inadequate thickness on which to bear piers carrying the magnitude of loads anticipated for the proposed Student Dormitories and inconsistencies would require further reductions in allowable loads to limit differential settlements. Based upon these factors, the gravel/cobble stratum shall not be considered as a bearing stratum.

The weathered and unweathered clay shales are considered potential bearing strata for drilled and underreamed piers. Selecting a bearing stratum/elevation for drilled piers in expansive clay shales, such as those present at this site, must take into account constructability, bearing capacity, settlement, potential heave, and cost. These can be conflicting requirements and the final selection must strike a reasonable compromise between these considerations. The weathered shale has the obvious advantage of being shallower, thus piers would not have to extend as deep and would have a lesser cost. It has the disadvantages of being jointed and fissured with sandy zones (which present constructability problems with forming underreams), has lower shear strengths, is more compressible, and has a higher expansion potential when compared to the uppermost unweathered clay shale. In addition to having better engineering and constructability properties, the unweathered clay shale contains numerous cemented seams which are stronger, more incompressible, and less expansive than even the uncemented portions of the unweathered clay shale. These advantages make the unweathered clay shale a significantly better bearing material than the weathered clay shale. Founding piers at least three feet into the uniformly dark gray unweathered shale (at the approximate elevations provided below, by building) will place the piers a sufficient depth into the unweathered shale to allow the underream to be constructed without risk of sloughing and represents a reasonable economical extension from piers considered near the bottom of the weathered shale stratum. This bearing material has been used in the past at Fort Sam Houston and has provided a satisfactory response with respect to pier movement. The existing Brooke Army Medical Center is founded on drilled and underreamed piers founded at least three feet within the unweathered clay shale (and with very similar design parameters as those presented herein for the proposed facility). Based on a recent site visit, visual inspection, and discussions with Facility Operations personnel for Brooke Army Medical Center, the drilled and underreamed pier foundation system, in service for over a decade, has performed exceptionally well, with no evidence of piers experiencing detrimental differential movements. Based on the discussions presented above, Student Dormitories 1 and 2 shall be founded on a reinforced concrete drilled and underreamed foundation system in accordance with the recommendations and requirements specified herein.

(2) Battalion Headquarters and Central Energy Plant. In contrast to the large, multi-story Student Dormitories, the Battalion Headquarters and Central Energy Plant are anticipated to be single-story facilities with relatively light column loads. The best foundation

performance by similar structures in the very highly expansive subsurface material conditions that are present at Fort Sam Houston has been achieved by two types of shallow foundation systems: a reinforced concrete ribbed mat slab and a reinforced concrete flat mat slab. These two shallow foundation systems, when properly designed and constructed, will act monolithically when subjected to shrink-swell movements of the subsurface materials, in contrast to other, unsuitable shallow foundation systems such as spot and continuous spread footings.

A deep foundation system is not considered well-suited to these lightly-loaded facilities. Based on the extensive experience of the Fort Worth District with facility design and construction in the very highly expansive subsurface conditions present at Fort Sam Houston, several factors must be implemented to counteract uplift forces (amounting to several hundred tons) on piers foundations. The load on the piers must be maximized (i.e., piers must be heavily-loaded), with column loads not less than 200 kips transferred to the individual piers. Adequate reinforcing steel must be included in the piers to prevent failure due to tensile stress induced by heave forces. Also, fractures within the weathered clay shale are noted conduits for moisture. Changes in the in situ moisture regime facilitated by this condition can potentially affect the entire weathered clay shale stratum. Furthermore, occasional fractures that may penetrate the dark gray unweathered shale, and moisture pathways along the surface of the pier concrete, can permit changes to the in situ moisture regime to occur within the dark gray unweathered shale, as well. Therefore, piers must be underreamed (not straight shaft) within the dark gray unweathered clay shale to provide adequate anchorage against uplift forces. In addition, the surface area upon which uplift forces can act should be minimized (i.e., the pier shaft size should be minimized). However, as previously noted, a deep foundation system is not considered well-suited for the proposed Battalion Headquarters and Central Energy Plant. These facilities are anticipated to be relatively lightly loaded (i.e., it is anticipated to be difficult to achieve a minimum 200-kip column load on piers). Deep piers would be required, founded at depths potentially exceeding 55 feet to 60 feet below existing grade for underreams to be founded at least 3 feet into the dark gray unweathered shale. It is anticipated that a properly designed monolithic shallow foundation system consisting of either a reinforced concrete ribbed mat or flat mat slab can be constructed more economically than a properly designed deep pier foundation, and provide superior life-cycle performance for these two facilities than a pier foundation. Therefore, the foundation types considered for the proposed Battalion Headquarters and Central Energy Plant shall be limited to either a monolithic reinforced concrete ribbed mat or flat mat slab, designed in accordance with the criteria and minimum requirements specified herein.

IT IS REQUIRED THAT ALL FOUNDATION, FLOOR SLAB, AND EARTHWORK DESIGNS AND CONSTRUCTION BY THE DESIGN-BUILD CONTRACTOR AND THEIR ASSOCIATES SHALL COMPLY WITH THE MINIMUM REQUIREMENTS PRESENTED HEREIN.

c. Pavement Design Considerations. The pavement designs presented in this report are based on criteria contained in *UFC 3-250-01FA, UFC 3-250-18FA*, and engineering judgment.

(1) Traffic Types and Conditions. Four (4) pavement structures were analyzed and designed for this project. New rigid pavement structures are anticipated to include a new concrete fire/emergency medical vehicle access lane, concrete aprons in front of trash dumpster pads, privately-owned vehicle (POV) parking areas, and service drives. Types of vehicles to occupy the POV parking areas are anticipated to be limited to passenger cars and trucks. Types of vehicles to occupy the remaining pavement structures are anticipated to consist of fire/emergency medical vehicles and trash trucks. Based on criteria contained in the aforementioned United Facilities Criteria, the following traffic conditions were assigned:

Pavement Structure	Traffic Category	Street Class	Design Index
Emergency Access Lane /Service Drives	IVA	F	4
Apron (Trash)	IVA	F	4
POV Parking Areas	II	E	2

(2) Pavement Design Parameters. California Bearing Ratio (CBR) and plate bearing tests were not performed for this project. Instead, dynamic cone penetrometer (DCP) testing was conducted to evaluate the raw subgrade for pavement design considerations. The penetration resistance obtained from the DCP test is a measure of the soil's relative density, which in turn is used to derive "in situ" CBR and modulus of subgrade reaction values.

The average in situ CBR values measured within the upper 12 inches of soils tested at the AIT Barracks Complex site range from approximately 12 to 55 percent, and below this depth, a CBR value of 8 percent was recorded. Modulus of subgrade reaction values measured within the upper 12 inches of soils tested at the AIT Barracks Complex site range from 226 to 382 pci, and below this depth, modulus of subgrade reaction values of 180 pci was recorded. In the past, the high plasticity clay subgrade indicative of Fort Sam Houston has been assigned CBR values ranging from 5 to 7 percent when compacted to 95 percent of laboratory maximum density, and 3 to 4 when compacted to 90 percent of laboratory maximum density. Previously conducted plate-bearing tests indicate that modulus of subgrade reaction values on the order of 75 pci to 125 pci can be assigned to the in situ soils when compacted to 90 percent and 95 percent, respectively, of laboratory maximum density. The CBR and subgrade modulus values determined from in situ DCP testing are variable and range higher than the historical CBR and subgrade modulus values described above. This is believed to be due to the presence of gravel/cobble in the near-surface soils at the boring locations. Based on the results of the geotechnical field investigation, the gravel/cobble content is quite variable across the project site. Based on these considerations, design CBR and modulus of subgrade reaction values of 4 percent and 100 pci, respectively, were assigned to the raw subgrade for each site when compacted to 90 percent of laboratory maximum density (ASTM D 1557).

(3) Material Sources. Material sources in the San Antonio area are capable of producing a high quality crushed aggregate for concrete mixes to meet strength requirements. For this reason, a concrete flexural strength of 650 psi at 28 days was considered in the design

of rigid pavements. To date, Alkali/Silica Reaction with Portland Cement Concrete has never been a problem when using local aggregate sources.

6. Recommendations and Requirements. The following foundation and pavement design recommendations and requirements are based on results of the field investigation, laboratory testing, and engineering studies.

a. Foundation Design Recommendations and Requirements.

(1) Foundation System.

(a) Student Dormitories. The proposed Student Dormitories 1 and 2 shall be supported on a reinforced concrete drilled and underreamed pier foundation system. **NO OTHER FOUNDATION SYSTEMS SHALL BE ALLOWED FOR STUDENT DORMITORIES 1 AND 2.** ***THE FOLLOWING FOUNDATION SYSTEMS ARE SPECIFICALLY PROHIBITED: SPOT AND/OR CONTINUOUS SPREAD FOOTINGS, STRAIGHT-SHAFT DRILLED PIERS, DRIVEN OR CAST-IN-PLACE PILES, AND AUGER CAST PILES.*** The bearing stratum for the drilled and underreamed piers is the uniformly dark gray unweathered clay shale. However, the contact depth of this stratum varies significantly not only across the entire project site, but also within the individual dormitory building footprints. Therefore, two different pier end-bearing elevations are provided for each dormitory. ***These elevations are based on the facility site layout available at the time of this report; these values shall be reevaluated for adequacy during reviews of the Design-Build Contractor's project design submittals.*** For Student Dormitory 1 (the northern student dormitory), drilled and underreamed piers in the western part of the building (including the west wings and central wing/core area) shall bear at a uniform elevation of 620.0 feet (NGVD) or at least 3 feet into the uniformly dark gray unweathered clay shale, whichever is deeper. Drilled and underreamed piers in the eastern part of Student Dormitory 1 (i.e., the east wing(s), east of the central core/wing area) shall bear at a uniform elevation of 615.0 feet (NGVD) or at least 3 feet into the uniformly dark gray unweathered clay shale, whichever is deeper. For Student Dormitory 2 (the southern student dormitory), drilled and underreamed piers in the building wings north of Koehler Road shall bear at a uniform elevation of 610.0 feet (NGVD) or at least 3 feet into the uniformly dark gray unweathered clay shale, whichever is deeper. Drilled and underreamed piers in the wings of Student Dormitory 2 in line with and south of Koehler Road shall bear at a uniform elevation of 605.0 feet (NGVD) or at least 3 feet into the uniformly dark gray unweathered clay shale, whichever is deeper. An allowable end bearing capacity of 25.0 ksf (net) should not be exceeded when sizing pier underreams founded within the uniformly dark gray unweathered clay shale at this elevation. However, the number/layout and sizing for piers/underreams should be designed, and pier loading should be distributed in such a manner as to maximize the loading to as close as possible to the allowable end bearing in order to counteract the uplift forces acting on the piers, in accordance with the requirements specified herein. It should be noted that this allowable bearing capacity is based on a factor of safety equal to 3 against shear failures. Based on structural requirements, the load used to size the piers shall consist of full dead load plus that portion of the live load that acts more or less continuously, usually 50 percent. For this project, the following allowable side shear values, by elevation, shall be used:

Student Dormitory 1 (North Dormitory) – Western Part of Building (as described above)

Elevation (ft. (NGVD))	Allowable Side Shear (ksf)
>650.0	0
650.0 – 625.0	2.0
<625.0	4.0

Student Dormitory 1 (North Dormitory) – Eastern Part of Building (as described above)

Elevation (ft. (NGVD))	Allowable Side Shear (ksf)
>650.0	0
650.0 – 620.0	2.0
<620.0	4.0

Student Dormitory 2 (South Dormitory) – Building Wings North of Koehler Road

(as described above)

Elevation (ft. (NGVD))	Allowable Side Shear (ksf)
>645.0	0
645.0 – 610.0	2.0
<610.0	4.0

Student Dormitory 2 (South Dormitory) – Building Wings South of/In Line with Koehler Road

(as described above)

Elevation (ft. (NGVD))	Allowable Side Shear (ksf)
>640.0	0
640.0 – 605.0	2.0
<605.0	4.0

The effective length shall be considered to extend to one underream diameter above the top of the pier underream. If the piers are designed for both end bearing and skin friction (and it is required that they be), the foundation notes need to reflect this condition.

To facilitate clean out and inspection of the pier holes during construction, pier shafts shall be at least 24 inches in diameter; however, it is recommended that the smallest possible shaft diameter should be used to minimize the surface area on which pier heave can act. Pier underream diameters shall be at least 2.5 times the diameter of the pier shaft but shall not exceed 3.0 times the diameter of the pier shaft. Once design pier underream sizes are determined, they shall be fixed to that diameter in the field. A minimum 12-inch void shall be maintained beneath all grade beams, and the void area shall be protected with concrete retainer blocks as shown in the latest edition of the SWD-AEIM. ***The bottom of all grade beams shall be formed with carton forms to provide the 12-inch void.***

To limit the potential for large differential movements from occurring, the following measures shall be implemented: (1) shaft diameters shall be the minimum required to limit the contact area with the surrounding expansive soils; (2) piers shall be widely spaced (not less than 20 feet center to center) in an attempt to impose a significant amount of dead load on the foundation; the most heavily loaded piers shall not be placed next to lightly loaded piers; (3) piers shall be properly reinforced to prevent stress (tensile) cracking within the pier concrete when subjected to uplift forces. Based on the results of analyses taking into account the expansion pressures of the soil and clay shale in combination with dead loads acting on individual piers, it was determined that piers 24 inches in diameter (shaft size) require a minimum of 3.0 percent reinforcing steel, piers 30 inches in diameter require a minimum of 2.75 percent reinforcing steel, and piers 36 inches in diameter require a minimum of 2.25 percent reinforcing steel; piers smaller than 24 inches in diameter shall not be used based on the anticipated bearing depth (>40 feet). ***It is required that the structural designer submit the proposed pier loading scheme to CESWF-EC-DG prior to final design for review for compliance with these requirements.***

As previously noted, minimum pier spacing shall not be less than 20 feet (center-to-center). At expansion joints, the two piers on either side of the joint should be combined into one larger pier spanning across the joint. An additional concern that couples with the spacing requirements is lightly loaded piers. Lightly loaded piers (i.e., those with column loads less than 200 kips) dissipate most or all of their load in side shear and none of the end bearing will be mobilized. Thus, the expansive clay shale below the pier has no structural restraint when this material begins to heave and the full expansion potential of the material is realized. To reduce this risk, any pier supporting a column load of less than 200 kips shall be deleted and the load redistributed to adjacent piers by grade beams. This normally requires special structural spans at stoops and elevator pits as well as not allowing grade beams to be supported independently from column locations. Transferring load by grade beams may not be economical, but is required for adequate performance of the foundation system. In addition, to minimize the effects of differential movements, large differences (>50%) in column loading between adjacent piers should be avoided. Compression or settlements of individual piers should be checked to ensure acceptable deflections which will not cause cracking or distress to the building structural wall/floor units and building facade. Perimeter piers at the ends of the building wings are typically less heavily loaded than adjacent piers; special attention should be paid to the pier and grade beam design to ensure that piers in these locations also achieve the loads specified herein.

Proper sizing of the piers, both shafts and bells, is essential. Shaft and bell diameters must be within -0 to +2 inches of the specified dimension. The contract shall require that the belling tool have some means, such as a chain, to restrict the travel of the underreamer to the required dimension.

Concrete slump for piers shall be from 6 to 8 inches.

The typical pier detail shall require the upper 5 feet of the pier shaft to be formed with a wax impregnated sonotube to eliminate a mushroom shaped pier top. The detail shall also show a wedge-shaped mound of Select Clay Backfill placed around the pier top that is 1 foot high and sloped at a 1V on 2H slope. This will prevent water from ponding directly around the top of the pier. These requirements are illustrated on ***Sheet B107***.

The contractor shall have temporary steel casing and pumps at the job site prior to construction of drilled piers. Groundwater should be anticipated during drilling operations; therefore, the above information should be provided in the contract documents as foundation notes. ***It should be assumed that approximately 100 percent of all piers will have to be cased to at least 50 feet below existing grade. If the stated bearing elevations do not reveal the bearing material, the Contractor shall coordinate with the Contracting Officer's representative. Final pier depths shall be subject to approval in the field by the Contracting Officer's representative.***

Drilling equipment should be of suitable type and of sufficient size to satisfactorily perform the required drilling for the soil conditions identified. To this end, all drill rigs shall have a 6-inch Kelly bar and be capable of producing minimum torque and crowd capacities of

50,000 lb-ft and 30,000 lb-ft, respectively.

The Design-Build Contractor shall edit the drilled pier specification and add foundation notes to include the above criteria and requirements for drilled pier construction.

(b) Battalion Headquarters and Central Energy Plant. Only the following foundation systems shall be allowed for the Battalion Headquarters and Central Energy Plant: 1) a reinforced concrete ribbed mat slab, or 2) a reinforced concrete flat mat slab, designed in accordance with the criteria and requirements specified herein. **NO OTHER FOUNDATION SYSTEMS SHALL BE ALLOWED FOR THE BATTALION HEADQUARTERS AND CENTRAL ENERGY PLANT.** ***THE FOLLOWING FOUNDATION SYSTEMS ARE SPECIFICALLY PROHIBITED: SPOT AND/OR CONTINUOUS SPREAD FOOTINGS, STRAIGHT-SHAFT DRILLED PIERS, DRIVEN OR CAST-IN-PLACE PILES, AND AUGER CAST PILES.***

The proposed Battalion Headquarters and Central Energy Plant shall be supported on either a reinforced concrete ribbed mat slab or flat mat slab foundation system. ***The mat slabs shall be conventionally reinforced – POST-TENSIONED SLABS ARE NOT ALLOWED.*** Based on the plasticity level of the near surface clayey and gravelly soils, the mat slabs shall be analyzed and designed for 1.0 inch of long-term differential movement. For this reason, interior ribs for ribbed mat slabs shall be spaced no further than 15 feet center-to-center, and diagonal stiffener ribs shall be placed at each corner of the mat slab. Design of the mat slabs shall meet the minimum requirements as presented in ***CESWD-ED-TS/G Criteria Letter, dated 29 January 1988 – Design Criteria for Ribbed Mat Foundations, SWDED-G Criteria Letter, dated 16 April 1987 – Criteria for Developing Geotechnical Design Parameters for SWD Ribbed Mat Design Methodology***, and the recommendations and requirements provided herein.

Interior and exterior beams for ribbed mat slabs should bottom a minimum of 24 inches below outside finished grade. An allowable bearing capacity of 2.0 ksf (net) shall be used to size the beams. For this phase of design, it should be noted that (1) the structural load is supported solely on the beam and the beam intersections, (2) load transfer occurs over the effective beam width, and (3) the beam and soil remain in contact. Beam intersections should be widened at column locations to accommodate the above allowable bearing value for the anticipated load condition. The load used to size the beams shall consist of full dead load plus that portion of the live load that acts more or less continuously, usually 50 percent.

The ribbed mat slab foundations shall incorporate adequate stiffness such that the deformations do not exceed the structural tolerance of any elements in the foundation or superstructure. Analyses shall consider a vertical separation of the foundation slab and beams from the subgrade of 1.0 inch at the outside of all perimeter beams, with loss of support beneath the foundation over a horizontal distance of not less than 6.5 feet. This loss of support condition corresponds to the **center lift mode**. Additionally, **edge lift analyses** shall consider an edge moisture variation distance equal to 3.0 feet, and an edge lift heave of 1.0 inch should be used in the design of the ribbed mat slab. This edge lift heave corresponds to an applied structural pressure of 100 psf. For edge lift considerations, two additional combinations of pressure and swell are required. For an allowable bearing capacity of 2.0 ksf, an edge lift heave of 0.75-inch can be expected to occur. At an ultimate bearing capacity of 6.0 ksf, 0.50-inch of heave should be anticipated. It should be noted that these anticipated heave amounts are based on the removal of a minimum of 7.0 feet of existing materials under building floor slabs and replacement with compacted nonexpansive fill, as required herein. If additional soils investigations, testing, and analyses show that a more stringent design is required to successfully mitigate total and differential movements due to settlement and/or heave, the foundation shall be designed accordingly. **NOTE: The site has been modified subsequent to the USACE geotechnical field investigation through grading and placement of fill materials within the building footprint limits. These fill materials do not meet the requirements for nonexpansive fill or select fill. The removal of a minimum of 7.0 feet of existing soils specified herein is measured with respect to the ORIGINAL (pre-construction) site grading (i.e., the grades existing at the time of the USACE geotechnical field investigation) – NOT the more recently modified site grading. THE CONTRACTOR**

SHALL ENSURE THAT A MINIMUM OF 7.0 FEET OF THE ORIGINALLY EXISTING SOILS, AS MEASURED FROM THE ORIGINAL EXISTING GRADE WITHIN THE BUILDING FOOTPRINT AREA, AND ANY OVERLYING FILL SUBSEQUENTLY PLACED WITHIN THE BUILDING FOOTPRINT AREA, ARE REMOVED AND REPLACED WITH COMPACTED NONEXPANSIVE FILL, AS SPECIFIED HEREIN.

A modulus of subgrade reaction equal to 200 psi/inch shall be used when analyzing the ribbed mat slabs to determine in-service deformations. This value, however, shall be factored to account for width effects such that $k_{design}=k_1/(B_{eff})$, where B_{eff} is the effective beam width in feet. Design of the ribbed mat slabs may use the *SWD-AEIM* sections as a minimum stiffness "first approximation".

A flat mat shall have a uniform thickness of not less than 2.0 feet. An allowable bearing capacity of 2.0 ksf (net) shall be used to size the mat foundation. The mat should be tapered as required to ensure the perimeter of the slab extends to a constant elevation and is at least 24 inches below outside finish grade. Flat mat slabs also shall incorporate adequate stiffness such that the deformations do not exceed the structural tolerance of any element of the foundations or superstructures nor cosmetic cracking of interior and exterior finishes. Control joints/panels shall be incorporated within interior finishes and exterior facades to help control potential cracking due to slab movements. The load used to size the flat mat slab shall consist of full dead load plus that portion of the live load that acts more or less continuously, usually 50 percent.

The mat slabs will, by design, be supported on-grade. A polyethylene vapor barrier (10-mil minimum thickness) and a minimum 6-inch capillary water barrier should be placed beneath the mat slab.

(c) Small Support-type Structures. Small support-type structures (if applicable) can be supported on a reinforced concrete slab-on-grade with turned-down edge beam foundation. The turned-down edge beam should extend a minimum of 12 inches below outside finished grade, and can be sized for a safe bearing pressure of 2,000 psf (net).

Subgrade preparation should consist of removing at least 7.0 feet of existing materials within the building footprint, and replacing with at least 7.0 feet of compacted non-expansive fill. Any additional fill required to achieve the final subgrade elevation below the floor slab system shall be nonexpansive material as well. The upper 6 inches of existing subgrade exposed after excavation operations, or cleared prior to fill placement shall be scarified, moistened, manipulated, and recompacted to the same density required for nonexpansive fill materials. Nonexpansive fill shall be placed in controlled lifts not exceeding 8 inches in loose thickness and compacted to at least 95 percent of laboratory maximum density (in accordance with ASTM D 1557). **NOTE: The site has been modified subsequent to the USACE geotechnical field investigation through grading and placement of fill materials within the building footprint limits. These fill materials do not meet the requirements for nonexpansive fill or select fill. The removal of a minimum of 7.0 feet of existing soils specified herein is measured with respect to the ORIGINAL (pre-construction) site grading (i.e., the grades existing at the time of the USACE geotechnical field investigation) – NOT the more recently modified site grading. THE CONTRACTOR SHALL ENSURE THAT A MINIMUM OF 7.0 FEET OF THE ORIGINALLY EXISTING SOILS, AS MEASURED FROM THE ORIGINAL EXISTING GRADE WITHIN THE BUILDING FOOTPRINT AREA, AND ANY OVERLYING FILL SUBSEQUENTLY PLACED WITHIN THE BUILDING FOOTPRINT AREA, ARE REMOVED AND REPLACED WITH COMPACTED NONEXPANSIVE FILL, AS SPECIFIED HEREIN.**

(2) Ground-Level Floor Slab System. Ground-level floor slabs within Student Dormitories 1 and 2 shall be supported above a minimum **12-inch** void or crawl space. The void area shall be protected with concrete retainer blocks as shown in the latest edition of the SWD-AEIM. The bottom of all grade beams and floor slabs shall be formed with carton forms to provide the 12-inch void. Stoops, porches, approaches, etc. shall also be structurally-supported to compensate for the active subgrade. Since the design requires the incorporation of a crawl space beneath the building, the underfloor area shall be sloped to collection points

and drained using sumps and pumps. Swales shall drain away from pier column locations such that ponded water never occurs adjacent to piers. The mat slab systems for the Battalion Headquarters and Central Energy Plant will, by design, be supported on-grade.

(3) Subgrade Preparation and Fill Requirements.

(a) Student Dormitories. For portions of the building pad that will be in a fill section, subgrade preparation for Student Dormitories 1 and 2 shall consist of removing the upper 12 inches of existing materials and replacing with a compacted select backfill. Any additional fill required to raise the subgrade to the final elevation(s) below the building floor slab system shall be select material as well. Select fill should be placed in controlled lifts not exceeding 8 inches in loose thickness and compacted to at least 90 percent of laboratory maximum density as determined in accordance with ASTM D 1557. For portions of the building pad that will be a cut section, subgrade preparation should consist of removing all existing materials to a depth that allows a minimum 12-inch void to be formed below the floor slab system. The upper 6 inches of existing subgrade exposed after cut and/or fill operations shall be scarified, moistened, and recompacted to the same density required for select fill.

(b) Battalion Headquarters and Central Energy Plant. For ribbed mat and flat mat slab foundations, the upper 7.0 feet (minimum) of existing soils within the Battalion Headquarters and Central Energy Plant building footprints shall be removed and replaced with compacted nonexpansive backfill, which should limit the magnitude of predicted movement to approximately 1 inch or less. Any additional fill required to achieve the final subgrade elevation below the floor slab system shall be nonexpansive material as well. The upper 6 inches of existing subgrade exposed after excavation operations, or cleared prior to fill placement shall be scarified, moistened, manipulated, and recompacted to the same density required for nonexpansive fill materials. Nonexpansive fill shall be placed in controlled lifts not exceeding 8 inches in loose thickness and compacted to at least 95 percent of laboratory maximum density (in accordance with ASTM D 1557). **NOTE: The site has been modified subsequent to the USACE geotechnical field investigation through grading and placement**

of fill materials within the building footprint limits. These fill materials do not meet the requirements for nonexpansive fill or select fill. The removal of a minimum of 7.0 feet of existing soils specified herein is measured with respect to the ORIGINAL (pre-construction) site grading (i.e., the grades existing at the time of the USACE geotechnical field investigation) – NOT the more recently modified site grading. THE CONTRACTOR SHALL ENSURE THAT A MINIMUM OF 7.0 FEET OF THE ORIGINALLY EXISTING SOILS, AS MEASURED FROM THE ORIGINAL EXISTING GRADE WITHIN THE BUILDING FOOTPRINT AREA, AND ANY OVERLYING FILL SUBSEQUENTLY PLACED WITHIN THE BUILDING FOOTPRINT AREA, ARE REMOVED AND REPLACED WITH COMPACTED NONEXPANSIVE FILL, AS SPECIFIED HEREIN.

If additional investigations and/or analyses by the Design-Build Contractor's geotechnical firm indicate greater movements or more stringent requirements of mat stiffness are warranted, the mat shall be designed accordingly.

Based on previous experience, if nonexpansive fill is placed outside the limits of the building footprint, the relatively higher permeability of the nonexpansive fill will allow moisture to infiltrate to the highly expansive soils adjacent to and beneath the foundation, potentially resulting in heave of the foundation. To limit moisture penetration to the area around and beneath the foundation, excavated areas beyond the limits of the building footprint shall be backfilled with select clay backfill materials. This select clay cap shall be a minimum of 2 feet in thickness and shall extend from the building perimeter to the limits of the excavation (completely capping/covering the compacted nonexpansive fill). Select clay backfill materials should be compacted to at least 92 percent of laboratory maximum density (with all other subgrade preparation and fill placement requirements being the same as those for nonexpansive fill).

(4) Material Testing Requirements. Testing shall be the responsibility of the contractor to ensure that the subgrade, fill, and backfill materials are properly compacted. To

this end, the Design-Build Contractor shall comply with the minimum testing frequencies specified in the RFP.

(5) Below-Grade Structures (Including Retaining Walls). The following parameters are provided for the design of all below-grade structures (including retaining wall construction). For the high plasticity clay and badly weathered clay shale, an at-rest lateral earth pressure coefficient (K_o) of 0.7, an active earth pressure coefficient (K_a) of 0.7, an angle of internal friction (ϕ) of 10^o, a cohesion value (c) of 100 psf, and an allowable bearing capacity of 2,000 psf shall be used. For cohesionless granular backfill placed behind retaining wall(s), an angle of internal friction (ϕ) of 30^o should be used. The clay, clay shale, and backfill material should be assumed to have a moist unit weight of 125 lb/ft^3. All backfill shall be nonexpansive or select material. Drainage and backfill zoning details for below-grade wall (and retaining wall) construction are shown on ***Sheet B107*** (Below-Grade Wall Backfill Details). The Design-Build Contractor's retaining wall analyses and designs shall also account for surcharge loadings (e.g., due to vehicular traffic) where applicable.

(6) Drainage Conditions. Proper site drainage is imperative to ensure satisfactory long-term foundation performance. Exterior grading adjacent to the building shall be sloped away from the structure a minimum of 5 percent for the first 10 feet. Runoff from the roofs shall be adequately discharged away from foundation edges. In no case should water be allowed to pond adjacent to or beneath the buildings, both during and after construction.

(7) Care of Water. Drainage of ground and surface water from the project site continually throughout the construction contract is essential. The contractor shall be required to protect the excavation and all constructed work throughout the life of the contract by means of ditches, berms, sumps with pumps, and any other means required to continually and effectively remove water from the site at all times. Ponding of water in the excavation or around the piers is unacceptable at any time. In addition, site excavations to include the crawl space excavation, utility trenching, grading, and retention basins shall be constructed so as not

to supply water directly or indirectly to the building or underlying active clay shale via the pervious gravel stratum. Such exposure of the underlying clay shale primary to surface runoff during construction could extend the active zone (via fractures) to much greater depths within the clay shale. This would activate these highly expansive materials and result in expansion pressures on the foundation elements that could create distress on the structural system of the facility. ***These requirements shall be reflected in the specifications and in the structural notes.***

The designer shall grade the site to ensure positive drainage of all water away from the structure. Crawl spaces shall be graded to collect water and carry it to sumps. The sumps shall drain by gravity or be equipped with automatic pumps to direct the water to the storm drainage system. Sumps shall be located at least 10 feet away from any pier in the crawlspace.

(8) Mechanical Connections. All exterior mechanical connections should be of the flexible type. Flexible connections shall be capable of resisting a minimum of 4 inches of both vertical and horizontal movement. All mechanical/structural connections between slabs on grade and structurally supported units or building perimeter entry/exit points must be designed and constructed to handle up to 4 inches of vertical movement. All condensate lines shall drain away from foundation edges. It is recommended that below-grade utility lines connecting to the buildings be aligned under the centerline of the respective building footprints. The use of exterior lines connecting to the buildings by numerous utility trenches is discouraged, as this would create high permeability pathways for moisture to gain access to, and activate, the expansive clay and clay shale materials within the building footprint.

(9) Backfill Adjacent to Exterior Grade Beam Excavation. Use select clay backfill adjacent to exterior grade beam excavation to minimize water penetration to expansive subsoils. Reference below-grade wall backfill details shown on Sheet B107.

(10) Foundation Material Definitions.

(a) Satisfactory Materials. Satisfactory materials include materials classified in ASTM D 2487 as GW, GM, GC, GP, SW, SP, SM, SC, CL, and CH and shall be free of trash, debris, roots or other organic matter, or stones larger than 3 inches in any dimension.

(b) Unsatisfactory Materials. Unsatisfactory materials include materials classified in ASTM D 2487 as Pt, OH, OL, ML, MH and any other materials not defined as satisfactory.

(c) Nonexpansive Soils. Nonexpansive soils should meet the requirements of Texas Department of Transportation Standard Specification for Base Course, Item 247, Type A, Grade 1 or 2, with plasticity index of not less than 4 percent nor greater than 12 percent when tested in accordance with ASTM D 4318.

(d) Select Soils. Select soils are satisfactory material having a liquid limit of 35 percent or less and a plasticity index not less than 8 nor greater than 18 when tested in accordance with ASTM D 4318.

(e) Select Clay Backfill. Select clay backfill shall be a satisfactory material having a liquid limit of 35 percent or less, and a plasticity index of not less than 8 nor greater than 20 when tested in accordance with ASTM D 4318, and classifying as a CL in accordance with ASTM D 2487.

(f) Cohesionless and Cohesive Materials. Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

(g) Capillary Water Barrier. Capillary Water Barrier shall consist of clean, crushed, nonporous rock, crushed gravel, or uncrushed gravel. The maximum particle size shall be 1.5 inches and no more than 2 percent by weight shall pass the 3/16-inch size (No. 4) sieve.

The Design-Build Contractor shall utilize and comply with above material definitions, subgrade preparation procedures, and material testing requirements.

(11) Instrumentation. Perimeter grade beam benchmarks, as shown in the

SWD-AEIM, Chapter IV (Plate S53), shall be installed around the perimeter of the Student Dormitories at select pier and grade beam locations. Additional benchmarks similar in design shall be installed on select interior columns. ***Final location of the benchmarks shall be determined by CESWF-EC-DG during the development of the Design-Build Contractor's structural design.*** The benchmarks should be surveyed to the nearest 1/100th of a foot from a permanent benchmark as soon as the forms are stripped and shall be surveyed monthly throughout the remainder of the construction contract from a permanent deep benchmark. Elevations for the benchmarks shall be supplied to the contracting officer for forwarding to CESWF-EC-DG within 7 days of completing the survey. ***A typical construction detail for the benchmarks and the benchmark installation locations shall be presented in the construction drawings***.

b. Pavement Design Recommendations and Requirements. The minimum pavement sections presented below are based on criteria contained in *UFC 3-250-01FA, UFC 3-250-18FA*, and engineering judgment. The Design-Build Contractor is responsible for developing the final pavement designs. The Design-Build Contractor shall use the subsurface conditions and laboratory testing data provided in this report, as well as his own supplemental subsurface investigations and testing, in accordance with the requirements specified herein, and any supplemental information regarding traffic loading conditions and requirements (beyond that provided herein) to develop the final pavement designs. The Design-Build Contractor shall use the United Facilities Criteria (UFCs) cited herein, as well as Pavement-Transportation Computer Assisted Structural Engineering (PCASE) software (available at ***https://transportation.wes.army.mil/triservice/pcase/*** as a free download) to develop the final pavement designs. However, **it is required that the Design-Build Contractor's final pavement sections meet (or exceed) the minimum pavement sections specified herein.**

(1) Rigid Pavement. The following minimum pavement section shall be used for fire/emergency medical vehicle access lanes, aprons for a minimum distance of 15 feet in front of trash dumpster pads, service drives and POV parking areas. The rigid pavement

designs consider a modulus of subgrade reaction equal to 100 pci for the raw subgrade when compacted to 90 percent of laboratory maximum density, and a concrete flexural strength of 650 pci at 28 days.

(a) Fire/Emergency Medical Vehicle Access Lanes and Aprons in Front of Trash Dumpster Pads. The rigid pavement design is based on Category IVA Traffic and a Class F Street (DI = 4).

6” Portland Cement Concrete reinforced with No. 4 bars spaced 16 inches o.c.e.w.

6” Aggregate Base Course compacted to at least 95 percent of maximum laboratory density (ASTM D 1557)

6” Raw Subgrade compacted to at least 90 percent of maximum laboratory density (ASTM D 1557)

(b) Service Drives. The rigid pavement design is based on Category IVA Traffic and a Class F Street (DI = 4).

7” Portland Cement Concrete (nonreinforced)

6” Aggregate Base Course compacted to at least 95 percent of maximum laboratory density (ASTM D 1557)

6” Raw Subgrade compacted to at least 90 percent of maximum laboratory density (ASTM D 1557)

(c) POV Parking Areas. The rigid pavement design is based on Category II Traffic and a Class D Street (DI=2).

6” Portland Cement Concrete (nonreinforced)

6” Aggregate Base Course compacted to at least 95 percent of maximum laboratory density (ASTM D 1557)

6” Raw Subgrade compacted to at least 90 percent of maximum laboratory density (ASTM D 1557)

Reinforcement for odd-shaped slabs, joint design, joint spacing, and other details shall be in accordance with the latest edition of the SWD-AEIM and UFC 3-250-01FA, where applicable. The reinforcement bars shall be placed a minimum of 1.5 inches clear distance from the surface of the pavement.

The following notes should be incorporated as part of the pavement details shown on the contract drawings.

> ***"1. The moisture content shall be at least 1 percent above optimum during compaction of the raw subgrade."***

(2) Pavement Material Definitions.

(a) Portland Cement Concrete. The maximum nominal size coarse aggregate shall be 1.5 inches, and the mixture shall be designed to attain a flexural strength of 650 psi at 28 days, as determined by tests made in accordance with ***ASTM C 78*** of beams fabricated and cured in accordance with ***ASTM C 192/C 192M***. Cementitious admixtures shall be limited to Class F fly ash; Class C fly ash shall not be used.

(b) Aggregate Base Course. Aggregates shall conform to the requirements presented herein. The gradation should conform to the requirements of TXDOT, Std Spec, Item 247, for Type "A", Grade 1 Material with a plasticity index not greater than 10. Aggregates shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C 131. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregates shall contain at least 50 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece. When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 50 percent of which, by weight, are retained on the maximum size sieve.

(c) Raw Subgrade. Material should conform to the requirements of

Satisfactory Materials, as specified herein.

(3) Vehicular Pavement Material Testing Requirements. Testing shall be the responsibility of the contractor to ensure that the subgrade, aggregate base course, and Portland cement concrete are properly constructed. To this end, the following testing requirements shall be included in the contract specifications as a minimum:

- In-place density testing of the subgrade and aggregate base course shall be performed, at a minimum, every 600 square yards per lift in accordance with ASTM D 1556 and ASTM D 2922. ASTM D 1556 shall be used as a check at least once per lift for each 3,000 square yards of completed subgrade and aggregate base course.

- Before starting work, at least one sample of aggregate base course material shall be tested in accordance with ASTM C 136. After the initial test, a minimum of one sieve analysis (ASTM C 136 and ASTM D 422) shall be performed for each 1,000 tons of aggregate base course placed, with a minimum of one analysis performed for each day's run until the course is completed. One liquid limit and plasticity index shall be performed for each sieve analysis per ASTM D 4318

- Wear tests shall be performed in accordance with ASTM C 131. A minimum of one test per aggregate base course material source shall be run.

- Thickness of the aggregate base course shall be measured for each 600 square yards of material placed. Compacted thickness of the aggregate base shall be as presented in this report and the completed section shall be within 3/8-inch of the thickness presented.

- The contractor shall be responsible for the development of the mixture proportion study for cementitious materials and chemical admixtures. The concrete mix design shall include a statement giving the maximum nominal coarse aggregate size and the proportions of all ingredients that will be used in the manufacture of concrete at least 60 days prior to commencing concrete operations. Trial design batches, mixture proportioning studies, and testing requirements shall be the responsibility of the Contractor. Strength requirements shall be based on flexural strength. Trial mixtures having proportions, slumps, and air content suitable for the work shall be based on methodology described in ACI 211.1, modified as necessary to accommodate flexural strength. The maximum water-cementitious material ratio is 0.45. Coarse and fine aggregates shall have a satisfactory service record of at least 5 years successful service in three paving projects, or if a new source is used, shall meet the requirements when tested for resistance to freezing and thawing. Coarse and fine aggregates not having a satisfactory demonstrable service record shall have a durability factor of 50 when subjected to freezing and thawing in concrete in accordance with COE CRD-C 114 (Test Method for Soundness of Aggregates by Freezing and Thawing of Concrete Specimens).

- Smoothness measurements shall be taken in successive positions parallel to the pavement centerline with a 12-foot straightedge. Measurements shall be taken perpendicular to the pavement centerline at 15-foot intervals. Surface smoothness shall not exceed 3/8-inch.

c. Requirements for the Design-Build Contractor's Foundation and Pavement Design Analysis. The successful proposer shall provide a Foundation and Pavement Design Analysis after contract award. ***The geotechnical firm responsible for the geotechnical design shall have demonstrated successful performance in design of at least five (5) projects of similar type and scope in expansive soil environments in Texas.*** The Foundation and Pavement Design Analysis (Report) shall include a description of the project, including a discussion of any unusual features of the project, a discussion for each structure that requires a foundation system, and a discussion of each pavement type.

(1) **Foundation System.** ***A foundation system consisting of reinforced concrete drilled and underreamed piers shall be used for Student Dormitories 1 and 2. The Design-Build Contractor shall design the drilled and underreamed pier foundation system in accordance with the requirements, recommendations, and design parameters provided in this report. A foundation system consisting of either a reinforced concrete ribbed mat slab or a reinforced concrete flat mat slab shall be used for the Battalion Headquarters and the Central Energy Plant. The Design-Build Contractor shall design the ribbed and/or flat mat foundation systems in accordance with the requirements, recommendations, and design parameters provided in this report.***

(2) **Floor Slab System and Subgrade Preparation.** ***The Design-Build Contractor shall comply with the floor slab system, subgrade preparation, and fill requirements specified in this report. Ground-level floor slabs (and grade beams) for Student Dormitories 1 and 2 shall be structurally-supported above a minimum 12-inch void. Slab-on-grade construction of ground-level floor slabs shall not be permitted for the Student Dormitories. The mat slab foundations will, by design, be supported on-grade. Excavation/removal of existing soil, compaction requirements for the raw subgrade, fill, and backfill materials, and foundation and pavement material definitions shall be as specified***

herein. Compaction shall be in accordance with the modified Proctor method (ASTM D 1557).

(3) **Pavement Sections.** The Design-Build Contractor shall provide separate subparagraphs for each pavement structure included in the project, ***using the pavement sections provided in this report as minimum sections***. The Design-Build Contractor shall use the UFCs cited herein and PCASE pavement design software to develop the final pavement designs, and shall present PCASE design output data tables in their report documentation for review by the Government. Each pavement design shall include as a minimum the following items: traffic types, road classifications and design indexes; subgrade strength values (CBR and modulus of subgrade reaction values for the specified compactive effort); pavement material thicknesses and compaction requirements; and concrete flexural strength for designated time frame.

(4) Exhibits to be Included in the Design-Build Contractor's Foundation and Pavement Design Analysis. The following exhibits shall be included in the Design-Build contractor's Foundation and Pavement Design Analysis. The Design-Build contractor may use the information provided in this report to partially satisfy these requirements, but shall supplement the information provided herein with additional subsurface drilling and testing, as described in the first paragraph of Section 5 of this report. Required exhibits to be included with the Design-Build contractor's Foundation and Pavement Design Analysis include:

- Site Plan with Boring Locations and Legend;
- Boring Logs;
- Plasticity Chart;
- Standard Penetration Tests versus Depth of Boring (if applicable);
- Moisture Content versus Depth (Chart);
- Moisture Content-Liquid Limit-Plastic Limit versus Depth (Chart);
- Strength Tests Results versus Depth (Chart);
- Tabulation of Laboratory Test Results (to include Boring Number, Sample Number, Depth, Laboratory Classification, Visual Descriptions, Grain Size Analysis (%Gravel, %Sand, %Fines), LL, PL, PI, MC, Unit Weight, and Strength Test Data;
- Consolidation-Expansion Tests/Swell Pressure Tests (if applicable).

FORT SAM HOUSTON, TEXAS
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX

References:

- TEAM Consultants, Incorporated Report No. 082047
- CESWF Foundation Design Analysis (FDA) – Brooke Army Medical Center Replacement Hospital, dated August 1989
- UFC 3-220-03FA – Soils and Geology Procedures for Foundation Design of Buildings and Other Structures (Except Hydraulic Structures)
- UFC 3-220-07 – Foundations in Expansive Soils
- UFC 3-250-01FA – Pavement Design for Roads, Streets, Walks, and Open Storage Areas
- UFC 3-250-18FA – General Provisions and Geometric Design For Roads, Streets, Walks, and Open Storage Areas
- Texas Department of Transportation - Standard Specifications For Construction of Highways, Streets and Bridges
- SWD-AEIM Architectural-Engineering Manual
- UFGS Guide Specifications For Construction

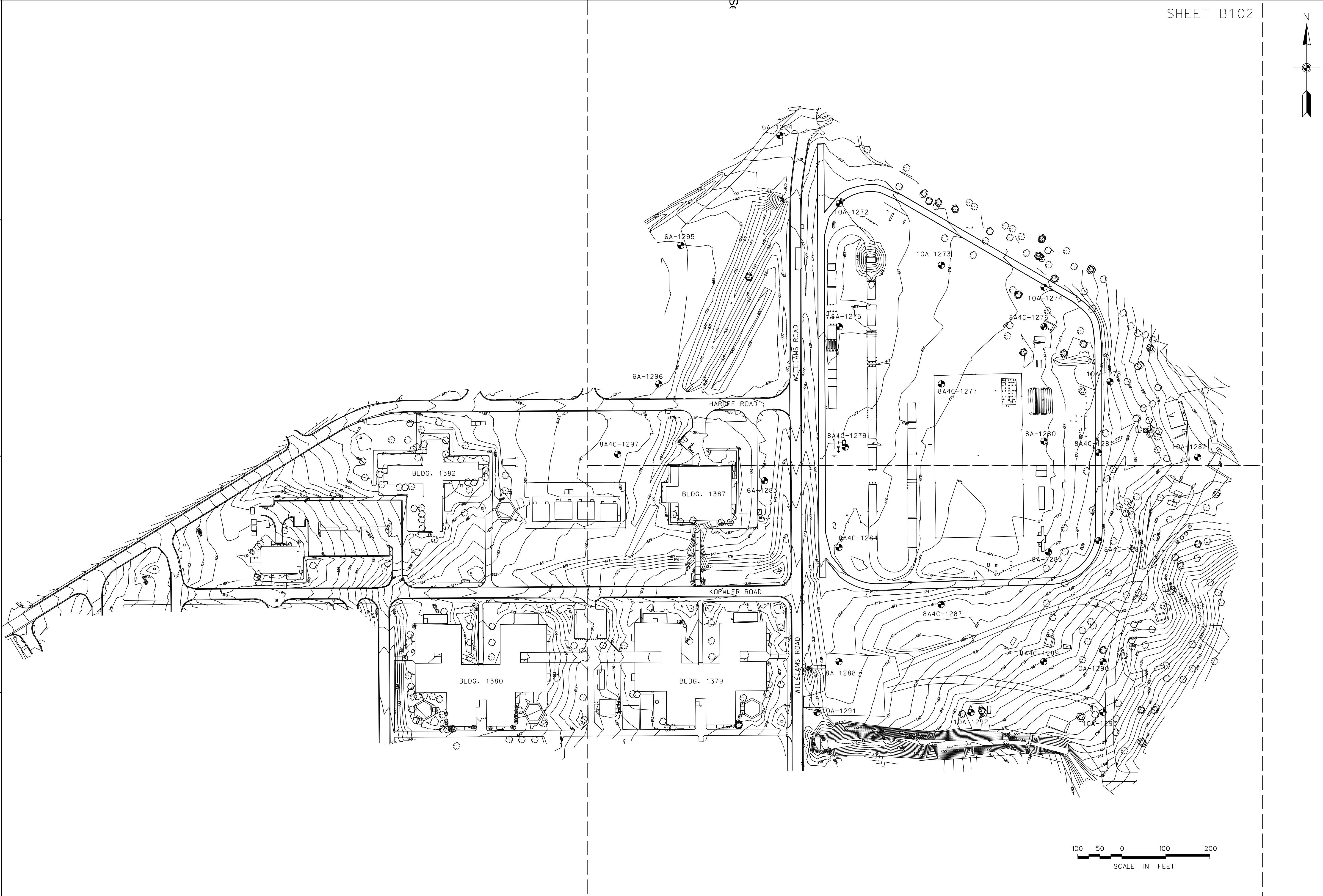
FORT WORTH DISTRICT
NOVEMBER 2008

Amended OCTOBER 2010 to include additional notes alerting the Battalion Headquarters Design-Build RFP bidders to site grading and fill placement activities that occurred subsequent to the USACE geotechnical site investigation. Clarifications are provided regarding requirements for plugging test holes and auger excavations made at the site (including elevator jack holes) to ensure these excavations do not permit water to access and infiltrate into the overburden clays and clay shale primary materials.

IT SHOULD BE NOTED THAT THERE HAVE BEEN NO CHANGES TO THE FOUNDATION, EARTHWORK, AND PAVEMENT DESIGN AND CONSTRUCTION RECOMMENDATIONS, REQUIREMENTS, AND DESIGN PARAMETERS SPECIFIED IN THE ORIGINAL OCTOBER 2008 REPORT.

APPENDIX A

BORING LOCATIONS & LOGS OF BORINGS



NOTE: USE THIS SHEET FOR BORING LOCATIONS ONLY.

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

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Reviewed by: L. PERRIN	Contr No.		
Submitted by: LESLIE L. PERRIN, P.E. CHIEF, GEOTECHNICAL SECTION	File name: $$cadd file name$$ Plot date: $$date$$ Plot scale:		

U.S. ARMY ENGINEER DISTRICT,
CORPS OF ENGINEERS
FORT WORTH, TEXAS

ENGINEERING/
CONSTRUCTION DIVISION
ENG. SERVICES BRANCH

FORT SAM HOUSTON, TEXAS
ADVANCED INDIVIDUAL TRAINING (AIT)
BARRACKS COMPLEX

BORING LOCATIONS - 1 OF 3
(OVERVIEW)

Sheet reference number:
B101

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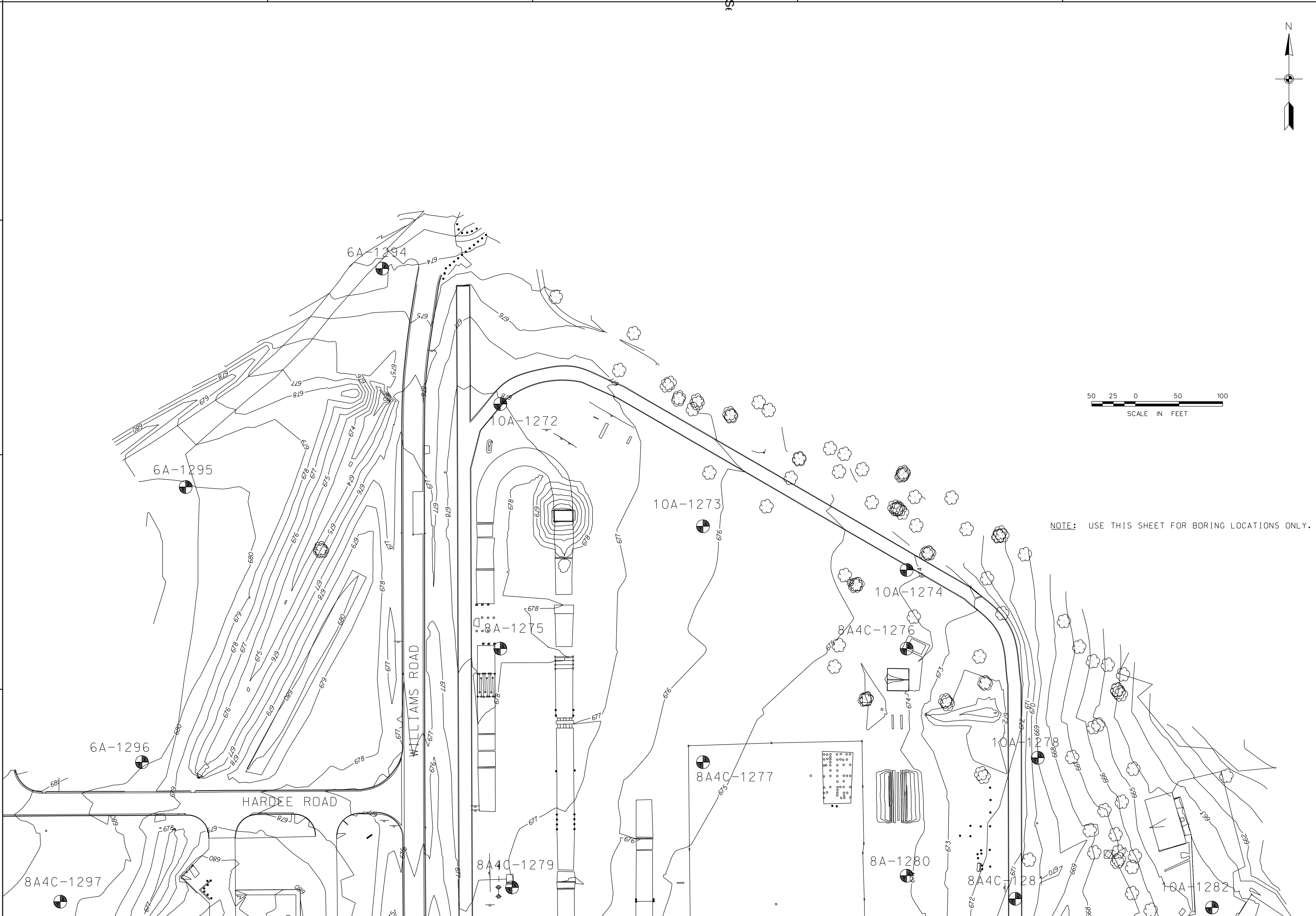

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: K. McCLESKEY
Dwn by: K. McCLESKEY
Reviewed by: L. PERRIN
Submitted by: LESLIE L. PERRIN, P.E. CHIEF, GEOTECHNICAL SECTION

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION ENG. SERVICES BRANCH

FORT SAM HOUSTON, TEXAS
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX

BORING LOCATIONS - 2 OF 3 (NORTHERN PART OF SITE)

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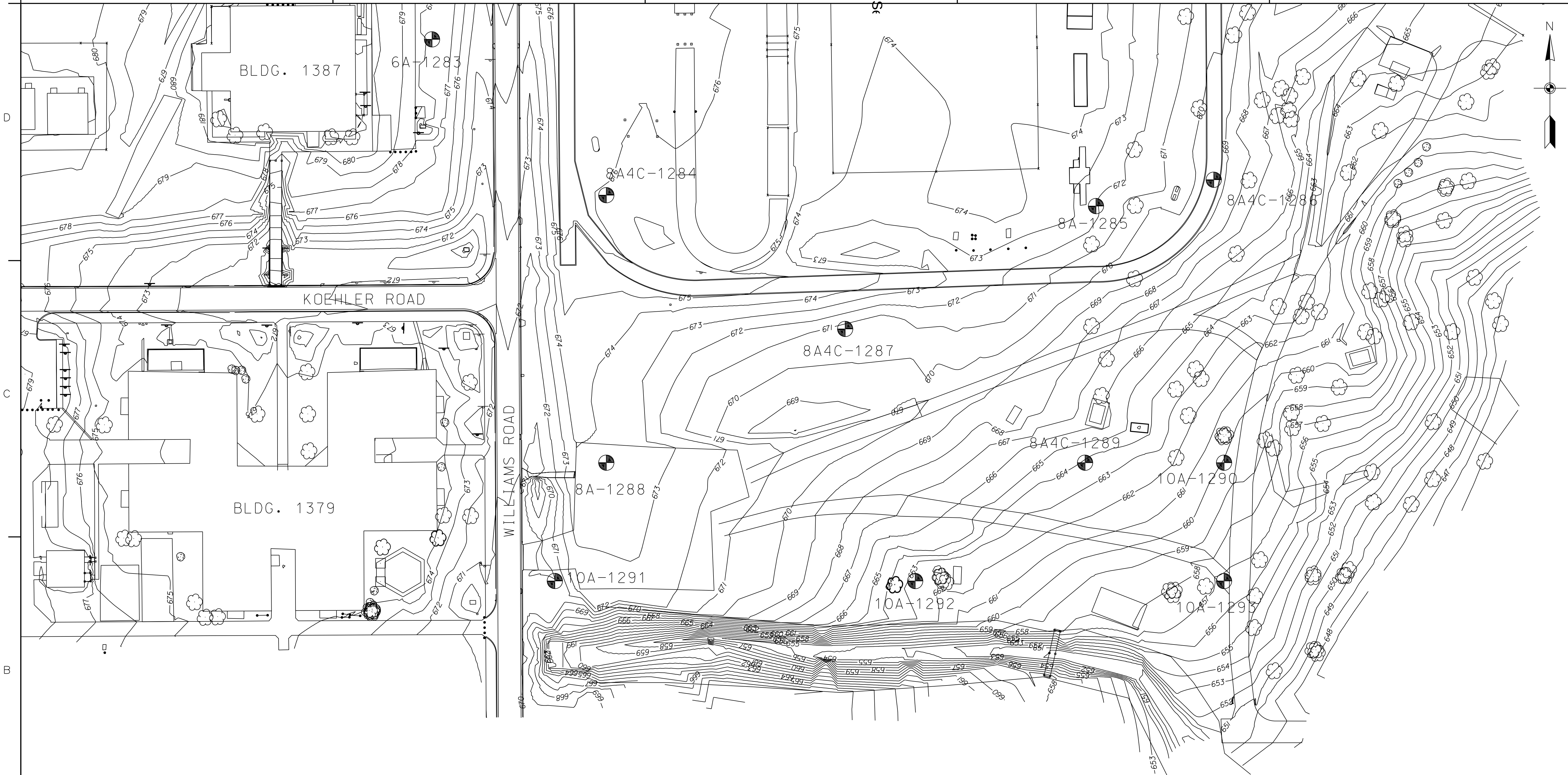

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SCALE IN FEET

NOTE: USE THIS SHEET FOR BORING LOCATIONS ONLY.

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: K. McCLESKEY | Date: | Rev.
Dwn by: K. McCLESKEY | Sol No.
Reviewed by: L. PERRIN | Contr No.
Submitted by: LESLIE L. PERRIN, P.E. CHIEF, GEOTECHNICAL SECTION | File name: $$cadd file name$$ Plot date: $$date$$ Plot scale:

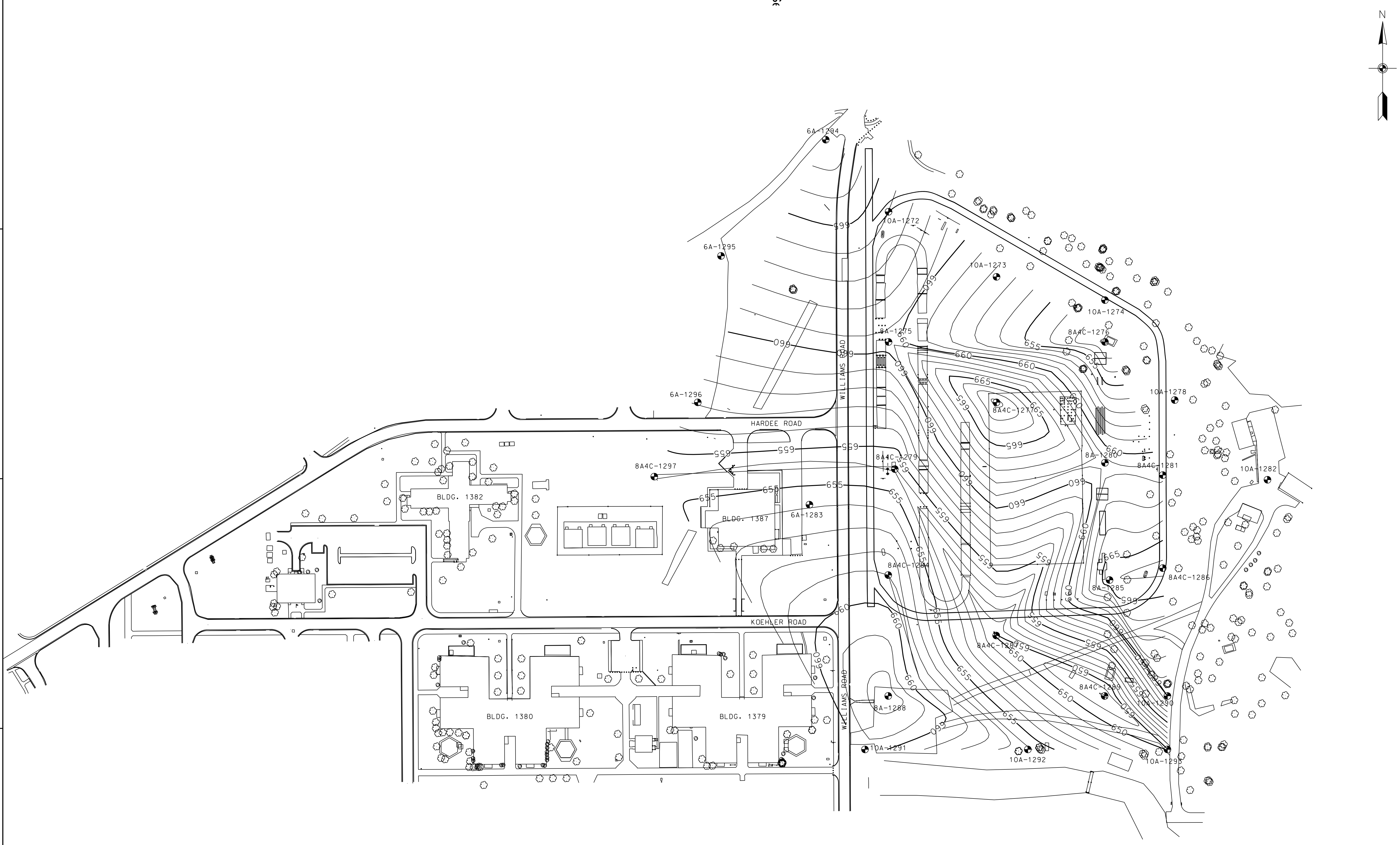
U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION ENG. SERVICES BRANCH

FORT SAM HOUSTON, TEXAS
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX

BORING LOCATIONS - 3 OF 3 (SOUTHERN PART OF SITE)

Sheet reference number:
B103



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SCALE IN FEET

NOTE: THESE ISOPACHS REPRESENT AN INTERPRETATION OF THE CONTACT ELEVATIONS BASED ON THE LOGS OF BORINGS. VARIATIONS TO THE ACTUAL CONTACT ELEVATION MAY EXIST.

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: J. PICKERING
Dwn by: J. PICKERING
Reviewed by: K. McCLESKEY
Submitted by: LESLIE L. PERRIN, P.E. CHIEF, GEOTECHNICAL SECTION

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

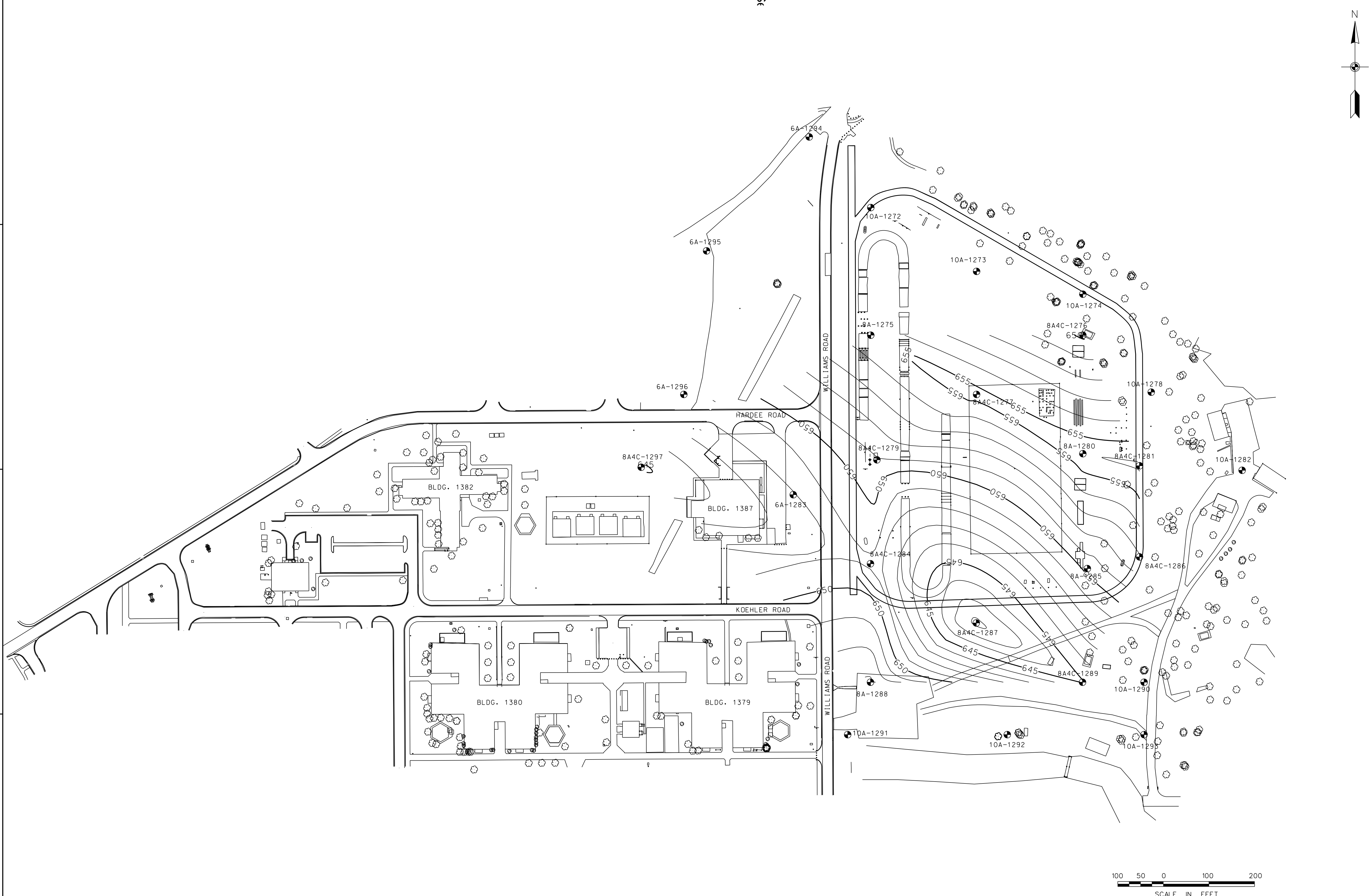
ENGINEERING/ CONSTRUCTION DIVISION DESIGN BRANCH

FORT SAM HOUSTON, TEXAS
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX

TOP OF GRAVEL ISOPACH MAP

Sheet reference number:

B104



NOTE: THESE ISOPACHS REPRESENT AN INTERPRETATION OF THE CONTACT ELEVATIONS BASED ON THE LOGS OF BORINGS. VARIATIONS TO THE ACTUAL CONTACT ELEVATION MAY EXIST.

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: J. PICKERING
Dwn by: J. PICKERING
Reviewed by: K. McCLESKEY
Submitted by: LESLIE L. PERRIN, P.E. CHIEF, GEOTECHNICAL SECTION

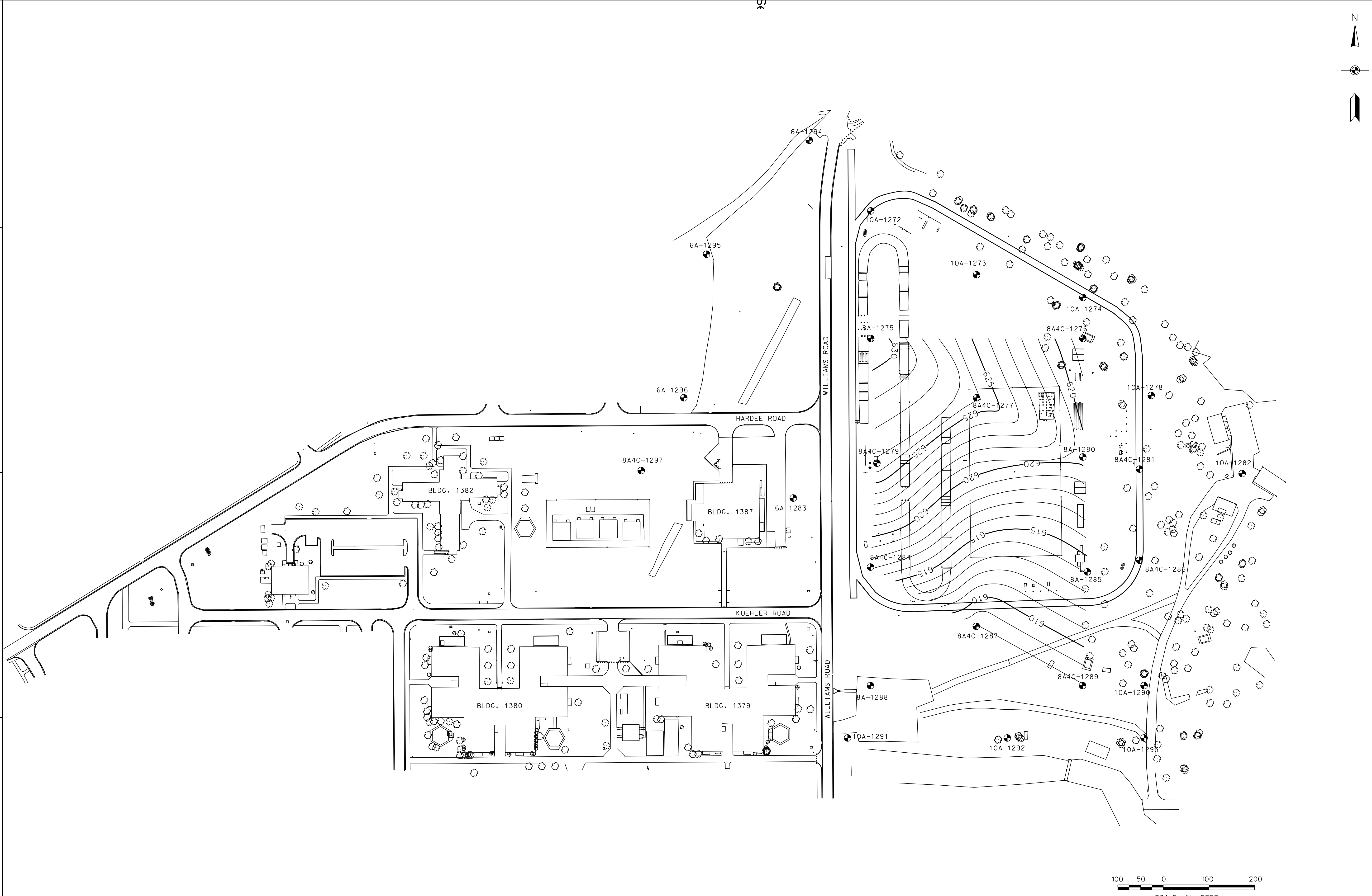
U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION DESIGN BRANCH

FORT SAM HOUSTON, TEXAS
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX

TOP OF WEATHERED SHALE ISOPACH MAP

Sheet reference number:
B105



NOTE: THESE ISOPACHS REPRESENT AN INTERPRETATION OF THE CONTACT ELEVATIONS BASED ON THE LOGS OF BORINGS. VARIATIONS TO THE ACTUAL CONTACT ELEVATION MAY EXIST.

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: J. PICKERING
Dwn by: J. PICKERING
Reviewed by: K. McCLESKEY
Submitted by: LESLIE E. PERRIN, P.E. CHIEF, GEOTECHNICAL SECTION
Date:
Sol No.
Contr No.
Rev.
Plot date: $$date$$
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U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION DESIGN BRANCH

FORT SAM HOUSTON, TEXAS
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX

TOP OF UNWEATHERED SHALE ISOPACH MAP

Sheet reference number:

B106

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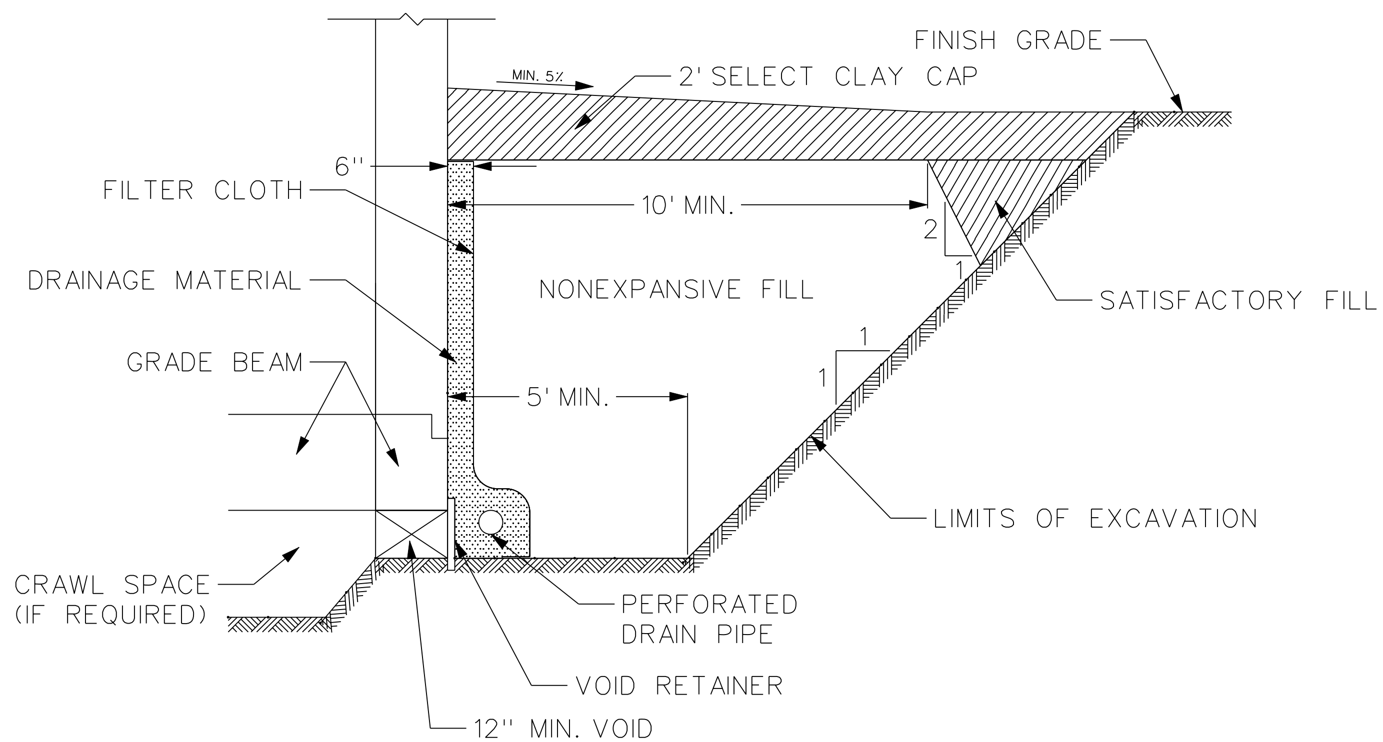
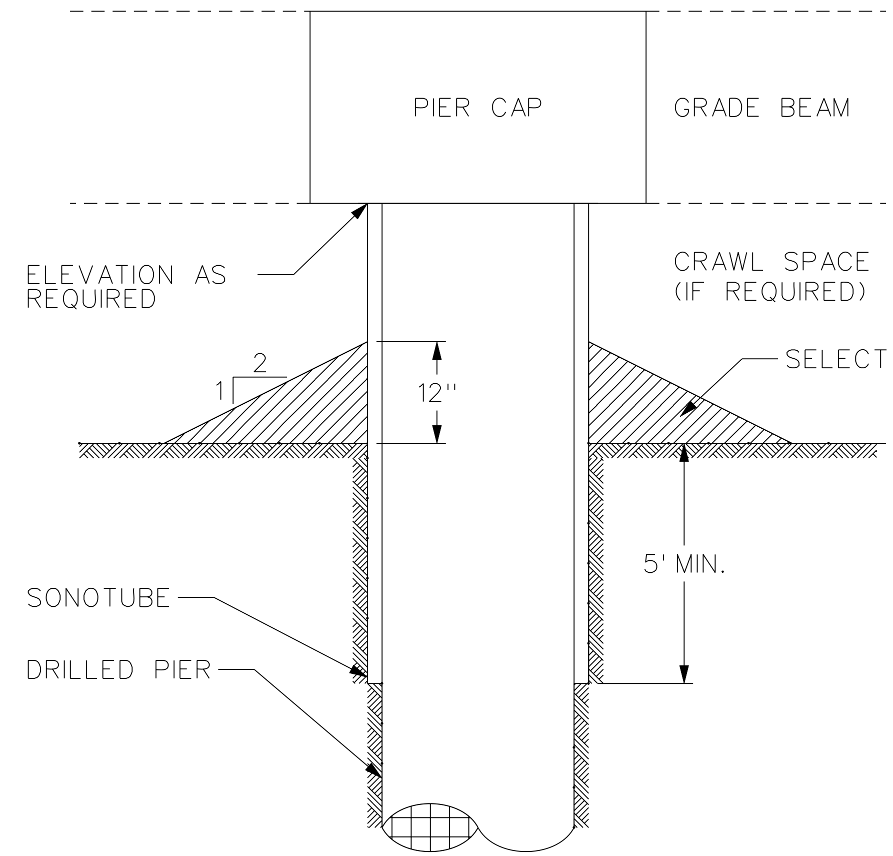


BASEMENT WALL BACKFILL DETAIL

NOT TO SCALE



SONOTUBE FORMING AND
CLAY CAP DETAILS

NOT TO SCALE

NOTES:

1. NONEXPANSIVE FILL SHALL BE PLACED IN CONTROLLED LIFTS NOT EXCEEDING 8 INCHES IN LOOSE THICKNESS AND COMPACTED TO AT LEAST 95 PERCENT OF LABORATORY MAXIMUM DENSITY AS DETERMINED IN ACCORDANCE WITH ASTM D 1557.

2. SELECT FILL AND SELECT CLAY FILL SHALL BE PLACED IN CONTROLLED LIFTS NOT EXCEEDING 8 INCHES IN LOOSE THICKNESS AND COMPACTED TO AT LEAST 90 PERCENT OF LABORATORY MAXIMUM DENSITY AS DETERMINED IN ACCORDANCE WITH ASTM D 1557.

3. REFER TO THE GOVERNMENT GEOTECHNICAL REPORT FOR NONEXPANSIVE FILL, SELECT FILL, AND SELECT CLAY FILL MATERIAL DEFINITIONS AND REQUIREMENTS, AND FOR COMPLETE FILL AND SUBGRADE PREPARATION MINIMUM REQUIREMENTS.

US Army Corps
of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: J. PICKERING
Dwn by: J. PICKERING
Reviewed by: L. PERRIN
Submitted by: LESLIE L. PERRIN, P.E. CHIEF, GEOTECHNICAL SECTION
Date:
Rev.
Sol No.
Contr No.
File name: $$cadd file name$$
Plot date: $$date$$
Plot scale:

U.S. ARMY ENGINEER DISTRICT,
CORPS OF ENGINEERS
FORT WORTH, TEXAS

ENGINEERING/
CONSTRUCTION DIVISION
ENG. SERVICES BRANCH

FORT SAM HOUSTON, TEXAS
ADVANCED INDIVIDUAL TRAINING (AIT)
BARRACKS COMPLEX

BASEMENT WALL BACKFILL DETAIL
& SONOTUBE FORMING
AND CLAY CAP DETAILS

Sheet
reference
number:
B107

Contr No.

$$time$$
$$date$$
$$user$$
$$cadd file name$$

$$time$$

$$date$$
$$user$$

$$cadd file name$$

Hole No. 10A-1272

DRILLING LOG	DIVISION SWD	INSTALLATION FORT WORTH DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX	10. SIZE AND TYPE OF BIT	6" AUGER
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY	USACE	12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
4. HOLE NO. (As shown on drawing title and file number)	10A-1272	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
5. NAME OF DRILLER	SALIK	14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER	DRY
7. THICKNESS OF OVERBURDEN	--	16. DATE HOLE	STARTED 26 JUN 08 / COMPLETED 26 JUN 08
8. DEPTH DRILLED INTO ROCK	--	17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE	10.0'	18. TOTAL CORE RECOVERY FOR BORING	N/A %
		19. SIGNATURE OF INSPECTOR	BOB MCVEY

% MOISTURE CONTENT a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10	VISUAL	0.0' TO 10.0' CLAY - HIGH PLASTICITY, HARD, DRY, SLIGHTLY SANDY, BLACK TO YELLOW BROWN, SLIGHTLY LIMY AFTER 5', WITH A FEW GRAVELS.		A B	JAR SAMPLES A. 0.0' TO 5.0' B. 5.0' TO 10.0'

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT AIT, FSH HOLE NO. 10A-1272

Hole No. 10A-1273

DRILLING LOG	DIVISION SWD	INSTALLATION FORT WORTH DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX	10. SIZE AND TYPE OF BIT	6" AUGER
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY	USACE	12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
4. HOLE NO. (As shown on drawing title and file number)	10A-1273	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
5. NAME OF DRILLER	SALIK	14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER	DRY
7. THICKNESS OF OVERBURDEN	--	16. DATE HOLE	STARTED 26 JUN 08 / COMPLETED 26 JUN 08
8. DEPTH DRILLED INTO ROCK	--	17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE	10.0'	18. TOTAL CORE RECOVERY FOR BORING	N/A %
		19. SIGNATURE OF INSPECTOR	BOB MCVEY

% MOISTURE CONTENT a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
18.4 19.5	10		0.0' TO 10.0' CLAY - HIGH PLASTICITY, HARD, DRY, SLIGHTLY SANDY, BLACK TO YELLOW BROWN, SLIGHTLY LIMY BY 5'.		A B	JAR SAMPLES A. 0.0' TO 5.0' B. 5.0' TO 10.0'

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT AIT, FSH HOLE NO. 10A-1273

Hole No. 10A-1274

DRILLING LOG	DIVISION SWD	INSTALLATION FORT WORTH DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX	10. SIZE AND TYPE OF BIT	6" AUGER
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY	USACE	12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
4. HOLE NO. (As shown on drawing title and file number)	10A-1274	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
5. NAME OF DRILLER	SALIK	14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER	DRY
7. THICKNESS OF OVERBURDEN	--	16. DATE HOLE	STARTED 26 JUN 08 / COMPLETED 26 JUN 08
8. DEPTH DRILLED INTO ROCK	--	17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE	10.0'	18. TOTAL CORE RECOVERY FOR BORING	N/A %
		19. SIGNATURE OF INSPECTOR	BOB MCVEY

% MOISTURE CONTENT a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	10	VISUAL	0.0' TO 10.0' CLAY - HIGH PLASTICITY, HARD, DRY, SLIGHTLY SANDY, BLACK TO 5' THEN YELLOW BROWN AND SLIGHTLY LIMY.		A B	JAR SAMPLES 1. 0.0' TO 5.0' 2. 5.0' TO 10.0'

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT AIT, FSH HOLE NO. 10A-1274

Hole No. 8A-1275

DRILLING LOG	DIVISION SWD	INSTALLATION FORT WORTH DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX	10. SIZE AND TYPE OF BIT	SEE REMARKS
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY	USACE	12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
4. HOLE NO. (As shown on drawing title and file number)	8A-1275	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 4 / UNDISTURBED 0
5. NAME OF DRILLER	SALIK	14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER	SEE REMARKS
7. THICKNESS OF OVERBURDEN	23.3'	16. DATE HOLE	STARTED 2 AUG 08 / COMPLETED 3 AUG 08
8. DEPTH DRILLED INTO ROCK	27.7'	17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE	51.0'	18. TOTAL CORE RECOVERY FOR BORING	N/A %
		19. SIGNATURE OF INSPECTOR	BOB MCVEY

% MOISTURE CONTENT a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
17.2 14.1 14.9 16.3 18.0 21.1 19.7 17.7 14.9 9.8	10 20 30 40 50 60	VISUAL VISUAL VISUAL	0.0' TO 9.5' CLAY - HIGH PLASTICITY, HARD, DRY TO SLIGHTLY MOIST BY 5', VERY DARK BROWN TO YELLOW BROWN BY 5', SLIGHTLY SANDY, SLIGHTLY LIMY AFTER 5'. 9.5' TO 12.5' GRAVEL - COARSE TO FINE, SLIGHTLY MOIST, YELLOW BROWN, CLAYEY AND SANDY. 12.5' TO 17.5' CLAY - MEDIUM PLASTICITY, VERY STIFF, MOIST, YELLOW BROWN, SLIGHTLY LIMY AND SANDY. 17.5' TO 23.3' GRAVEL - COARSE TO FINE, DENSE TO VERY DENSE, MOIST, YELLOW BROWN, CLAYEY AND SANDY (WITH SEAMS), WITH COBBLES. 23.3' TO 51.0' SHALE - WEATHERED YELLOW BROWN, LIGHT GRAY, AND STRONG BROWN UNTIL 47.0', THEN AN UNWEATHERED DARK GRAY, WHERE UNCTUOUS AND MODERATELY HARD (ROCK CLASSIFICATION), OTHERWISE, MOISTLY SOFT (ROCK CLASSIFICATION), SLIGHTLY MOIST, SILTY, CALCAREOUS, BLOCKY STRUCTURE, FRACTURES NOTED, GYPSUM NOTED AFTER 35'.		A B C D E F G H I J	DRILLING 0.0' TO 45.0' - 8" AUGER. 45.0' TO 51.0' - 6" AUGER. WATER LEVEL DRY - OPEN TO 44.3'. JAR SAMPLES A. 0.0' TO 5.0' B. 5.0' TO 9.5' C. 12.5' TO 17.5' D. 19.0' TO 21.0' (WATER ADDED) E. 23.3' TO 29.0' F. 29.0' TO 35.0' G. 35.0' TO 40.0' H. 40.0' TO 45.0' I. 45.0' TO 47.0' J. 47.0' TO 51.0'

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT AIT, FSH HOLE NO. 8A-1275

NOTES:

1. USE THIS SHEET FOR BORING LOGS ONLY.
2. MOISTURE CONTENT, WHERE SHOWN, IS EXPRESSED AS PERCENT DRY WEIGHT AT TIME OF LABORATORY CLASSIFICATION.
3. LEGEND SHOWS OVERBURDEN MATERIALS CLASSIFIED ACCORDING TO ASTM D 2487 AND ASTM D 2488.
4. DESCRIPTION OF OVERBURDEN MATERIALS CHANGED TO CORRESPOND WITH LABORATORY CLASSIFICATION AS NECESSARY.
5. ORIGINAL DRILLING LOGS AVAILABLE AT CORPS OF ENGINEERS OFFICES.

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: K. McCLESKEY	Date: APRIL 2008	Rev.
Dwn by: K. McCLESKEY	Sol No. W9126G-08-R-0175	
Reviewed by: L. PERRIN	Contr No.	
Submitted by: LESLIE L. PERRIN, P.E. CHIEF, GEOTECHNICAL SECTION	File name: $$cadd file name$$ Plot date: $$date$$ Plot scale:	

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION ENG. SERVICES BRANCH

FORT SAM HOUSTON, TEXAS
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX

LOGS OF BORINGS - 1 OF 7

Sheet reference number: B201

Contr No.

REFERENCE FILES:
$$REFERENCEFILE1$$
$$REFERENCEFILE2$$
$$REFERENCEFILE3$$
$$REFERENCEFILE4$$
$$REFERENCEFILE5$$
$$REFERENCEFILE6$$
$$REFERENCEFILE7$$
$$REFERENCEFILE8$$
$$REFERENCEFILE9$$
$$REFERENCEFILE10$$
$$REFERENCEFILE11$$
$$REFERENCEFILE12$$
$$REFERENCEFILE13$$
$$REFERENCEFILE14$$
$$REFERENCEFILE15$$

DRILLING LOG — Hole No. 8A4C-1276

Field	Entry
DIVISION	SWD
INSTALLATION	FORT WORTH DISTRICT
SHEET	1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS
3. DRILLING AGENCY	USACE
4. HOLE NO. (As shown on drawing title and file number)	8A4C-1276
5. NAME OF DRILLER	SALIK
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	24.5'
8. DEPTH DRILLED INTO ROCK	39.5'
9. TOTAL DEPTH OF HOLE	64.0'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 5 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	SEE REMARKS
16. DATE HOLE	STARTED 4 AUG 08 / COMPLETED 6 AUG 08
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	92 %
19. SIGNATURE OF INSPECTOR	BOB McVEY

Columns: % MOISTURE CONTENT (a) | DEPTH (b) | LEGEND (c) | CLASSIFICATION OF MATERIALS (Description) (d) | % CORE RECOVERY (e) | BOX OR SAMPLE NO. (f) | REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)

% Moisture content: 22.0, 17.2, 16.4, 17.0, 14.0, 19.1, 18.9, 18.3, 10.1, 9.9

Box or sample no.: A, B, C, D, E, C-1, C-2, C-3, C-4, C-5

Legend: VISUAL (at 24.5')

Classification of materials:

0.0' TO 22.5'

CLAY

0.0' TO 5.0' - HIGH PLASTICITY, HARD, DRY, VERY DARK BROWN, SLIGHTLY SANDY, WITH GRAVEL.

5.0' TO 22.5' - HIGH PLASTICITY (0' TO 15') TO MEDIUM PLASTICITY (BELOW 15'), VERY STIFF, SLIGHTLY MOIST, SLIGHTLY LIMY TO 10', SLIGHTLY SANDY, MOISTLY YELLOW BROWN WITH RED YELLOW ZONES AFTER 10' AND LIGHT GRAY WITH STRONG BROWN ZONES AFTER 20', SILTY, CALCAREOUS.

22.5' TO 24.5'

GRAVEL - COARSE TO FINE, SLIGHTLY MOIST, YELLOW BROWN, CLAYEY AND SANDY, A FEW COBBLES NOTED.

24.5' TO 64.0'

SHALE

24.5' TO 56.0' - WEATHERED YELLOW BROWN, LIGHT GRAY, AND STRONG BROWN, MASSIVE, BLOCKY STRUCTURE, CALCAREOUS, SOFT (ROCK CLASSIFICATION), SILTY, SLIGHTLY MOIST, NUMEROUS HEALED FRACTURES (MODERATE TO HIGH-ANGLE) SCATTERED ABOUT WITH GYPSUM CRYSTALS WITHIN AFTER 33', SOME DARK GRAY AFTER 49.6'

56.0' TO 64.0' - AS ABOVE SHALE, EXCEPT AN UNWEATHERED DARK GRAY, MODERATELY HARD (ROCK CLASSIFICATION), UNCTUOUS, UNFRACTURED.

Remarks:

DRILLING

0.0' TO 26.0' - 10" AUGER; SET 30' OF 8" CASING AND CIRCULATION PAN; CLEANED TO 31.0' WITH AUGER.
31.0' TO 64.0' - 4" CARBOLOY CORE BIT; DIAMOND BIT AFTER 57.5'; BAILED AND GROUTED.

WATER LEVEL

BAILED TO 53.0' UPON COMPLETION OF DRILLING.
18-HR CHECK AT 53.2'.

JAR SAMPLES

A. 0.0' TO 5.0'
B. 5.0' TO 10.0'
C. 10.0' TO 15.0'
D. 15.0' TO 20.0'
3. 20.0' TO 22.5'

CARTON SAMPLES

C-1. 34.1' TO 35.0'
C-2. 43.1' TO 44.0'
C-3. 49.2' TO 50.0'
C-4. 56.2' TO 57.0'
C-5. 62.2' TO 63.0'

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. | PROJECT AIT, FSH | HOLE NO. 8A4C-1276

DRILLING LOG — Hole No. 8A4C-1277

Field	Entry
DIVISION	SWD
INSTALLATION	FORT WORTH DISTRICT
SHEET	1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS
3. DRILLING AGENCY	USACE
4. HOLE NO.	8A4C-1277
5. NAME OF DRILLER	SALIK/NETHERLAND
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	20.0'
8. DEPTH DRILLED INTO ROCK	43.0'
9. TOTAL DEPTH OF HOLE	63.0'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 3 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	SEE REMARKS
16. DATE HOLE	STARTED 18 JUL 08 / COMPLETED 21 JUL 08
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	86 %
19. SIGNATURE OF INSPECTOR	BOB McVEY

% Moisture content: 17.4, 22.2, 12.4, 17.9, 20.9, 20.0, 19.4, 15.7, 9.9

Box or sample no.: A, B, C, C-1, C-2, C-3, C-4, C-5, C-6

Legend: VISUAL (at 7.0'), VISUAL (at 15')

Classification of materials:

0.0' TO 7.0'

CLAY - HIGH PLASTICITY, HARD, DRY TO SLIGHTLY MOIST, DARK BROWN TO YELLOW BROWN AND LIMY AFTER 4.5', SLIGHTLY SANDY.

7.0' TO 20.0'

GRAVEL - COARSE TO FINE, COBBLES TO 5.5" DIAMETER RECOVERED FROM HOLE, DRY, YELLOW BROWN, LIMY, SANDY AND CLAYEY (WITH SEAMS), DENSE TO VERY DENSE, CALCAREOUS.

20.0' TO 63.0'

SHALE

20.0' TO 49.2' - WEATHERED YELLOW BROWN, LIGHT GRAY, WITH STRONG BROWN, SLIGHTLY MOIST, MASSIVE, BLOCKY STRUCTURE, SOFT (ROCK CLASSIFICATION), CALCAREOUS, SILTY, FOSSILIFEROUS, LIMY AT TOP OF SECTION, A FEW SCATTERED LIMONITE CONCRETIONS NOTED, NUMEROUS MODERATE TO HIGH-ANGLE HEALED FRACTURES THROUGHOUT, GYPSUM (SELENITE) IN FRACTURES AFTER 40'.

49.2' TO 63.0' - AS ABOVE SHALE, EXCEPT AN UNWEATHERED DARK GRAY, MODERATELY HARD (ROCK CLASSIFICATION), UNCTUOUS, UNFRACTURED.

Remarks:

DRILLING

0.0' TO 21.0' - 10" AUGER WITH DRAGBIT/ROCK BIT; SET 21' OF 8" CASING AND CIRCULATION PAN; CLEANED TO 23.0' WITH AUGER.
23.0' TO 63.0' - 4" CARBOLOY CORE BIT TO 53', THEN 4" DIAMOND BIT CORE TO 63.0'; BAILED, PULLED CASING, AND GROUTED AFTER DRILLING.

WATER LEVEL

BAILED TO 52.0' UPON COMPLETION OF DRILLING.
18-HR CHECK AT 39.0'

JAR SAMPLES

A. 0.0' TO 4.5'
B. 4.5' TO 7.0'
C. 10.0' TO 13.0' (WATER ADDED)

CARTON SAMPLES

C-1. 27.0' TO 28.0'
C-2. 34.1' TO 35.0'
C-3. 40.1' TO 41.0'
C-4. 46.1' TO 47.0'
C-5. 52.1' TO 53.0'
C-6. 59.1' TO 60.0'

SOIL RESISTIVITY TEST

2.5' PIN SPACING
x 191.5
x 1 MULTIPLIER
x 0.6 DIAL READING
= 287 OHM-CM.

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. | PROJECT AIT, FSH | HOLE NO. 8A4C-1277

DRILLING LOG — Hole No. 10A-1278

Field	Entry
DIVISION	SWD
INSTALLATION	FORT WORTH DISTRICT
SHEET	1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS
3. DRILLING AGENCY	USACE
4. HOLE NO.	10A-1278
5. NAME OF DRILLER	SALIK
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	--
8. DEPTH DRILLED INTO ROCK	--
9. TOTAL DEPTH OF HOLE	10.0'
10. SIZE AND TYPE OF BIT	6" AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	DRY
16. DATE HOLE	STARTED 26 JUN 08 / COMPLETED 26 JUN 08
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. SIGNATURE OF INSPECTOR	BOB McVEY

Legend: VISUAL

Box or sample no.: A, B

Classification of materials:

0.0' TO 10.0'

CLAY - HIGH PLASTICITY, HARD, DRY, VERY DARK BROWN TO YELLOW BROWN AND SLIGHTLY LIMY AFTER 4', SLIGHTLY SANDY, GRAVELS FROM 0' TO 4'.

Remarks:

JAR SAMPLES

A. 0.0' TO 4.0'
B. 4.0' TO 10.0'

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. | PROJECT AIT, FSH | HOLE NO. 10A-1278

NOTES:

1. USE THIS SHEET FOR BORING LOGS ONLY.
2. MOISTURE CONTENT, WHERE SHOWN, IS EXPRESSED AS PERCENT DRY WEIGHT AT TIME OF LABORATORY CLASSIFICATION.
3. LEGEND SHOWS OVERBURDEN MATERIALS CLASSIFIED ACCORDING TO ASTM D 2487 AND ASTM D 2488.
4. DESCRIPTION OF OVERBURDEN MATERIALS CHANGED TO CORRESPOND WITH LABORATORY CLASSIFICATION AS NECESSARY.
5. ORIGINAL DRILLING LOGS AVAILABLE AT CORPS OF ENGINEERS OFFICES.

DRILLING LOG — Hole No. 8A4C-1279

Field	Entry
DIVISION	SWD
INSTALLATION	FORT WORTH DISTRICT
SHEET	1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS
3. DRILLING AGENCY	USACE
4. HOLE NO.	8A4C-1279
5. NAME OF DRILLER	SALIK
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	26.0'
8. DEPTH DRILLED INTO ROCK	39.0'
9. TOTAL DEPTH OF HOLE	65.0'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 5 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	SEE REMARKS
16. DATE HOLE	STARTED 31 JUL 08 / COMPLETED 2 AUG 08
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	97 %
19. SIGNATURE OF INSPECTOR	BOB McVEY

% Moisture content: 16.7, 17.5, 17.1, 15.6, 17.6, 19.7, 20.6, 19.7, 15.2, 16.2

Box or sample no.: A, B, C, D, E, C-1, C-2, C-3, C-4, C-5

Legend: VISUAL (at 26.0')

Classification of materials:

0.0' TO 23.0'

CLAY

0.0' TO 5.0' - HIGH PLASTICITY, HARD, DRY, BLACK, SLIGHTLY SANDY, CALCAREOUS.

5.0' TO 16.0' - MEDIUM TO HIGH PLASTICITY, HARD, SLIGHTLY MOIST, YELLOW BROWN, SLIGHTLY LIMY AND SANDY.

16.0' TO 23.0' - MEDIUM TO HIGH PLASTICITY, VERY STIFF, MOIST, YELLOW BROWN, LIGHT GRAY, STRONG BROWN.

23.0' TO 26.0'

GRAVEL - COARSE TO FINE, DENSE, COBBLES TO 5" DIAMETER RECOVERED DURING DRILLING, MOIST, YELLOW BROWN AND STRONG BROWN, CLAYEY AND SANDY.

26.0' TO 65.0'

SHALE

26.0' TO 50.1' - WEATHERED YELLOW BROWN, LIGHT GRAY, AND SOME STRONG BROWN, SOFT (ROCK CLASSIFICATION), SLIGHTLY MOIST, MASSIVE, BLOCKY STRUCTURE, SILTY, FRACTURES SCATTERED THROUGHOUT (WELL HEALED WITH GYPSUM CRYSTALS WITHIN AFTER 38.5', CALCAREOUS, FOSSILS.

50.1' TO 65.0' - UNWEATHERED DARK GRAY WITH MINOR STAINS UNTIL 51', MODERATELY HARD (ROCK CLASSIFICATION), UNCTUOUS, UNFRACTURED, MASSIVE, BLOCKY, SILTY, CALCAREOUS, FOSSILIFEROUS.

Remarks:

DRILLING

0.0' TO 27.0' - 10" AUGER AND DRAGBIT IN GRAVEL; SET 29' OF 8" CASING AND CIRCULATION PAN, CLEANED TO 31.0' WITH AUGER.
31.0' TO 65.0' - 4" CORE; BAILED AND GROUTED.

WATER LEVEL

BAILED TO 52.0' UPON COMPLETION OF DRILLING.
24-HR CHECK AT 36.0' AND CAVED TO 47.0'.

JAR SAMPLES

A. 0.0' TO 5.0'
B. 5.0' TO 11.0'
C. 11.0' TO 16.0'
D. 16.0' TO 21.0'
E. 21.0' TO 23.0'

CARTON SAMPLES

C-1. 34.1' TO 35.0'
C-2. 42.1' TO 43.0'
C-3. 48.1' TO 49.0'
C-4. 54.1' TO 55.0'
C-5. 61.1' TO 62.0'

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. | PROJECT AIT, FSH | HOLE NO. 8A4C-1279

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: K. McCLESKEY
Dwn by: K. McCLESKEY
Reviewed by: L. PERRIN
Submitted by: LESLIE L. PERRIN, P.E. CHIEF, GEOTECHNICAL SECTION
Date: APRIL 2008
Sol No. W9126G-08-R-0175
Contr No.
Rev.

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION ENG. SERVICES BRANCH

FORT SAM HOUSTON, TEXAS
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX

LOGS OF BORINGS - 2 OF 7

Sheet reference number: B202

Contr No.

Hole No. 8A-1280

DRILLING LOG	DIVISION SWD	INSTALLATION FORT WORTH DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX	10. SIZE AND TYPE OF BIT	8" AND 6" AUGER
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY	USACE	12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
4. HOLE NO. (As shown on drawing title and file number)	8A-1280	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 3 / UNDISTURBED 0
5. NAME OF DRILLER	SALIK	14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER	DRY - OPEN TO 55.0'
7. THICKNESS OF OVERBURDEN	18.2'	16. DATE HOLE	STARTED 22 JUL 08 / COMPLETED 22 JUL 08
8. DEPTH DRILLED INTO ROCK	42.8'	17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE	61.0'	18. TOTAL CORE RECOVERY FOR BORING	N/A %
		19. SIGNATURE OF INSPECTOR	BOB McVEY

% MOISTURE CONTENT (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
		VISUAL	0.0' TO 12.7' CLAY - HIGH PLASTICITY, HARD, DRY TO SLIGHTLY MOIST, DARK BROWN TO YELLOW BROWN BY 5.5', SLIGHTLY SANDY, LIMY AFTER 5.5', CALCAREOUS. 12.7' TO 18.2' GRAVEL - COARSE TO FINE, COBBLES UP TO 4.5" DIAMETER NOTED, SLIGHTLY MOIST, YELLOW BROWN, LIMY, SANDY, AND CLAYEY. 18.2' TO 61.0' SHALE 18.2' TO 53.6' - WEATHERED YELLOW BROWN, LIGHT GRAY, AND STRONG BROWN, SLIGHTLY MOIST, LIMY AT THE TOP OF THE SECTION, BLOCKY, SILTY, CALCAREOUS, SOFT (ROCK CLASSIFICATION), SANDY ZONES, GYPSUM NOTED AFTER 36'. 53.6' TO 61.0' - AS ABOVE SHALE EXCEPT AN UNWEATHERED DARK GRAY, MODERATELY HARD (ROCK CLASSIFICATION), UNFRACTURED, UNCTUOUS.		A, B, C, D, E, F, G, H, I	JAR SAMPLES A. 0.0' TO 5.5' B. 5.5' TO 12.7' C. 13.0' TO 17.0' D. 18.2' TO 24.0' E. 24.0' TO 30.0' F. 30.0' TO 36.0' G. 36.0' TO 46.0' H. 46.0' TO 53.6' I. 53.6' TO 61.0'

Depth scale: 10, 20, 30, 40, 50, 60, 70

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71 | PROJECT AIT, FSH | HOLE NO. 8A-1280

Hole No. 8A4C-1281

DRILLING LOG	DIVISION SWD	INSTALLATION FORT WORTH DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX	10. SIZE AND TYPE OF BIT	SEE REMARKS
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY	USACE	12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
4. HOLE NO. (As shown on drawing title and file number)	8A4C-1281	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0 / UNDISTURBED 2
5. NAME OF DRILLER	SALIK	14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER	SEE REMARKS
7. THICKNESS OF OVERBURDEN	14.5'	16. DATE HOLE	STARTED 17 JUL 08 / COMPLETED 18 JUL 08
8. DEPTH DRILLED INTO ROCK	30.5'	17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE	45.0'	18. TOTAL CORE RECOVERY FOR BORING	97 %
		19. SIGNATURE OF INSPECTOR	BOB MCVEY

% MOISTURE CONTENT (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
16.5 14.6 20.9 16.9 17.2 19.4		VISUAL VISUAL VISUAL	0.0' TO 9.0' CLAY 0.0' TO 5.0' - HIGH PLASTICITY, HARD, DRY, VERY DARK BROWN, SLIGHTLY SANDY. 5.0' TO 9.0' - AS ABOVE, EXCEPT YELLOW BROWN AND SLIGHTLY LIMY. 9.0' TO 14.5' GRAVEL - COARSE TO FINE, COBBLES TO 4.5" DIAMETER NOTED, DENSE, DRY, YELLOW BROWN, LIMY AT THE TOP, SANDY AND CLAYEY. 14.5' TO 45.0' SHALE - WEATHERED YELLOW BROWN, LIGHT GRAY, AND STRONG BROWN, MASSIVE, BLOCKY STRUCTURE, SOFT (ROCK CLASSIFICATION), SILTY, CALCAREOUS, FOSSILIFEROUS, LIMONITIC SEAMS, SLIGHTLY MOIST, NUMEROUS MODERATE TO HIGH-ANGLE HEALED FRACTURES SCATTERED, GYPSUM SEAMS IN FRACTURES AFTER 33'.		ST-1 ST-2 C-1 C-2 C-3 C-4	DRILLING 0.0' TO 18.0' - 10" AUGER WITH 3" SHELBY TUBE PUSHES; DRY TO 18'; SET 19' OF 8" CASING AND CIRCULATION PAN; CLEANED TO 20.0' WITH A 7 7/8" AUGER. 20.0' TO 45.0' - 4" CARBOLOY CORE BIT; BAILED AND GROUTED AFTER DRILLING AND FINAL WATER LEVEL CHECK. WATER LEVEL BAILED TO 40.5' UPON COMPLETION OF DRILLING. 24-HR CHECK AT 40.6' AND OPEN TO 41.0'. SHELBY TUBE SAMPLES ST-1. 1.0' TO 3.0' (PENETROMETER > 4.5) ST-2. 7.0' TO 9.0' (PENETROMETER > 4.5) CARTON SAMPLES C-1. 23.0' TO 24.0' C-2. 29.1' TO 30.0' C-3. 35.1' TO 36.0' C-4. 42.0' TO 43.0'

Depth scale: 10, 20, 30, 40, 50, 60

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71 | PROJECT AIT, FSH | HOLE NO. 8A4C-1281

Hole No. 10A-1282

DRILLING LOG	DIVISION SWD	INSTALLATION FORT WORTH DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX	10. SIZE AND TYPE OF BIT	6" AUGER
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY	USACE	12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
4. HOLE NO. (As shown on drawing title and file number)	10A-1282	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 3 / UNDISTURBED 0
5. NAME OF DRILLER	SALIK	14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER	DRY
7. THICKNESS OF OVERBURDEN	--	16. DATE HOLE	STARTED 26 JUN 08 / COMPLETED 26 JUN 08
8. DEPTH DRILLED INTO ROCK	--	17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE	10.0'	18. TOTAL CORE RECOVERY FOR BORING	N/A %
		19. SIGNATURE OF INSPECTOR	BOB MCVEY

% MOISTURE CONTENT (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
23.1 21.6		VISUAL VISUAL	0.0' TO 0.15' - ASPHALT 0.15' TO 0.6' - BASE (GRAVEL) - COARSE TO FINE, DRY, BROWN, SANDY. 0.6' TO 8.8' CLAY - HIGH PLASTICITY, STIFF, MOIST, BLACK TO YELLOW BROWN AFTER 5', SLIGHTLY SANDY. 8.8' TO 10.0' GRAVEL - COARSE TO FINE, DRY, YELLOW BROWN, SANDY AND CLAYEY.		A B C	JAR SAMPLES A. 0.6' TO 5.0' B. 5.0' TO 8.8' C. 8.8' TO 10.0'

Depth scale: 10, 20

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71 | PROJECT AIT, FSH | HOLE NO. 10A-1282

Hole No. 6A-1283

DRILLING LOG	DIVISION SWD	INSTALLATION FORT WORTH DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX	10. SIZE AND TYPE OF BIT	6" AUGER
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY	USACE	12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
4. HOLE NO. (As shown on drawing title and file number)	6A-1283	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
5. NAME OF DRILLER	SALIK	14. TOTAL NUMBER CORE BOXES	0
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER	DRY
7. THICKNESS OF OVERBURDEN	--	16. DATE HOLE	STARTED 26 JUN 08 / COMPLETED 26 JUN 08
8. DEPTH DRILLED INTO ROCK	--	17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE	10.0'	18. TOTAL CORE RECOVERY FOR BORING	N/A %
		19. SIGNATURE OF INSPECTOR	BOB MCVEY

% MOISTURE CONTENT (a)	DEPTH (b)	LEGEND (c)	CLASSIFICATION OF MATERIALS (Description) (d)	% CORE RECOVERY (e)	BOX OR SAMPLE NO. (f)	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)
18.6 17.3		VISUAL	0.0' TO 7.5' CLAY 0.0' TO 5.0' - HIGH PLASTICITY, HARD, DRY, BLACK, SLIGHTLY SANDY. 5.0' TO 7.5' - HIGH PLASTICITY, HARD, DRY, YELLOW BROWN, SLIGHTLY SANDY AND LIMY. 7.5' TO 10.0' GRAVEL - COARSE TO FINE, DRY, YELLOW BROWN, SANDY AND CLAYEY.		A B	JAR SAMPLES A. 0.0' TO 5.0' B. 5.0' TO 7.5'

Depth scale: 10, 20

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71 | PROJECT AIT, FSH | HOLE NO. 6A-1283

NOTES:

1. USE THIS SHEET FOR BORING LOGS ONLY.
2. MOISTURE CONTENT, WHERE SHOWN, IS EXPRESSED AS PERCENT DRY WEIGHT AT TIME OF LABORATORY CLASSIFICATION.
3. LEGEND SHOWS OVERBURDEN MATERIALS CLASSIFIED ACCORDING TO ASTM D 2487 AND ASTM D 2488.
4. DESCRIPTION OF OVERBURDEN MATERIALS CHANGED TO CORRESPOND WITH LABORATORY CLASSIFICATION AS NECESSARY.
5. ORIGINAL DRILLING LOGS AVAILABLE AT CORPS OF ENGINEERS OFFICES.

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: K. McCLESKEY	Date: APRIL 2008	Rev.	
Dwn by: K. McCLESKEY	Sol No. W9126G-08-R-0175		
Reviewed by: L. PERRIN	Contr No.		
Submitted by: LESLIE L. PERRIN, P.E. CHIEF, GEOTECHNICAL SECTION	File name: $$cadd file name$$ Plot date: $$date$$ Plot scale:		

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION ENG. SERVICES BRANCH

FORT SAM HOUSTON, TEXAS
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX

LOGS OF BORINGS - 3 OF 7

Sheet reference number: B203

Contr No.

$$time$$
$$date$$ $$user$$
$$cadd file name$$
REFERENCE FILES:
$$REFERENCEFILE1$$ $$REFERENCEFILE2$$ $$REFERENCEFILE3$$ $$REFERENCEFILE4$$ $$REFERENCEFILE5$$ $$REFERENCEFILE6$$ $$REFERENCEFILE7$$ $$REFERENCEFILE8$$ $$REFERENCEFILE9$$ $$REFERENCEFILE10$$ $$REFERENCEFILE11$$ $$REFERENCEFILE12$$ $$REFERENCEFILE13$$ $$REFERENCEFILE14$$ $$REFERENCEFILE15$$

DRILLING LOG — Hole No. 8A4C-1284

DRILLING LOG	DIVISION: SWD
INSTALLATION	FORT WORTH DISTRICT
SHEET	1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS
3. DRILLING AGENCY	USACE
4. HOLE NO. (As shown on drawing title and file number)	8A4C-1284
5. NAME OF DRILLER	SALIK
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	27.2'
8. DEPTH DRILLED INTO ROCK	36.8'
9. TOTAL DEPTH OF HOLE	64.0'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 4 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	SEE REMARKS
16. DATE HOLE	STARTED 15 JUN 08 / COMPLETED 16 JUN 08
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	98 %
19. SIGNATURE OF INSPECTOR	BOB McVEY

Columns: % MOISTURE CONTENT (a) · DEPTH (b) · LEGEND (c) · CLASSIFICATION OF MATERIALS (Description) (d) · % CORE RECOVERY (e) · BOX OR SAMPLE NO. (f) · REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)

% Moisture content: 15.1, 15.8, 13.5, 12.1, 23.5, 20.6, 20.9, 19.0, 14.6

Depth: 10, 20, 30, 40, 50, 60, 70

Legend: VISUAL

Sample no.: A, B, C, D; C-1, C-2, C-3, C-4, C-5

Classification of materials

0.0' TO 17.0'

CLAY

0.0' TO 5.2' - HIGH PLASTICITY, HARD, DRY, BLACK, SLIGHTLY SANDY.

5.2' TO 17.0' - MEDIUM TO HIGH PLASTICITY, VERY STIFF, DRY TO SLIGHTLY MOIST, YELLOW BROWN, SILTY, SLIGHTLY SANDY AND LIMY.

17.0' TO 27.2'

GRAVEL - COARSE TO FINE, SLIGHTLY MOIST, YELLOW BROWN TO STRONG BROWN, SOME LIGHT GRAY, SANDY AND CLAYEY, LOOSE AND CLAY SEAMS TO 19', THEN DENSE TO VERY DENSE AND COBBLES.

27.2' TO 64.0'

SHALE

27.2' TO 58.8' - WEATHERED YELLOW BROWN, LIGHT GRAY AND STRONG BROWN, MASSIVE, BLOCKY STRUCTURE, CALCAREOUS, SILTY AND SANDY, SOFT (ROCK CLASSIFICATION), SLIGHTLY FOSSILIFEROUS, HEALED FRACTURES THROUGHOUT, GYPSUM AFTER 40', SOME DARK GRAY BY 52'.

58.8' TO 64.0' - AS ABOVE SHALE, EXCEPT UNWEATHERED DARK GRAY, UNFRACTURED, MODERATELY HARD (ROCK CLASSIFICATION), UNCTUOUS.

Remarks

DRILLING

0.0' TO 28.0' - 10" AUGER WITH FISHTAIL AND ROCKBIT IN GRAVEL; SET 30' OF 8" CASING AND CIRCULATION PAN; CLEANED TO 30.0' WITH AUGER.
30.0' TO 64.0' - 4" CORE; BAILED AND GROUTED.

WATER LEVEL

DURING DRILLING: WATER STABILIZED AT 26.3' (1-HR CHECK) AFTER DRILLING TO 28'.

JAR SAMPLES

A. 0.0' TO 5.2'
B. 5.2' TO 10.0'
C. 10.0' TO 17.0'
D. 17.0' TO 19.0'

CARTON SAMPLES

C-1. 33.1' TO 34.0'
C-2. 41.2' TO 42.0'
C-3. 50.2' TO 51.0'
C-4. 56.1' TO 57.0'
C-5. 63.1' TO 64.0'

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. | PROJECT AIT, FSH | HOLE NO. 8A4C-1284

DRILLING LOG — Hole No. 8A-1285

DRILLING LOG	DIVISION: SWD
INSTALLATION	FORT WORTH DISTRICT
SHEET	1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS
3. DRILLING AGENCY	USACE
4. HOLE NO. (As shown on drawing title and file number)	8A-1285
5. NAME OF DRILLER	SALIK
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	21.8'
8. DEPTH DRILLED INTO ROCK	40.2'
9. TOTAL DEPTH OF HOLE	62.0'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	SEE REMARKS
16. DATE HOLE	STARTED 19 JUN 08 / COMPLETED 23 JUN 08
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. SIGNATURE OF INSPECTOR	BOB McVEY

Depth: 10, 20, 30, 40, 50, 60, 70

Legend: VISUAL

Sample no.: A, B, C, D, E, F, G, H, I

Classification of materials

0.0' TO 6.2'

CLAY - HIGH PLASTICITY, HARD, DRY TO SLIGHTLY MOIST BY 4.6', BLACK TO RED YELLOW BY 4.6', SLIGHTLY SANDY AND GRAVELLY, SLIGHTLY LIMY AFTER 4.6'.

6.2' TO 21.8'

GRAVEL - COARSE TO FINE, SLIGHTLY MOIST, TO WET?, LIMY AT TOP, VERY DENSE WITH DENSE ZONES, YELLOW BROWN, CLAYEY AND SANDY.

21.8' TO 62.0'

SHALE

21.8' TO 58.0' - WEATHERED YELLOW BROWN, LIGHT GRAY, AND STRONG BROWN, MASSIVE, BLOCKY, SILTY AND SANDY, CALCAREOUS, SOFT (ROCK CLASSIFICATION), SLIGHTLY FOSSILIFEROUS, GYPSUM BY 36', SOME DARK GRAY BY 54'.

58.0' TO 62.0' - AS ABOVE SHALE, EXCEPT AN UNWEATHERED DARK GRAY WITH MINOR STAINS TO 60', MODERATELY HARD (ROCK CLASSIFICATION).

Remarks

DRILLING

0.0' TO 6.5' - 8" AUGER TO REFUSAL; FISHTAIL BIT REFUSED AT 6.8'; OFFSET 15' SOUTHEAST AND REDRILLED - 0.0' TO 6.5' (AUGER REFUSAL); SET 2' OF CASING AND CIRCULATION PAN.
6.5' TO 23.0' - 7 7/8" ROCKBIT.
23.0' TO 62.0' - 6" AUGER TO 31', THEN 4" AUGER BAIL AND GROUT.

WATER LEVEL

18-HR CHECK AFTER 25' AT 21.2'.
18-HR CHECK AFTER 62' AT 51.0'

JAR SAMPLES

A. 0.0' TO 4.6'
B. 4.6' TO 6.2'
C. 25.0' TO 31.0'
D. 31.0' TO 36.0'
E. 36.0' TO 41.0'
F. 41.0' TO 46.0'
G. 46.0' TO 51.0'
H. 51.0' TO 58.0'
I. 58.0' TO 62.0'

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. | PROJECT AIT, FSH | HOLE NO. 8A-1285

DRILLING LOG — Hole No. 8A4C-1286

DRILLING LOG	DIVISION: SWD
INSTALLATION	FORT WORTH DISTRICT
SHEET	1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS
3. DRILLING AGENCY	USACE
4. HOLE NO. (As shown on drawing title and file number)	8A4C-1286
5. NAME OF DRILLER	SALIK-NETHERLAND
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	16.5'
8. DEPTH DRILLED INTO ROCK	28.5'
9. TOTAL DEPTH OF HOLE	45.0'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	SEE REMARKS
16. DATE HOLE	STARTED 23 JUL 08 / COMPLETED 29 JUL 08
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	98 %
19. SIGNATURE OF INSPECTOR	BOB MCVEY

% Moisture content: 20.4, 24.0, 20.7, 23.4

Depth: 10, 20, 30, 40, 50, 60

Legend: VISUAL

Sample no.: C-1, C-2, C-3, C-4

Classification of materials

0.0' TO 3.0'

CLAY - HIGH PLASTICITY, HARD, DRY, VERY DARK BROWN, SLIGHTLY SANDY, SCATTERED GRAVEL.

3.0' TO 16.5'

GRAVEL AND COBBLE - COARSE TO FINE, DRY, YELLOW BROWN BY 4', SANDY AND CLAYEY, DENSE TO VERY DENSE.

16.5' TO 45.0'

SHALE - WEATHERED YELLOW BROWN, LIGHT GRAY AND STRONG BROWN, MASSIVE, BLOCKY, SOFT (ROCK CLASSIFICATION), SILTY, CALCAREOUS, GYPSUM AFTER 32', HIGHLY FRACTURED THROUGHOUT (GYPSUM IN FRACTURES).

Remarks

DRILLING

0.0' TO 18.0' - 10" AUGER WITH DRAGBIT AND ROCKBIT; SET 20' OF 8" CASING AND CIRCULATION PAN; CLEANED TO 21.0' WITH AUGER.
21.0' TO 45.0' - 4" CARBOLOY CORE BIT; BAILED AND GROUTED.

WATER LEVEL

BAILED TO 42.7' UPON COMPLETION OF DRILLING.
18-HR CHECK AT 40.8' AND CAVAED TO 43.0'.

CARTON SAMPLES

C-1. 24.6' TO 25.5'
C-2. 31.1' TO 32.0'
C-3. 37.1' TO 38.0'
C-4. 43.1' TO 44.0'

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. | PROJECT AIT, FSH | HOLE NO. 8A4C-1286

NOTES:

1. USE THIS SHEET FOR BORING LOGS ONLY.
2. MOISTURE CONTENT, WHERE SHOWN, IS EXPRESSED AS PERCENT DRY WEIGHT AT TIME OF LABORATORY CLASSIFICATION.
3. LEGEND SHOWS OVERBURDEN MATERIALS CLASSIFIED ACCORDING TO ASTM D 2487 AND ASTM D 2488.
4. DESCRIPTION OF OVERBURDEN MATERIALS CHANGED TO CORRESPOND WITH LABORATORY CLASSIFICATION AS NECESSARY.
5. ORIGINAL DRILLING LOGS AVAILABLE AT CORPS OF ENGINEERS OFFICES.

DRILLING LOG — Hole No. 8A4C-1287

DRILLING LOG	DIVISION: SWD
INSTALLATION	FORT WORTH DISTRICT
SHEET	1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS
3. DRILLING AGENCY	USACE
4. HOLE NO. (As shown on drawing title and file number)	8A4C-1287
5. NAME OF DRILLER	SALIK
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	29.2'
8. DEPTH DRILLED INTO ROCK	35.8'
9. TOTAL DEPTH OF HOLE	65.0'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0 / UNDISTURBED 3
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	SEE REMARKS
16. DATE HOLE	STARTED 15 JUL 08 / COMPLETED 16 JUL 08
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	98 %
19. SIGNATURE OF INSPECTOR	BOB McVEY

% Moisture content: 18.0, 19.3, 15.2, 24.4, 19.9, 21.0, 20.1, 9.8

Depth: 10, 20, 30, 40, 50, 60, 70

Legend: VISUAL, VISUAL, VISUAL, VISUAL

Sample no.: ST-1, ST-2, ST-3; C-1, C-2, C-3, C-4, C-5

Classification of materials

0.0' TO 21.0'

CLAY

0.0' TO 4.5' - HIGH PLASTICITY, HARD, DRY, DARK BROWN, SANDY AND GRAVELLY WITH SEAMS.

4.5' TO 21.0' - MEDIUM TO HIGH PLASTICITY, HARD TO VERY STIFF, DRY TO SLIGHTLY MOIST, YELLOW BROWN, LIMY WITH NODULES, SANDY TO VERY SANDY, SAND ZONES AFTER 19' AS WELL AS LOWER PLASTICITY, LIGHT GRAY AFTER 13'.

21.0' TO 29.2'

GRAVEL - COARSE TO FINE, DENSE, COBBLES TO 4.5" DIAMETER NOTED, WET, YELLOW BROWN, SANDY AND CLAYEY.

29.2' TO 65.0'

SHALE

29.2' TO 62.3' - WEATHERED YELLOW BROWN, LIGHT GRAY, AND STRONG BROWN, MASSIVE, BLOCKY CALCAREOUS, SILTY, SOFT (ROCK CLASSIFICATION), LIMONITIC, SLIGHTLY MOIST, FOSSILIFEROUS, GYPSUM AFTER 42', SOME DARK GRAY BY 59', HEALED FRACTURES THROUGHOUT.

62.3' TO 65' - AS ABOVE SHALE, EXCEPT AN UNWEATHERED DARK GRAY WITH STAINED SEAM (0.2' THICK) AT 63', UNCTUOUS, MODERATELY HARD (ROCK CLASSIFICATION), UNFRACTURED.

Remarks

DRILLING

0.0' TO 31.0' - 10" AUGER AND 3" SHELBY TUBE PUSHES; SET 31' OF 8" CASING AND CIRCULATION PAN; CLEANED TO 32.0' WITH AUGER.
32.0' TO 65.0' - 4" CARBOLOY CORE BIT; BAILED AND GROUTED.

WATER LEVEL

DURING DRILLING, WATER STABILIZED AT 22.7' WITHIN 30 MINUTES AFTER AUGERING TO 24.0'.

SHELBY TUBE SAMPLES

ST-1. 2.0' TO 4.0' (PENETROMETER > 4.5)
ST-2. 9.0' TO 11.0' (PENETROMETER > 4.5)
ST-3. 19.0' TO 21.0' (PENETROMETER = 4.2)

CARTON SAMPLES

C-1. 35.6' TO 36.5'
C-2. 43.2' TO 44.0'
C-3. 49.1' TO 50.0'
C-4. 55.1' TO 56.0'
C-5. 63.1' TO 64.0'

SOIL RESISTIVITY TEST

2.5' PIN SPACING
x 191.5
x 1 MULTIPLIER
x 2 DIAL READING
= 958 OHM-CM.

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. | PROJECT AIT, FSH | HOLE NO. 8A4C-1287

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION ENG. SERVICES BRANCH

Designed by: K. McCLESKEY	Date: APRIL 2008	Rev.
Dwn by: K. McCLESKEY	Sol No. W9126G-08-R-0175	
Reviewed by: L. PERRIN	Contr No.	
Submitted by: LESLIE L. PERRIN, P.E. CHIEF, GEOTECHNICAL SECTION	File name: $$cadd file name$$ Plot date: $$date$$ Plot scale:	

FORT SAM HOUSTON, TEXAS
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX

LOGS OF BORINGS - 4 OF 7

Sheet reference number: B204

Contr No.

DRILLING LOG — Hole No. 8A-1288

DIVISION	SWD
INSTALLATION	FORT WORTH DISTRICT
SHEET	1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS
3. DRILLING AGENCY	USACE
4. HOLE NO. (As shown on drawing title and file number)	8A-1288
5. NAME OF DRILLER	SALIK
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	20.5'
8. DEPTH DRILLED INTO ROCK	44.5'
9. TOTAL DEPTH OF HOLE	65.0'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 3; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	DRY
16. DATE HOLE	STARTED 14 JUN 08; COMPLETED 14 JUN 08
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. SIGNATURE OF INSPECTOR	BOB McVEY

Columns: % MOISTURE CONTENT (a) · DEPTH (b) · LEGEND (c) · CLASSIFICATION OF MATERIALS (Description) (d) · % CORE RECOVERY (e) · BOX OR SAMPLE NO. (f) · REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)

Depth scale: 10, 20, 30, 40, 50, 60, 70. Legend: VISUAL (0.0' to 20.5').

Box or sample no.: A, B, C, D, E, F, G, H, I, J, K

Classification of materials:

0.0' TO 0.2' - GRAVEL (FILL)

0.2' TO 11.0'

CLAY

0.2' TO 4.7' - HIGH PLASTICITY, HARD, DRY, BLACK, SLIGHTLY SANDY.

4.7' TO 11.0' - AS ABOVE EXCEPT SLIGHTLY MOIST, YELLOW BROWN, SLIGHTLY LIMY.

11.0' TO 20.5'

GRAVEL - COARSE TO FINE, LOOSE TO DENSE, DRY, YELLOW BROWN, CLAYEY AND SANDY, WITH A FEW COBBLES.

20.5' TO 65.0'

SHALE - WEATHERED YELLOW BROWN, LIGHT GRAY, AND STRONG BROWN, BLOCKY STRUCTURE, SOFT (ROCK CLASSIFICATION), SILTY, CALCAREOUS, GYPSUM AFTER 32', SOME DARK GRAY BY 61'.

Remarks:

DRILLING

0.0' TO 65.0' - 8" AUGER.
NOTE: FISHTAIL BIT NEEDED 16.5' TO 20.5' WITH AUGER.

JAR SAMPLES

A. 0.2' TO 4.7'
B. 4.7' TO 11.0'
C. 11.0' TO 16.0'
D. 20.5' TO 26.0'
E. 26.0' TO 31.0'
F. 31.0' TO 36.0'
G. 36.0' TO 41.0'
H. 41.0' TO 46.0'
I. 46.0' TO 51.0'
J. 56.0' TO 61.0'
K. 61.0' TO 65.0'

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71 — PROJECT: AIT, FSH — HOLE NO. 8A-1288

DRILLING LOG — Hole No. 8A4C-1289

DIVISION	SWD
INSTALLATION	FORT WORTH DISTRICT
SHEET	1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS
3. DRILLING AGENCY	USACE
4. HOLE NO. (As shown on drawing title and file number)	8A4C-1289
5. NAME OF DRILLER	SALIK
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	19.0'
8. DEPTH DRILLED INTO ROCK	46.0'
9. TOTAL DEPTH OF HOLE	65.0'
10. SIZE AND TYPE OF BIT	SEE REMARKS
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 4; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	SEE REMARKS
16. DATE HOLE	STARTED 30 JUL 08; COMPLETED 31 JUL 08
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	94 %
19. SIGNATURE OF INSPECTOR	BOB McVEY

Columns: % MOISTURE CONTENT (a) · DEPTH (b) · LEGEND (c) · CLASSIFICATION OF MATERIALS (Description) (d) · % CORE RECOVERY (e) · BOX OR SAMPLE NO. (f) · REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)

% Moisture content (top to bottom): 12.6, 19.7, 15.1, 11.9, 22.5, 23.0, 23.0, 18.7, 21.9, 20.6

Depth scale: 10, 20, 30, 40, 50, 60, 70. Legend: VISUAL; VISUAL.

Box or sample no.: A, B, C, D; core recovery: C-1, C-2, C-3, C-4, C-5, C-6

Classification of materials:

0.0' TO 2.9'

CLAY - HIGH PLASTICITY, HARD, DRY, DARK BROWN, SLIGHTLY SANDY.

2.9' TO 6.0'

GRAVEL - COARSE TO FINE, DRY, YELLOW BROWN, SANDY, COBBLES.

6.0' TO 16.0'

CLAY - MEDIUM TO HIGH PLASTICITY, VERY STIFF, SLIGHTLY MOIST, LIGHT GRAY WITH YELLOW AND STRONG BROWN, LIMY.

16.0' TO 19.0'

GRAVEL - COARSE TO FINE, MEDIUM DENSE, COBBLES TO 4" DIAMETER NOTED, WET, STRONG BROWN AND YELLOW BROWN, CLAYEY AND SANDY.

19.0' TO 65.0'

SHALE

19.0' TO 42.0' - WEATHERED YELLOW BROWN, LIGHT GRAY, AND STRONG BROWN, SOFT (ROCK CLASSIFICATION), CALCAREOUS, SILTY, MASSIVE, BLOCKY, FRACTURES, GYPSUM AFTER 30.0'.

42.0' TO 56.0' - WEATHERED SHALE, AS ABOVE, BUT INTERBEDDED WITH UNWEATHERED DARK GRAY (ABOUT 70%).

56.0' TO 65.0' - UNWEATHERED DARK GRAY WITH WEATHER STAIN (0.2' THICK) AT 61', MODERATELY HARD (ROCK CLASSIFICATION), UNCTUOUS, UNFRACTURED.

Remarks:

DRILLING

0.0' TO 20.0' - 10" AUGER WITH 7 7/8" DRAGBIT; SET 20' OF 8" CASING AND CIRCULATION PAN; CLEANED TO 21.0' WITH 7 7/8" AUGER.
21.0' TO 65.0' - 4" CORE; BAILED AND GROUTED.

WATER LEVEL

WATER NOTED IN HOLE AT 16.3' DURING AUGERING.
BAILED TO 58.0' AFTER DRILLING.
24-HR CHECK AT 14.8'.

JAR SAMPLES

A. 0.0' TO 2.9'
B. 6.0' TO 11.0'
C. 11.0' TO 16.0'
D. 17.0' TO 19.0'

CARTON SAMPLES

C-1. 25.1' TO 26.0'
C-2. 32.0' TO 33.0'
C-3. 39.1' TO 40.0'
C-4. 47.1' TO 48.0'
C-5. 53.1' TO 54.0'
C-6. 60.1' TO 61.0'

NOTE: SURFACE GRAVEL IN AREA.

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71 — PROJECT: AIT, FSH — HOLE NO. 8A4C-1289

DRILLING LOG — Hole No. 10A-1290

DIVISION	SWD
INSTALLATION	FORT WORTH DISTRICT
SHEET	1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS
3. DRILLING AGENCY	USACE
4. HOLE NO. (As shown on drawing title and file number)	10A-1290
5. NAME OF DRILLER	SALIK
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	--
8. DEPTH DRILLED INTO ROCK	--
9. TOTAL DEPTH OF HOLE	10.0'
10. SIZE AND TYPE OF BIT	6" AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 1; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	DRY
16. DATE HOLE	STARTED 26 JUN 08; COMPLETED 26 JUN 08
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. SIGNATURE OF INSPECTOR	BOB MCVEY

Columns: % MOISTURE CONTENT (a) · DEPTH (b) · LEGEND (c) · CLASSIFICATION OF MATERIALS (Description) (d) · % CORE RECOVERY (e) · BOX OR SAMPLE NO. (f) · REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)

Depth scale: 10. Legend: VISUAL. Box or sample no.: A

Classification of materials:

0.0' TO 10.0'

GRAVEL - COARSE TO FINE, COBBLES TO 4" DIAMETER NOTED, DRY, BROWN, SANDY AND CLAYEY, WITH CLAY SEAMS (YELLOW BROWN, LIMY).

Remarks:

JAR SAMPLES

A. 5.0' TO 7.0'

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71 — PROJECT: AIT, FSH — HOLE NO. 10A-1290

DRILLING LOG — Hole No. 10A-1291

DIVISION	SWD
INSTALLATION	FORT WORTH DISTRICT
SHEET	1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS
3. DRILLING AGENCY	USACE
4. HOLE NO. (As shown on drawing title and file number)	10A-1291
5. NAME OF DRILLER	SALIK
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ___ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	--
8. DEPTH DRILLED INTO ROCK	--
9. TOTAL DEPTH OF HOLE	10.0'
10. SIZE AND TYPE OF BIT	6" AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 3; UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	DRY
16. DATE HOLE	STARTED 26 JUN 08; COMPLETED 26 JUN 08
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. SIGNATURE OF INSPECTOR	BOB MCVEY

Columns: % MOISTURE CONTENT (a) · DEPTH (b) · LEGEND (c) · CLASSIFICATION OF MATERIALS (Description) (d) · % CORE RECOVERY (e) · BOX OR SAMPLE NO. (f) · REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) (g)

Depth scale: 10, 20. Legend: VISUAL. Box or sample no.: A, B, C

Classification of materials:

0.0' TO 0.5' - GRAVEL - FILL, COARSE TO FINE, DRY, WHITE TO BROWN, SANDY.

0.5' TO 4.5'

CLAY - FILL, HIGH PLASTICITY, HARD, SLIGHTLY MOIST, VERY DARK BROWN AND YELLOW BROWN, SANDY.

4.5' TO 6.5'

SAND - FILL, MOSTLY FINE WITH SOME COARSE, DRY, BROWN, SILTY.

6.5' TO 9.5'

CLAY - FILL?, HIGH PLASTICITY, MEDIUM STIFF, MOIST, YELLOW BROWN, SANDY AND SILTY.

Remarks:

JAR SAMPLES

A. 0.5' TO 4.5'
B. 4.5' TO 6.5'
C. 6.5' TO 10.0'

9.5' TO 10.0'

GRAVEL - COARSE TO FINE, DRY, BROWN.

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71 — PROJECT: AIT, FSH — HOLE NO. 10A-1291

NOTES:

1. USE THIS SHEET FOR BORING LOGS ONLY.
2. MOISTURE CONTENT, WHERE SHOWN, IS EXPRESSED AS PERCENT DRY WEIGHT AT TIME OF LABORATORY CLASSIFICATION.
3. LEGEND SHOWS OVERBURDEN MATERIALS CLASSIFIED ACCORDING TO ASTM D 2487 AND ASTM D 2488.
4. DESCRIPTION OF OVERBURDEN MATERIALS CHANGED TO CORRESPOND WITH LABORATORY CLASSIFICATION AS NECESSARY.
5. ORIGINAL DRILLING LOGS AVAILABLE AT CORPS OF ENGINEERS OFFICES.

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: K. McCLESKEY	Date: APRIL 2008
Dwn by: K. McCLESKEY	Sol No. W9126G-08-R-0175
Reviewed by: L. PERRIN	Contr No.
Submitted by: LESLIE L. PERRIN, P.E. CHIEF, GEOTECHNICAL SECTION	File name: $$cadd file name$$ Plot date: $$date$$ Plot scale:
Rev.	

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS
FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION
ENG. SERVICES BRANCH

FORT SAM HOUSTON, TEXAS
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX

LOGS OF BORINGS - 5 OF 7

Sheet reference number: B205

Contr No.

$$time$$ $$date$$ $$user$$ $$cadd file name$$

REFERENCE FILES: $$REFERENCEFILE$$

DRILLING LOG — Hole No. 10A-1292

DRILLING LOG	DIVISION: SWD
INSTALLATION	FORT WORTH DISTRICT
SHEET	1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS
3. DRILLING AGENCY	USACE
4. HOLE NO. (As shown on drawing title and file number)	10A-1292
5. NAME OF DRILLER	SALIK
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	--
8. DEPTH DRILLED INTO ROCK	--
9. TOTAL DEPTH OF HOLE	10.0'
10. SIZE AND TYPE OF BIT	6" AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	DRY
16. DATE HOLE	STARTED 26 JUN 08 / COMPLETED 26 JUN 08
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. SIGNATURE OF INSPECTOR	BOB MCVEY

% MOISTURE CONTENT a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
16.2			0.0' TO 6.7' CLAY 0.0' TO 4.5' - HIGH PLASTICITY, HARD, DRY, BLACK, SANDY.		A	JAR SAMPLES A. 0.0' TO 4.5' B. 4.5' TO 6.7'
15.6			4.5' TO 6.7' - MEDIUM PLASTICITY, HARD, DRY, YELLOW BROWN, SLIGHTLY SANDY AND LIMY.		B	
	10	VISUAL	6.7' TO 10.0' GRAVEL - COARSE TO FINE, DRY, YELLOW BROWN, SANDY AND CLAYEY.			
	20					

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71 — PROJECT: AIT, FSH — HOLE NO. 10A-1292

DRILLING LOG — Hole No. 10A-1293

DRILLING LOG	DIVISION: SWD
INSTALLATION	FORT WORTH DISTRICT
SHEET	1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS
3. DRILLING AGENCY	USACE
4. HOLE NO. (As shown on drawing title and file number)	10A-1293
5. NAME OF DRILLER	SALIK
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	--
8. DEPTH DRILLED INTO ROCK	--
9. TOTAL DEPTH OF HOLE	10.0'
10. SIZE AND TYPE OF BIT	6" AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	DRY
16. DATE HOLE	STARTED 26 JUN 08 / COMPLETED 26 JUN 08
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. SIGNATURE OF INSPECTOR	BOB MCVEY

% MOISTURE CONTENT a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		VISUAL	0.0' TO 4.0' GRAVEL - COARSE TO FINE, DRY, BROWN, SANDY, CLAY SEAMS.		A	JAR SAMPLES A. 0.0' TO 4.0' B. 4.0' TO 7.0'
			4.0' TO 7.0' CLAY - HIGH PLASTICITY, VERY STIFF, SLIGHTLY MOIST, YELLOW BROWN, SANDY AND GRAVELLY, SLIGHTLY LIMY.		B	
	10		7.0' TO 10.0' GRAVEL - COARSE TO FINE, DRY, BROWN.			
	20					

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71 — PROJECT: AIT, FSH — HOLE NO. 10A-1293

DRILLING LOG — Hole No. 6A-1294

DRILLING LOG	DIVISION: SWD
INSTALLATION	FORT WORTH DISTRICT
SHEET	1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS
3. DRILLING AGENCY	USACE
4. HOLE NO. (As shown on drawing title and file number)	6A-1294
5. NAME OF DRILLER	SALIK
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	--
8. DEPTH DRILLED INTO ROCK	--
9. TOTAL DEPTH OF HOLE	6.5'
10. SIZE AND TYPE OF BIT	6" AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 1 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	DRY
16. DATE HOLE	STARTED 13 JUN 08 / COMPLETED 13 JUN 08
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. SIGNATURE OF INSPECTOR	BOB MCVEY

% MOISTURE CONTENT a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		VISUAL	0.0' TO 0.5' - GRAVEL (FILL)			JAR SAMPLES
16.3			0.5' TO 5.5' CLAY - HIGH PLASTICITY, HARD, DRY, YELLOW BROWN, SLIGHTLY LIMY AND SANDY.		A	A. 0.5' TO 5.5' AUGER REFUSAL AT 6.5'.
		VISUAL	5.5' TO 6.5' GRAVEL - COARSE TO FINE, DRY, YELLOW BROWN, SANDY AND CLAYEY.			
	10					
	20					

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71 — PROJECT: AIT, FSH — HOLE NO. 6A-1294

DRILLING LOG — Hole No. 6A-1295

DRILLING LOG	DIVISION: SWD
INSTALLATION	FORT WORTH DISTRICT
SHEET	1 OF 1 SHEETS
1. PROJECT	AIT BARRACKS COMPLEX
2. LOCATION (Coordinates or Station)	FORT SAM HOUSTON, TEXAS
3. DRILLING AGENCY	USACE
4. HOLE NO. (As shown on drawing title and file number)	6A-1295
5. NAME OF DRILLER	SALIK
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	--
8. DEPTH DRILLED INTO ROCK	--
9. TOTAL DEPTH OF HOLE	10.0'
10. SIZE AND TYPE OF BIT	6" AUGER
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
12. MANUFACTURER'S DESIGNATION OF DRILL	FAILING 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	0
15. ELEVATION GROUND WATER	DRY
16. DATE HOLE	STARTED 13 JUN 08 / COMPLETED 13 JUN 08
17. ELEVATION TOP OF HOLE	
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. SIGNATURE OF INSPECTOR	BOB MCVEY

% MOISTURE CONTENT a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
		VISUAL	0.0' TO 0.5' - GRAVEL (FILL) 0.5' TO 10.0' CLAY 0.5' TO 5.0' - HIGH PLASTICITY, HARD, DRY, BLACK, SLIGHTLY SANDY.		A	JAR SAMPLES A. 0.5' TO 5.5' B. 5.5' TO 10.0'
	10				B	5.0' TO 10.0' - AS ABOVE, EXCEPT YELLOW BROWN, SLIGHTLY MOIST AND LIMY.

ENG FORM 1836 PREVIOUS EDITIONS ARE OBSOLETE. MAR 71 — PROJECT: AIT, FSH — HOLE NO. 6A-1295

NOTES:

1. USE THIS SHEET FOR BORING LOGS ONLY.
2. MOISTURE CONTENT, WHERE SHOWN, IS EXPRESSED AS PERCENT DRY WEIGHT AT TIME OF LABORATORY CLASSIFICATION.
3. LEGEND SHOWS OVERBURDEN MATERIALS CLASSIFIED ACCORDING TO ASTM D 2487 AND ASTM D 2488.
4. DESCRIPTION OF OVERBURDEN MATERIALS CHANGED TO CORRESPOND WITH LABORATORY CLASSIFICATION AS NECESSARY.
5. ORIGINAL DRILLING LOGS AVAILABLE AT CORPS OF ENGINEERS OFFICES.

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: K. McCLESKEY	Date: APRIL 2008
Dwn by: K. McCLESKEY	Sol No. W9126G-08-R-0175
Reviewed by: L. PERRIN	Contr No.
Submitted by: LESLIE L. PERRIN, P.E. CHIEF, GEOTECHNICAL SECTION	File name: $$cadd file name$$ Plot date: $$date$$ Plot scale:
Rev.	

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION ENG. SERVICES BRANCH

FORT SAM HOUSTON, TEXAS
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX

LOGS OF BORINGS - 6 OF 7

Sheet reference number:
B206

Contr No.

Hole No. 6A-1296

DRILLING LOG	DIVISION SWD	INSTALLATION FORT WORTH DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT AIT BARRACKS COMPLEX		10. SIZE AND TYPE OF BIT 6" AUGER	
2. LOCATION (Coordinates or Station) FORT SAM HOUSTON, TEXAS		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY USACE		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number)	6A-1296	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 2 / UNDISTURBED 0
5. NAME OF DRILLER SALIK		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.		15. ELEVATION GROUND WATER DRY	
7. THICKNESS OF OVERBURDEN	--	16. DATE HOLE	STARTED 13 JUN 08 / COMPLETED 13 JUN 08
8. DEPTH DRILLED INTO ROCK	--	17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE	10.0'	18. TOTAL CORE RECOVERY FOR BORING	N/A %
		19. SIGNATURE OF INSPECTOR BOB MCVEY	

% MOISTURE CONTENT	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
		VISUAL	0.0' TO 0.4' - GRAVEL (FILL)			JAR SAMPLES
22.7			0.4 TO 10.0'		A	A. 0.4' TO 5.0' B. 5.0' TO 10.0'
			CLAY			
17.1	10		0.4' TO 5.0' - HIGH PLASTICITY, HARD, DRY, BLACK, SLIGHTLY SANDY.		B	5.0' TO 10.0' - AS ABOVE, EXCEPT YELLOW BROWN, SLIGHTLY MOIST AND LIMY.

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT AIT, FSH HOLE NO. 6A-1296

Hole No. 8A4C-1297

DRILLING LOG	DIVISION SWD	INSTALLATION FORT WORTH DISTRICT	SHEET 1 OF 1 SHEETS
1. PROJECT AIT BARRACKS COMPLEX		10. SIZE AND TYPE OF BIT SEE REMARKS	
2. LOCATION (Coordinates or Station) FORT SAM HOUSTON, TEXAS		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY USACE		12. MANUFACTURER'S DESIGNATION OF DRILL FAILING 1500	
4. HOLE NO. (As shown on drawing title and file number)	8A4C-1297	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED 0 / UNDISTURBED 4
5. NAME OF DRILLER SALIK		14. TOTAL NUMBER CORE BOXES 0	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ___ DEG. FROM VERT.		15. ELEVATION GROUND WATER SEE REMARKS	
7. THICKNESS OF OVERBURDEN	35.5'	16. DATE HOLE	STARTED 12 JUN 08 / COMPLETED 13 JUN 08
8. DEPTH DRILLED INTO ROCK	9.5'	17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE	45.0'	18. TOTAL CORE RECOVERY FOR BORING	96 %
		19. SIGNATURE OF INSPECTOR BOB MCVEY	

% MOISTURE CONTENT	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
		VISUAL	0.0' TO 26.4'			DRILLING
7.7			CLAY		ST-1	0.0' TO 37.0' - 10" AUGER AND DRAGBIT WITH 3" SHELBY TUBE PUSHES: SET 37' OF 8" CASING AND CIRCULATION PAN: CLEANED TO 38.0' WITH AUGER.
		VISUAL	0.0' TO 5.5' - HIGH PLASTICITY, HARD, DRY, DARK GRAY BROWN, SLIGHTLY SANDY, SILTY.			
17.8	10		5.5' TO 10.0' - AS ABOVE, EXCEPT VERY STIFF, YELLOW BROWN, SLIGHTLY MOIST.		ST-2	38.0' TO 45.0' - 4" CARBOLOY CORE BIT: BAILED AND GROUTED AFTER DRILLING.
		VISUAL	10.0' TO 26.4' - HIGH PLASTICITY, VERY STIFF TO HARD, SLIGHTLY MOIST, STRONG BROWN, YELLOW BROWN, AND LIGHT GRAY, LIMY, SANDY.			WATER LEVEL DURING DRILLING, FREE WATER STABLE AT 30.1' AFTER AUGERING TO 33'.
20.7			26.4' TO 35.5'		ST-3	SHELBY TUBE SAMPLES
	20	VISUAL	GRAVEL - COARSE TO FINE, DENSE TO VERY DENSE, SLIGHTLY MOIST TO WET, YELLOW BROWN AND STRONG BROWN, COBBLES (CHERT NOTED) AFTER 30'.			ST-1. 1.0' TO 3.0' (PENETROMETER > 4.5) ST-2. 8.0' TO 10.0' (PENETROMETER = 4.4) ST-3. 15.0' TO 17.0' (PENETROMETER = 4.3) ST-4. 23.0' TO 25.0' (PENETROMETER > 4.5)
17.2			35.5' TO 45.0'		ST-4	CARTON SAMPLE
	30	VISUAL	SHALE - WEATHERED YELLOW BROWN, LIGHT GRAY, AND STRONG BROWN, SOFT (ROCK CLASSIFICATION), SILTY, CALCAREOUS, MASSIVE, BLOCKY STRUCTURE, HEALED FRACTURES SCATTERED (WELL HEALED).			C-1. 42.1' TO 43.0'
	40					
22.2					C-1	
	50					
	60					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. PROJECT AIT, FSH HOLE NO. 8A4C-1297

NOTES:

1. USE THIS SHEET FOR BORING LOGS ONLY.
2. MOISTURE CONTENT, WHERE SHOWN, IS EXPRESSED AS PERCENT DRY WEIGHT AT TIME OF LABORATORY CLASSIFICATION.
3. LEGEND SHOWS OVERBURDEN MATERIALS CLASSIFIED ACCORDING TO ASTM D 2487 AND ASTM D 2488.
4. DESCRIPTION OF OVERBURDEN MATERIALS CHANGED TO CORRESPOND WITH LABORATORY CLASSIFICATION AS NECESSARY.
5. ORIGINAL DRILLING LOGS AVAILABLE AT CORPS OF ENGINEERS OFFICES.

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: K. McCLESKEY
Dwn by: K. McCLESKEY
Reviewed by: L. PERRIN
Submitted by: LESLIE L. PERRIN, P.E. CHIEF, GEOTECHNICAL SECTION
Date: APRIL 2008
Sol No. W9126G-08-R-0175
Contr No.
Rev.
File name: $$cadd file name$$
Plot date: $$date$$
Plot scale:

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS
ENGINEERING/ CONSTRUCTION DIVISION ENG. SERVICES BRANCH

FORT SAM HOUSTON, TEXAS
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX
LOGS OF BORINGS - 7 OF 7

Sheet reference number:
B207

Contr No.

$$time$$ $$date$$ $$user$$ $$cadd file name$$
REFERENCE FILES: $$REFERENCEFILE1$$ ... $$REFERENCEFILE14$$

APPENDIX B

LABORATORY TESTING DATA PLOTS

ADVANCED INDIVIDUAL TRAINING (AIT)
BARRACKS COMPLEX
PLASTICITY CHART

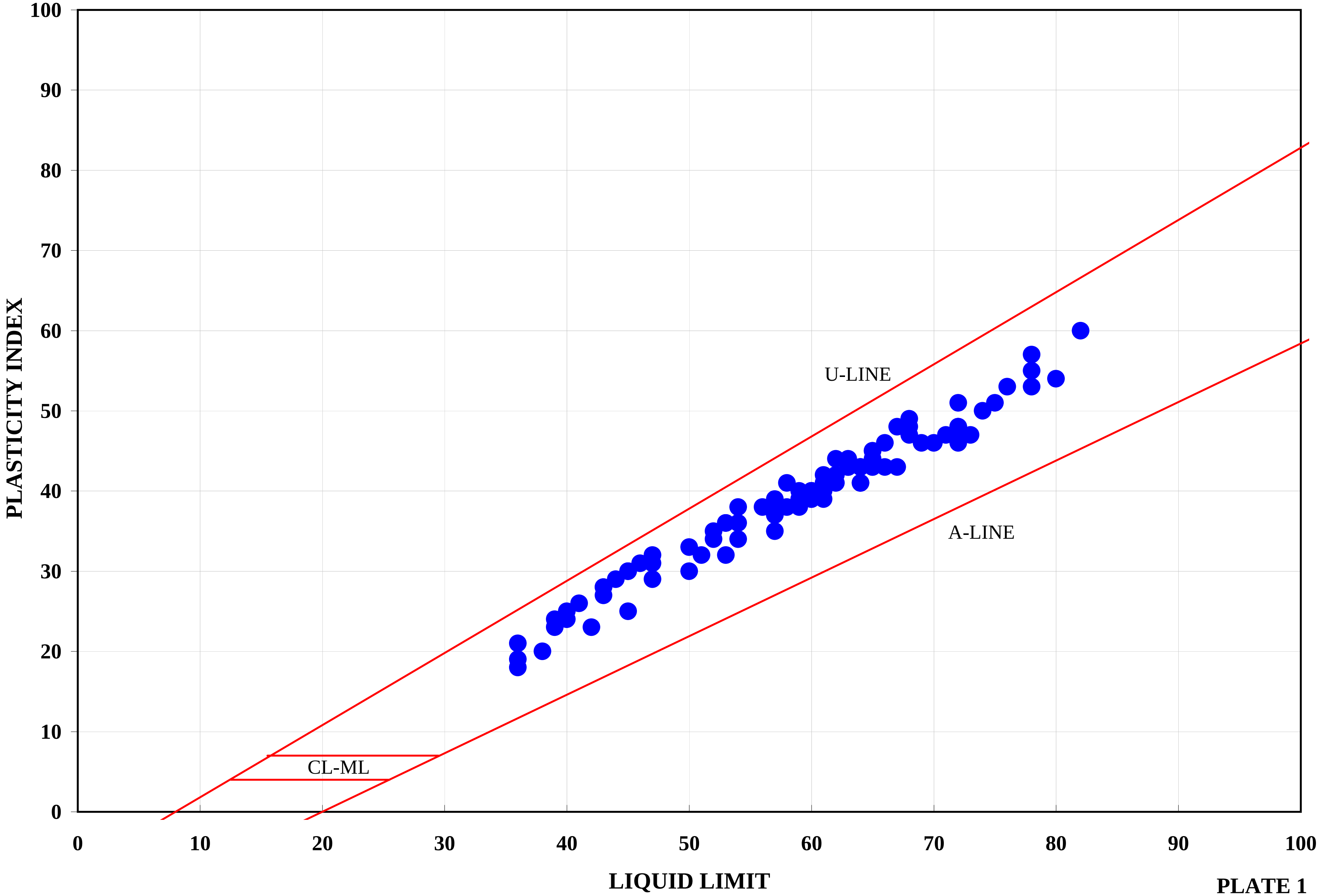


PLATE 1

ADVANCED INDIVIDUAL TRAINING (AIT)
BARRACKS COMPLEX
MOISTURE CONTENT VS DEPTH

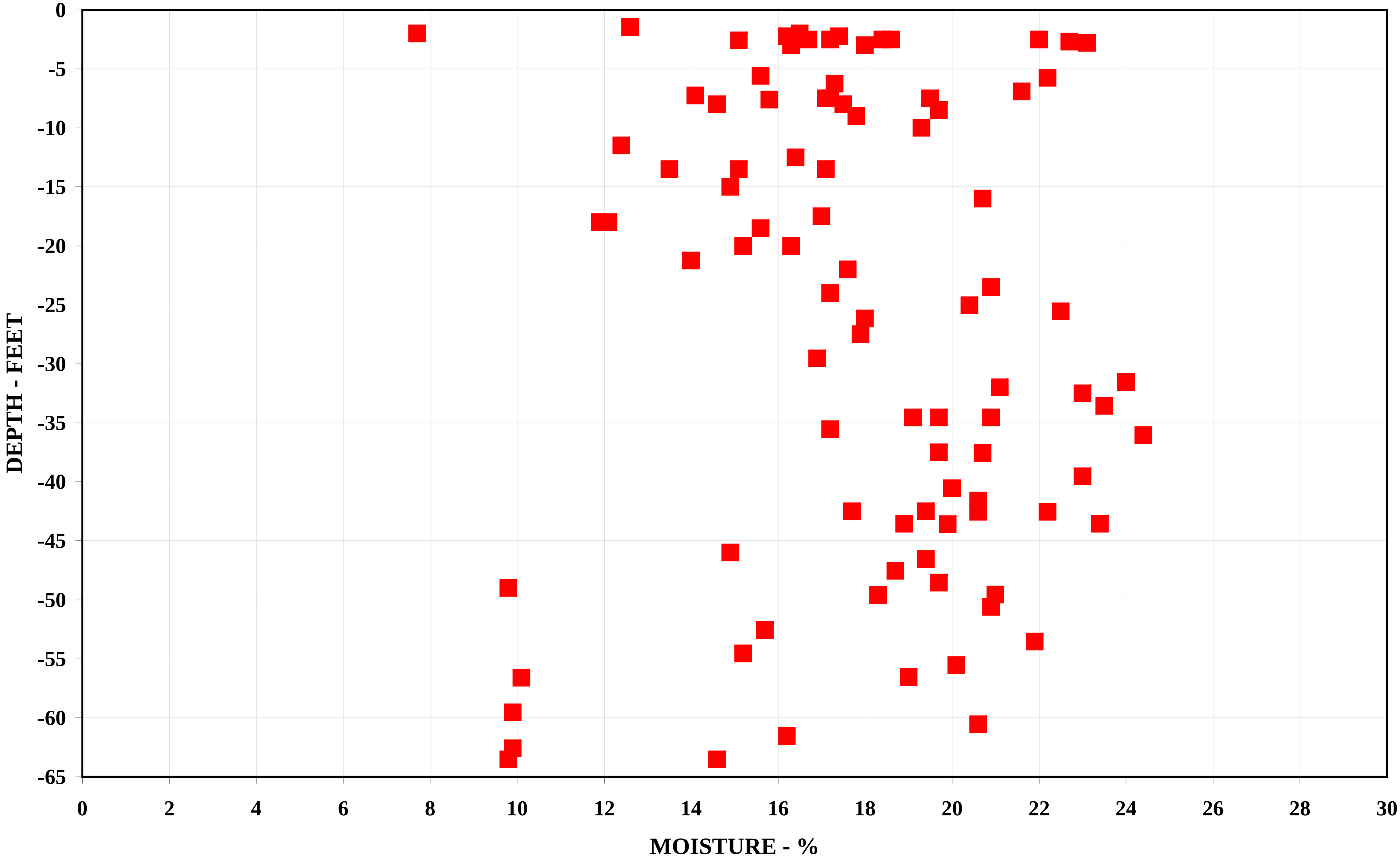


PLATE 2

ADVANCED INDIVIDUAL TRAINING (AIT)
BARRACKS COMPLEX
ATTERBERG LIMITS VS DEPTH

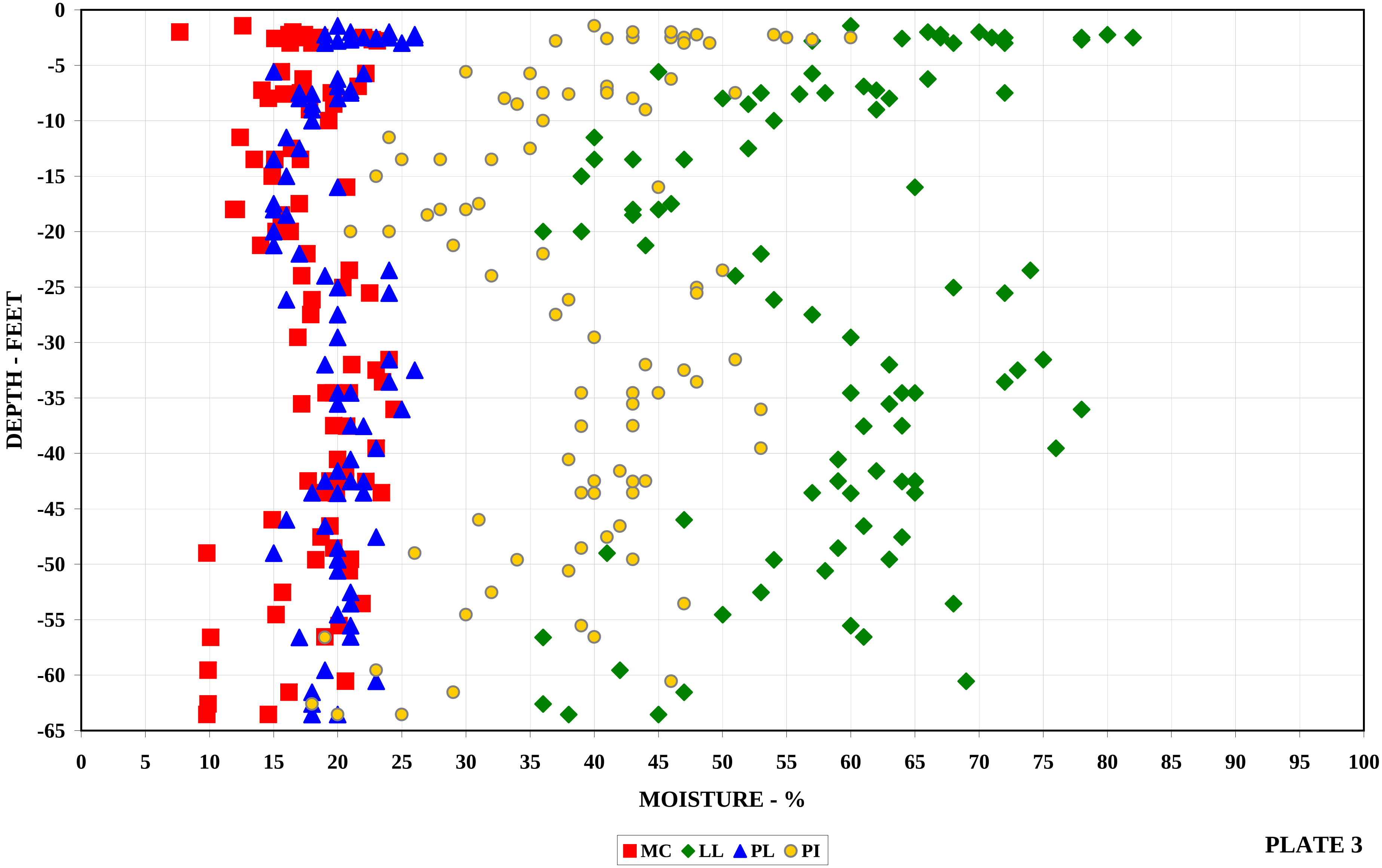


PLATE 3

ADVANCED INDIVIDUAL TRAINING (AIT)
BARRACKS COMPLEX
MOISTURE CONTENT - DRY DENSITY VS DEPTH

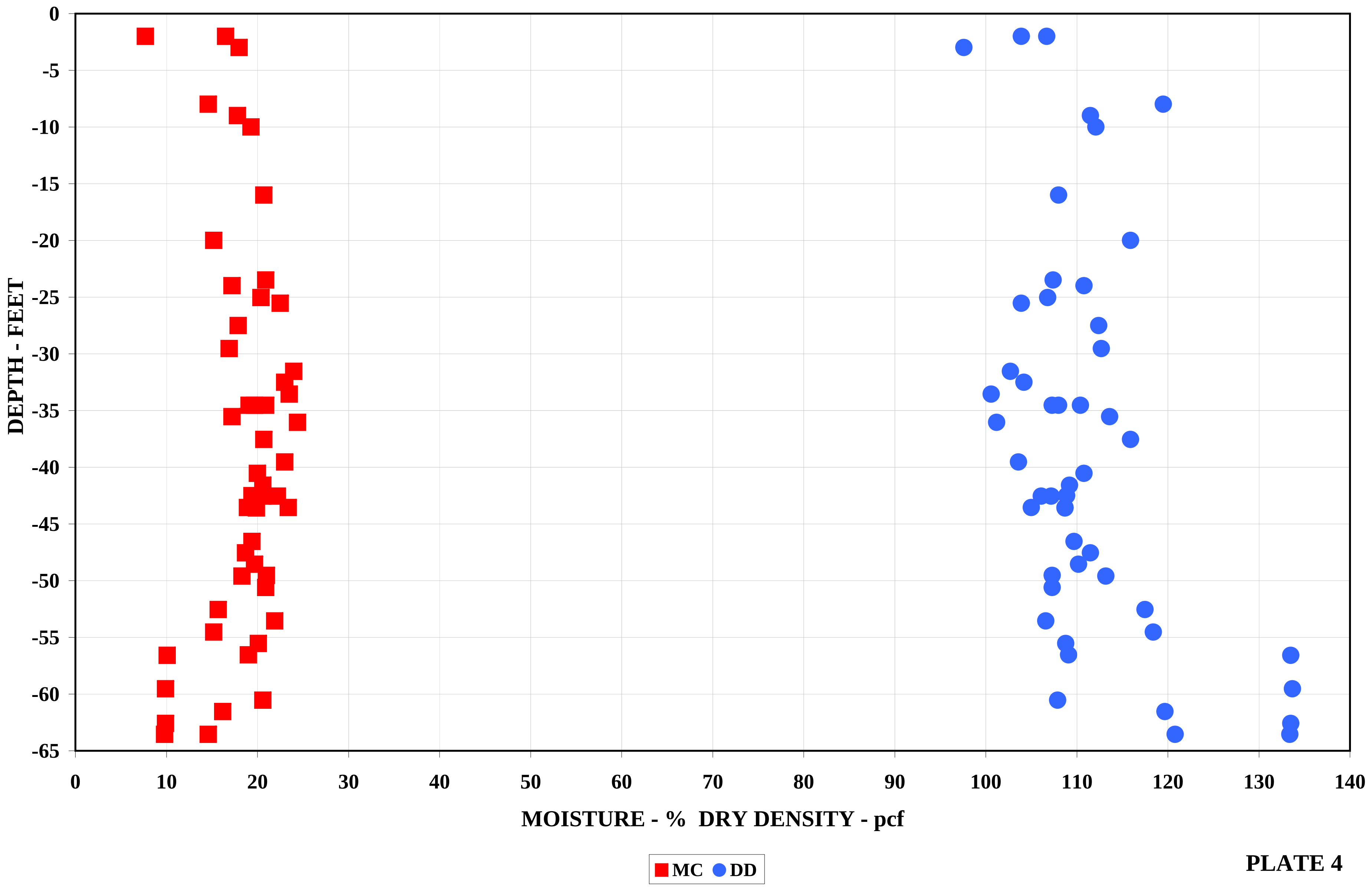


PLATE 4

ADVANCED INDIVIDUAL TRAINING (AIT)
BARRACKS COMPLEX
ULTIMATE COMPRESSIVE STRENGTH VS DEPTH

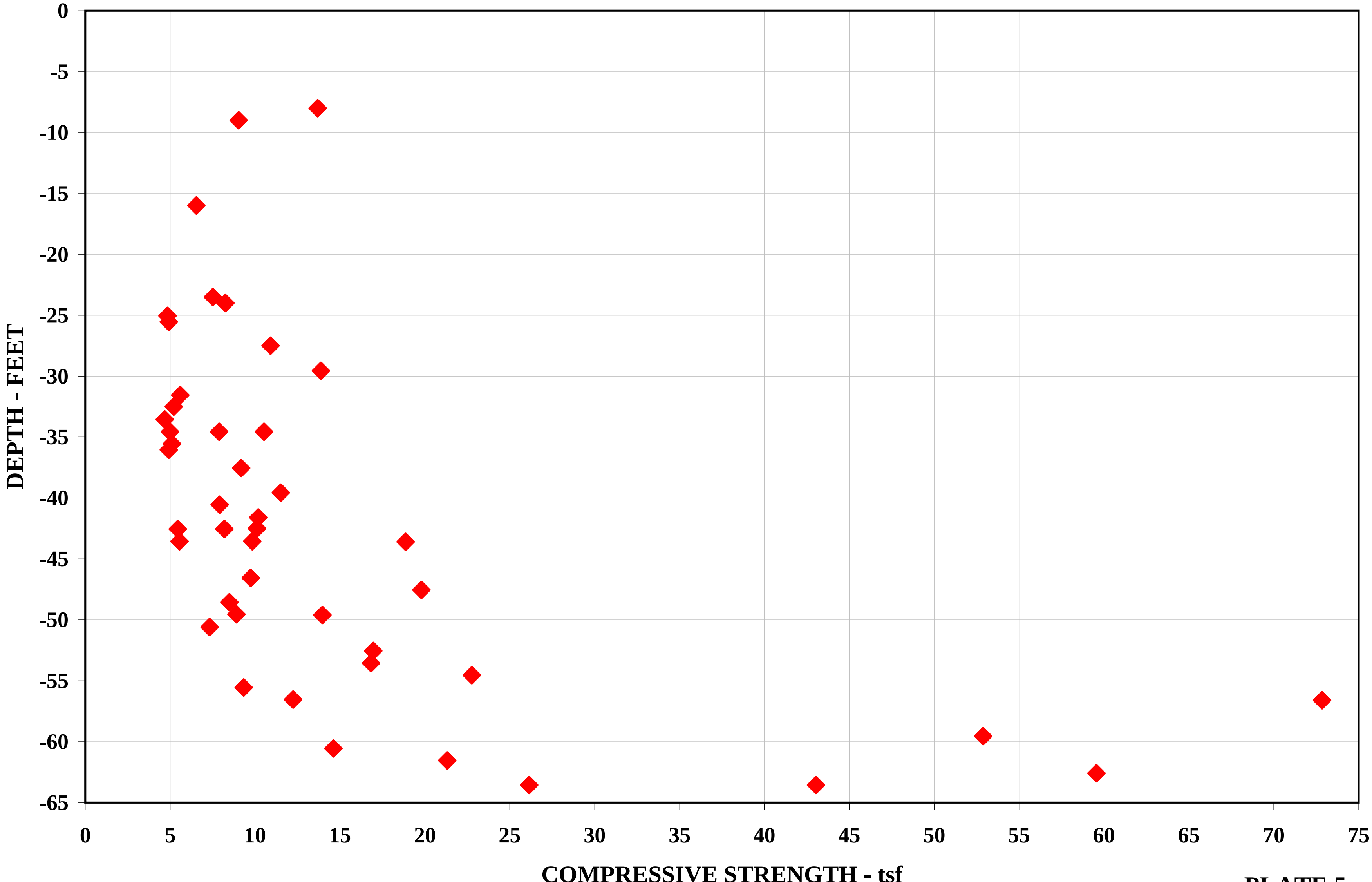


PLATE 5

APPENDIX C

LABORATORY TESTING DATA

SUMMARY OF LABORATORY TEST RESULTS

LABORATORY TESTING SERVICES
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX
FORT SAM HOUSTON, TEXAS

Boring No.	Sample No.	Sample Depth (ft.)	Visual Description & Unified Soil Classification (ASTM D-2488)		Percent Passing Sieve #4	#10	#20	#40	#60	#80	#100	#200
10A-1273	A	0-5	Dark brown clay	CH	100.0	99.7	99.4	99.0	98.7	98.2	97.9	96.2
	B	5-10	Light brown clay	CH	100.0	100.0	99.8	99.4	99.2	98.9	98.5	97.2
8A-1275	A	0-5	Dark brown clay	CH	100.0	99.4	98.7	98.3	97.9	97.5	97.2	95.1
	B	5-9.5	Light brown clay	CH	100.0	99.9	99.6	99.2	98.5	97.9	97.5	95.3
	C	12.5-17.5	Light brown and tan clay with sand	CL	99.5	99.1	98.6	95.4	88.5	83.2	80.5	73.6
	D	19-21	Tan sandy clay with occasional gravel	CL	96.5	93.2	91.2	87.1	79.0	73.0	70.6	63.3
	E	23.3-29	Tan weathered shale	N/A	100.0	99.7	99.5	99.1	98.9	98.4	98.2	95.1
	F	29-35	Tan weathered shale	N/A	99.8	99.7	99.5	99.4	99.2	99.0	99.0	98.2
	G	35-40	Tan weathered shale	N/A	100.0	100.0	99.9	99.8	99.7	99.5	99.4	98.5
	H	40-45	Tan weathered shale	N/A	100.0	99.6	99.0	98.5	98.2	97.8	97.6	96.4
	I	45-47	Tan weathered shale	N/A	100.0	99.9	99.2	98.6	97.9	97.2	96.9	93.9
	J	47-51	Tan weathered shale	N/A	100.0	99.7	99.2	98.7	98.0	97.3	97.0	93.9
8A4C-1276	A	0-5	Dark brown clay	CH	100.0	99.8	99.2	98.7	98.3	97.8	97.4	95.3
	B	5-10	Light brown and tan silty clay	CH	100.0	99.9	99.8	99.7	99.4	98.9	98.7	96.8
	C	10-15	Light brown and tan silty clay	CH	100.0	100.0	99.9	99.8	99.6	99.3	99.1	97.9
	D	15-20	Light brown and tan silty clay	CL	99.9	99.6	98.9	98.7	97.6	96.3	95.6	92.2
	E	20-22.5	Tan and light gray clay with sand	CL	99.9	99.2	98.8	98.0	95.2	91.0	89.2	80.2
	C-1	34.1-35	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-2	43.1-44	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-3	49.2-50	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-4	56.2-57	Dark gray shale, cemented	N/A	---	---	---	---	---	---	---	---
	C-5	62.2-63	Dark gray shale, cemented	N/A	---	---	---	---	---	---	---	---
8A4C-1277	A	0-4.5	Dark brown clay	CH	99.9	99.6	98.8	98.2	97.8	97.3	97.0	95.0
	B	4.5-7	Light brown clay	CH	99.8	99.6	98.9	98.3	97.9	97.5	97.2	95.6
	C	10-13	Light brown clayey sand with gravel	SC	70.2	51.1	39.8	32.9	30.6	28.9	28.3	26.0
	C-1	27-28	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-2	34.1-35	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-3	40.1-41	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-4	46.1-47	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-5	52.1-53	Dark gray shale	N/A	---	---	---	---	---	---	---	---
	C-6	59.1-60	Dark gray shale, cemented	N/A	---	---	---	---	---	---	---	---

SUMMARY OF LABORATORY TEST RESULTS

LABORATORY TESTING SERVICES
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX
FORT SAM HOUSTON, TEXAS

Boring No.	Sample No.	Sample Depth (ft.)	Visual Description & Unified Soil Classification (ASTM D-2488)		Percent Passing Sieve #4	#10	#20	#40	#60	#80	#100	#200
8A4C-1279	A	0-5	Dark brown clay	CH	100.0	99.7	99.4	99.0	98.6	98.2	98.0	96.1
	B	5-11	Light brown clay	CH	100.0	99.7	99.2	98.8	89.5	98.2	98.0	96.7
	C	11-16	Light brown clay with sand	CL	100.0	99.2	98.4	97.0	94.1	90.2	88.5	82.9
	D	16-21	Tan and light gray clay with sand	CL	100.0	99.6	98.8	94.7	88.4	88.2	85.8	77.8
	E	21-23	Tan and light gray clay with some sand	CH	100.0	99.3	98.7	98.3	96.6	93.0	90.3	85.9
	C-1	34.1-35	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-2	42.1-43	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-3	48.1-49	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-4	54.1-55	Dark gray shale, lightly cemented	N/A	---	---	---	---	---	---	---	---
	C-5	61.1-62	Dark gray shale, lightly cemented	N/A	---	---	---	---	---	---	---	---
8A4C-1281	ST-1	1-3	Dark brown clay	CH	99.7	99.3	98.2	97.4	96.8	96.2	97.8	93.6
	ST-2	7-9	Light brown silty clay	CH	100.0	99.6	99.0	97.8	95.9	93.9	93.0	89.0
	C-1	23-24	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-2	29.1-30	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-3	35.1-36	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-4	42-43	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
10A-1282	A	0.6-5	Dark brown clay	CH	99.8	99.5	98.7	97.7	96.2	94.5	93.6	89.7
	B	5-8.8	Light brown clay with sand	CH	91.0	90.7	90.1	88.9	87.6	86.5	85.9	81.8
10A-1283	A	0-5	Dark brown clay	CH	100.0	99.8	99.1	98.6	98.3	97.8	97.6	95.4
	B	5-7.5	Light brown clay	CH	99.5	99.0	98.2	97.2	96.1	95.2	94.8	93.1
8A4C-1284	A	0-5.2	Dark brown clay	CH	100.0	98.8	98.2	97.6	97.3	96.8	96.5	94.4
	B	5.2-10	Light brown silty clay	CH	100.0	100.0	99.8	99.4	99.0	98.4	98.1	95.6
	C	10-17	Tan silty clay with sand	CL	100.0	99.8	99.3	98.1	95.0	90.3	87.9	78.7
	D	17-19	Tan and gray sandy clay with some gravel	CL	90.3	88.6	87.2	84.9	79.1	71.6	68.4	61.2
	C-1	33.1-34	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-2	41.2-42	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-3	50.2-51	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-4	56.1-57	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-5	63.1-64	Dark gray shale, lightly cemented	N/A	---	---	---	---	---	---	---	---
8A4C-1286	C-1	24.6-25.5	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-2	31.1-32	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-3	37.1-38	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-4	43.1-44	Tan weathered shale	N/A	---	---	---	---	---	---	---	---

SUMMARY OF LABORATORY TEST RESULTS

LABORATORY TESTING SERVICES
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX
FORT SAM HOUSTON, TEXAS

Boring No.	Sample No.	Sample Depth (ft.)	Visual Description & Unified Soil Classification (ASTM D-2488)		Percent Passing Sieve							
					#4	#10	#20	#40	#60	#80	#100	#200
8A4C-1287	ST-1	2-4	Dark brown clay	CH	99.9	98.6	97.6	97.0	96.7	96.4	96.2	94.2
	ST-2	9-11	Light brown clay	CH	100.0	99.9	99.7	99.4	98.8	98.0	97.6	94.8
	ST-3	19-21	Tan and light gray clay with sand	CL	100.0	100.0	98.4	99.0	94.4	86.2	82.2	73.9
	C-1	35.6-36.5	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-2	43.2-44	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-3	49.1-50	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-4	55.1-56	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-5	63.1-64	Dark gray shale, cemented	N/A	---	---	---	---	---	---	---	---
8A4C-1289	A	0-2.9	Dark brown clay	CH	99.1	98.5	97.5	96.4	95.2	94.0	93.5	90.7
	B	6-11	Tan and light gray clay	CH	99.8	98.7	98.0	97.5	96.8	96.0	95.5	92.9
	C	11-16	Tan and light gray clay with sand	CL	100.0	99.7	99.1	98.4	96.5	93.4	91.7	84.9
	D	17-19	Light brown clayey gravel with sand	GC	43.3	35.3	31.2	27.9	25.5	24.3	23.9	22.7
	C-1	25.1-26	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-2	32-33	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-3	39.1-40	Tan weathered shale	N/A	---	---	---	---	---	---	---	---
	C-4	47.1-48	Dark gray shale	N/A	---	---	---	---	---	---	---	---
	C-5	53.1-54	Tan weathered shale with dark gray shale	N/A	---	---	---	---	---	---	---	---
	C-6	60.1-61	Dark gray shale	N/A	---	---	---	---	---	---	---	---
10A-1292	A	0-4.5	Dark brown clay	CH	99.4	99.0	98.2	97.0	95.9	94.8	94.1	91.2
	B	4.5-6.7	Light brown sandy clay	CL	98.3	96.4	95.2	92.1	85.9	78.8	75.1	63.2
10A-1294	A	0.5-5.5	Light brown clay	CH	99.9	99.7	99.2	98.4	97.6	96.9	96.7	95.1
10A-1296	A	0.4-5	Dark brown clay	CH	99.9	99.6	99.1	98.7	98.3	97.7	97.4	94.5
	B	5-10	Light brown silty clay	CH	100.0	99.7	99.3	98.9	98.5	98.0	97.8	96.2
8A4C-1297	ST-1	1-3	Dark brown clay	CH	99.5	98.6	97.1	96.3	95.6	95.0	94.6	91.9
	ST-2	8-10	Light brown silty clay	CH	100.0	99.8	99.6	99.4	99.1	98.8	98.7	97.4
	ST-3	15-17	Tan and light gray clay	CH	100.0	99.7	98.5	97.8	97.3	96.9	96.7	95.5
	ST-4	23-25	Tan and light gray silty clay	CH	100.0	99.4	98.9	97.6	95.6	93.6	92.7	87.3
	C-1	42.1-43	Tan weathered shale	N/A	---	---	---	---	---	---	---	---

SUMMARY OF LABORATORY TEST RESULTS

LABORATORY TESTING SERVICES
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX
FORT SAM HOUSTON, TEXAS

Boring No.	Sample No.	Sample Depth (ft.)	Visual Description & Unified Soil Classification (ASTM D-2488)		Moisture Content (%)	Unit Dry Weight (pcf)	Atterberg Limits LL	PL	PI	Consolidation Test
10A-1273	A	0-5	Dark brown clay	CH	18.4	---	78	23	55	
	B	5-10	Light brown clay	CH	19.5	---	72	21	51	
8A-1275	A	0-5	Dark brown clay	CH	17.2	---	67	24	43	
	B	5-9.5	Light brown clay	CH	14.1	---	62	21	41	
	C	12.5-17.5	Light brown and tan clay with sand	CL	14.9	---	39	16	23	
	D	19-21	Tan sandy clay with occasional gravel	CL	16.3	---	36	15	21	
	E	23.3-29	Tan weathered shale	N/A	18.0	---	54	16	38	
	F	29-35	Tan weathered shale	N/A	21.1	---	63	19	44	
	G	35-40	Tan weathered shale	N/A	19.7	---	64	21	43	
	H	40-45	Tan weathered shale	N/A	17.7	---	59	19	40	
	I	45-47	Tan weathered shale	N/A	14.9	---	47	16	31	
	J	47-51	Tan weathered shale	N/A	9.8	---	41	15	26	
8A4C-1276	A	0-5	Dark brown clay	CH	22.0	---	72	26	46	
	B	5-10	Light brown and tan silty clay	CH	17.2	---	53	17	36	
	C	10-15	Light brown and tan silty clay	CH	16.4	---	52	17	35	
	D	15-20	Light brown and tan silty clay	CL	17.0	---	46	15	31	
	E	20-22.5	Tan and light gray clay with sand	CL	14.0	---	44	15	29	
	C-1	34.1-35	Tan weathered shale	N/A	19.1	107.3	64	21	43	
	C-2	43.1-44	Tan weathered shale	N/A	18.9	108.7	57	18	39	
	C-3	49.2-50	Tan weathered shale	N/A	18.3	113.2	54	20	34	
	C-4	56.2-57	Dark gray shale, cemented	N/A	10.1	133.5	36	17	19	
	C-5	62.2-63	Dark gray shale, cemented	N/A	9.9	133.5	36	18	18	
8A4C-1277	A	0-4.5	Dark brown clay	CH	17.4	---	80	26	54	
	B	4.5-7	Light brown clay	CH	22.2	---	57	22	35	
	C	10-13	Light brown clayey sand with gravel	SC	12.4	---	40	16	24	
	C-1	27-28	Tan weathered shale	N/A	17.9	112.4	57	20	37	*
	C-2	34.1-35	Tan weathered shale	N/A	20.9	108.0	65	20	45	
	C-3	40.1-41	Tan weathered shale	N/A	20.0	110.8	59	21	38	
	C-4	46.1-47	Tan weathered shale	N/A	19.4	109.7	61	19	42	
	C-5	52.1-53	Dark gray shale	N/A	15.7	117.5	53	21	32	*
	C-6	59.1-60	Dark gray shale, cemented	N/A	9.9	133.7	42	19	23	*

* See attached "Laboratory Test Data Sheets" for Consolidation Test Results

SUMMARY OF LABORATORY TEST RESULTS

LABORATORY TESTING SERVICES
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX
FORT SAM HOUSTON, TEXAS

Boring No.	Sample No.	Sample Depth (ft.)	Visual Description & Unified Soil Classification (ASTM D-2488)		Moisture Content (%)	Unit Dry Weight (pcf)	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	Consolidation Test
8A4C-1279	A	0-5	Dark brown clay	CH	16.7	---	71	24	47	
	B	5-11	Light brown clay	CH	17.5	---	63	20	43	
	C	11-16	Light brown clay with sand	CL	17.1	---	47	15	32	
	D	16-21	Tan and light gray clay with sand	CL	15.6	---	43	16	27	
	E	21-23	Tan and light gray clay with some sand	CH	17.6	---	53	17	36	
	C-1	34.1-35	Tan weathered shale	N/A	19.7	110.4	60	21	39	
	C-2	42.1-43	Tan weathered shale	N/A	20.6	107.2	65	22	43	
	C-3	48.1-49	Tan weathered shale	N/A	19.7	110.2	59	20	39	
	C-4	54.1-55	Dark gray shale, lightly cemented	N/A	15.2	118.4	50	20	30	
	C-5	61.1-62	Dark gray shale, lightly cemented	N/A	16.2	119.7	47	18	29	
8A4C-1281	ST-1	1-3	Dark brown clay	CH	16.5	103.9	70	24	46	
	ST-2	7-9	Light brown silty clay	CH	14.6	119.5	50	17	33	
	C-1	23-24	Tan weathered shale	N/A	20.9	107.4	74	24	50	
	C-2	29.1-30	Tan weathered shale	N/A	16.9	112.7	60	20	40	
	C-3	35.1-36	Tan weathered shale	N/A	17.2	113.6	63	20	43	
	C-4	42-43	Tan weathered shale	N/A	19.4	108.9	65	21	44	
10A-1282	A	0.6-5	Dark brown clay	CH	23.1	---	57	20	37	
	B	5-8.8	Light brown clay with sand	CH	21.6	---	61	20	41	
10A-1283	A	0-5	Dark brown clay	CH	18.6	---	82	22	60	
	B	5-7.5	Light brown clay	CH	17.3	---	66	20	46	
8A4C-1284	A	0-5.2	Dark brown clay	CH	15.1	---	64	23	41	
	B	5.2-10	Light brown silty clay	CH	15.8	---	56	18	38	
	C	10-17	Tan silty clay with sand	CL	13.5	---	40	15	25	
	D	17-19	Tan and gray sandy clay with some gravel	CL	12.1	---	43	15	28	
	C-1	33.1-34	Tan weathered shale	N/A	23.5	100.6	72	24	48	
	C-2	41.2-42	Tan weathered shale	N/A	20.6	109.2	62	20	42	
	C-3	50.2-51	Tan weathered shale	N/A	20.9	107.3	58	20	38	
	C-4	56.1-57	Tan weathered shale	N/A	19.0	109.1	61	21	40	
	C-5	63.1-64	Dark gray shale, lightly cemented	N/A	14.6	120.8	45	20	25	
8A4C-1286	C-1	24.6-25.5	Tan weathered shale	N/A	20.4	106.8	68	20	48	
	C-2	31.1-32	Tan weathered shale	N/A	24.0	102.7	75	24	51	
	C-3	37.1-38	Tan weathered shale	N/A	20.7	115.9	61	22	39	
	C-4	43.1-44	Tan weathered shale	N/A	23.4	105.0	65	22	43	

SUMMARY OF LABORATORY TEST RESULTS

LABORATORY TESTING SERVICES
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX
FORT SAM HOUSTON, TEXAS

Boring No.	Sample No.	Sample Depth (ft.)	Visual Description & Unified Soil Classification (ASTM D-2488)		Moisture Content (%)	Unit Dry Weight (pcf)	Atterberg Limits LL	PL	PI	Consolidation Test
8A4C-1287	ST-1	2-4	Dark brown clay	CH	18.0	97.6	72	25	47	*
	ST-2	9-11	Light brown clay	CH	19.3	112.1	54	18	36	
	ST-3	19-21	Tan and light gray clay with sand	CL	15.2	115.9	39	15	24	*
	C-1	35.6-36.5	Tan weathered shale	N/A	24.4	101.2	78	25	53	
	C-2	43.2-44	Tan weathered shale	N/A	19.9	108.7	60	20	40	
	C-3	49.1-50	Tan weathered shale	N/A	21.0	107.3	63	20	43	*
	C-4	55.1-56	Tan weathered shale	N/A	20.1	108.8	60	21	39	
	C-5	63.1-64	Dark gray shale, cemented	N/A	9.8	133.4	38	18	20	
8A4C-1289	A	0-2.9	Dark brown clay	CH	12.6	---	60	20	40	
	B	6-11	Tan and light gray clay	CH	19.7	---	52	18	34	
	C	11-16	Tan and light gray clay with sand	CL	15.1	---	43	15	28	
	D	17-19	Light brown clayey gravel with sand	GC	11.9	---	45	15	30	
	C-1	25.1-26	Tan weathered shale	N/A	22.5	103.9	72	24	48	
	C-2	32-33	Tan weathered shale	N/A	23.0	104.2	73	26	47	
	C-3	39.1-40	Tan weathered shale	N/A	23.0	103.6	76	23	53	
	C-4	47.1-48	Dark gray shale	N/A	18.7	111.5	64	23	41	
	C-5	53.1-54	Tan weathered shale with dark gray shale	N/A	21.9	106.6	68	21	47	
	C-6	60.1-61	Dark gray shale	N/A	20.6	107.9	69	23	46	
10A-1292	A	0-4.5	Dark brown clay	CH	16.2	---	67	19	48	
	B	4.5-6.7	Light brown sandy clay	CL	15.6	---	45	15	30	
10A-1294	A	0.5-5.5	Light brown clay	CH	16.3	---	68	19	49	
10A-1296	A	0.4-5	Dark brown clay	CH	22.7	---	78	21	57	
	B	5-10	Light brown silty clay	CH	17.1	---	58	17	41	
8A4C-1297	ST-1	1-3	Dark brown clay	CH	7.7	106.7	66	21	43	
	ST-2	8-10	Light brown silty clay	CH	17.8	111.5	62	18	44	
	ST-3	15-17	Tan and light gray clay	CH	20.7	108.0	65	20	45	
	ST-4	23-25	Tan and light gray silty clay	CH	17.2	110.8	51	19	32	
	C-1	42.1-43	Tan weathered shale	N/A	22.2	106.1	64	21	43	

* See attached "Laboratory Test Data Sheets" for Consolidation Test Results

SUMMARY OF LABORATORY TEST RESULTS

LABORATORY TESTING SERVICES
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX
FORT SAM HOUSTON, TEXAS

Boring No.	Sample No.	Sample Depth (ft.)	Visual Description & Unified Soil Classification (ASTM D-2488)		Moisture Content (%)	Unit Dry Weight (pcf)	Confining Pressure (tsf)	Q (tsf)	Strain @ Failure (%)	Type Failure
10A-1273	A	0-5	Dark brown clay	CH	18.4	---	---	---	---	
	B	5-10	Light brown clay	CH	19.5	---	---	---	---	
8A-1275	A	0-5	Dark brown clay	CH	17.2	---	---	---	---	
	B	5-9.5	Light brown clay	CH	14.1	---	---	---	---	
	C	12.5-17.5	Light brown and tan clay with sand	CL	14.9	---	---	---	---	
	D	19-21	Tan sandy clay with occasional gravel	CL	16.3	---	---	---	---	
	E	23.3-29	Tan weathered shale	N/A	18.0	---	---	---	---	
	F	29-35	Tan weathered shale	N/A	21.1	---	---	---	---	
	G	35-40	Tan weathered shale	N/A	19.7	---	---	---	---	
	H	40-45	Tan weathered shale	N/A	17.7	---	---	---	---	
	I	45-47	Tan weathered shale	N/A	14.9	---	---	---	---	
	J	47-51	Tan weathered shale	N/A	9.8	---	---	---	---	
8A4C-1276	A	0-5	Dark brown clay	CH	22.0	---	---	---	---	
	B	5-10	Light brown and tan silty clay	CH	17.2	---	---	---	---	
	C	10-15	Light brown and tan silty clay	CH	16.4	---	---	---	---	
	D	15-20	Light brown and tan silty clay	CL	17.0	---	---	---	---	
	E	20-22.5	Tan and light gray clay with sand	CL	14.0	---	---	---	---	
	C-1	34.1-35	Tan weathered shale	N/A	19.1	107.3	2.159	10.53	3.9	Angular (70°)
	C-2	43.1-44	Tan weathered shale	N/A	18.9	108.7	2.722	9.83	6.4	Internal
	C-3	49.2-50	Tan weathered shale	N/A	18.3	113.2	3.100	13.96	6.0	Internal
	C-4	56.2-57	Dark gray shale, cemented	N/A	10.1	133.5	0*	72.84	1.4	Vertical
	C-5	62.2-63	Dark gray shale, cemented	N/A	9.9	133.5	0*	59.56	1.5	Vertical
8A4C-1277	A	0-4.5	Dark brown clay	CH	17.4	---	---	---	---	
	B	4.5-7	Light brown clay	CH	22.2	---	---	---	---	
	C	10-13	Light brown clayey sand with gravel	SC	12.4	---	---	---	---	
	C-1	27-28	Tan weathered shale	N/A	17.9	112.4	1.719	10.92	5.1	Internal
	C-2	34.1-35	Tan weathered shale	N/A	20.9	108.0	2.159	4.99	7.9	Multi-Angular (45-70°)
	C-3	40.1-41	Tan weathered shale	N/A	20.0	110.8	2.534	7.91	5.4	Angular (45°)
	C-4	46.1-47	Tan weathered shale	N/A	19.4	109.7	2.909	9.75	6.6	Internal
	C-5	52.1-53	Dark gray shale	N/A	15.7	117.5	3.284	16.96	6.4	Internal
	C-6	59.1-60	Dark gray shale, cemented	N/A	9.9	133.7	0*	52.88	1.2	Vertical

* This sample was tested for strength in an unconfined condition, as the anticipated strength of the sample was likely to exceed the rated capacity of standard Triaxial Test equipment.

SUMMARY OF LABORATORY TEST RESULTS

LABORATORY TESTING SERVICES
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX
FORT SAM HOUSTON, TEXAS

Boring No.	Sample No.	Sample Depth (ft.)	Visual Description & Unified Soil Classification (ASTM D-2488)		Moisture Content (%)	Unit Dry Weight (pcf)	Confining Pressure (tsf)	Q (tsf)	Strain @ Failure (%)	Type Failure
8A4C-1279	A	0-5	Dark brown clay	CH	16.7	---	---	---	---	
	B	5-11	Light brown clay	CH	17.5	---	---	---	---	
	C	11-16	Light brown clay with sand	CL	17.1	---	---	---	---	
	D	16-21	Tan and light gray clay with sand	CL	15.6	---	---	---	---	
	E	21-23	Tan and light gray clay with some sand	CH	17.6	---	---	---	---	
	C-1	34.1-35	Tan weathered shale	N/A	19.7	110.4	2.159	7.88	5.9	Angular (60^{υ})
	C-2	42.1-43	Tan weathered shale	N/A	20.6	107.2	2.659	8.19	5.9	Internal
	C-3	48.1-49	Tan weathered shale	N/A	19.7	110.2	3.034	8.48	6.2	Angular (60^{υ})
	C-4	54.1-55	Dark gray shale, lightly cemented	N/A	15.2	118.4	0*	22.77	3.1	Vertical
	C-5	61.1-62	Dark gray shale, lightly cemented	N/A	16.2	119.7	0*	21.32	2.3	Vertical
8A4C-1281	ST-1	1-3	Dark brown clay	CH	16.5	103.9	---	---	---	
	ST-2	7-9	Light brown silty clay	CH	14.6	119.5	0.500	13.69	5.8	Internal
	C-1	23-24	Tan weathered shale	N/A	20.9	107.4	1.469	7.51	4.6	Angular (45^{υ})
	C-2	29.1-30	Tan weathered shale	N/A	16.9	112.7	1.847	13.88	3.3	Angular (50^{υ})
	C-3	35.1-36	Tan weathered shale	N/A	17.2	113.6	2.222	5.12	3.4	Angular (60^{υ})
	C-4	42-43	Tan weathered shale	N/A	19.4	108.9	2.656	10.12	4.9	Angular (45^{υ})
10A-1282	A	0.6-5	Dark brown clay	CH	23.1	---	---	---	---	
	B	5-8.8	Light brown clay with sand	CH	21.6	---	---	---	---	
10A-1283	A	0-5	Dark brown clay	CH	18.6	---	---	---	---	
	B	5-7.5	Light brown clay	CH	17.3	---	---	---	---	
8A4C-1284	A	0-5.2	Dark brown clay	CH	15.1	---	---	---	---	
	B	5.2-10	Light brown silty clay	CH	15.8	---	---	---	---	
	C	10-17	Tan silty clay with sand	CL	13.5	---	---	---	---	
	D	17-19	Tan and gray sandy clay with some gravel	CL	12.1	---	---	---	---	
	C-1	33.1-34	Tan weathered shale	N/A	23.5	100.6	2.909	4.68	5.8	Multi-Angular ($30\text{-}45^{\upsilon}$)
	C-2	41.2-42	Tan weathered shale	N/A	20.6	109.2	2.600	10.19	3.7	Internal
	C-3	50.2-51	Tan weathered shale	N/A	20.9	107.3	3.162	7.33	5.8	Internal
	C-4	56.1-57	Tan weathered shale	N/A	19.0	109.1	3.534	12.24	6.5	Internal
	C-5	63.1-64	Dark gray shale, lightly cemented	N/A	14.6	120.8	3.972	26.15	4.0	Internal
8A4C-1286	C-1	24.6-25.5	Tan weathered shale	N/A	20.4	106.8	1.566	4.84	9.4	Angular (50^{υ})
	C-2	31.1-32	Tan weathered shale	N/A	24.0	102.7	1.972	5.60	3.7	Angular (60^{υ})
	C-3	37.1-38	Tan weathered shale	N/A	20.7	115.9	2.347	9.19	7.9	Angular (60^{υ})
	C-4	43.1-44	Tan weathered shale	N/A	23.4	105.0	2.722	5.55	8.6	Angular (40^{υ})

* This sample was tested for strength in an unconfined condition, as the anticipated strength of the sample was likely to exceed the rated capacity of standard Triaxial Test equipment.

SUMMARY OF LABORATORY TEST RESULTS

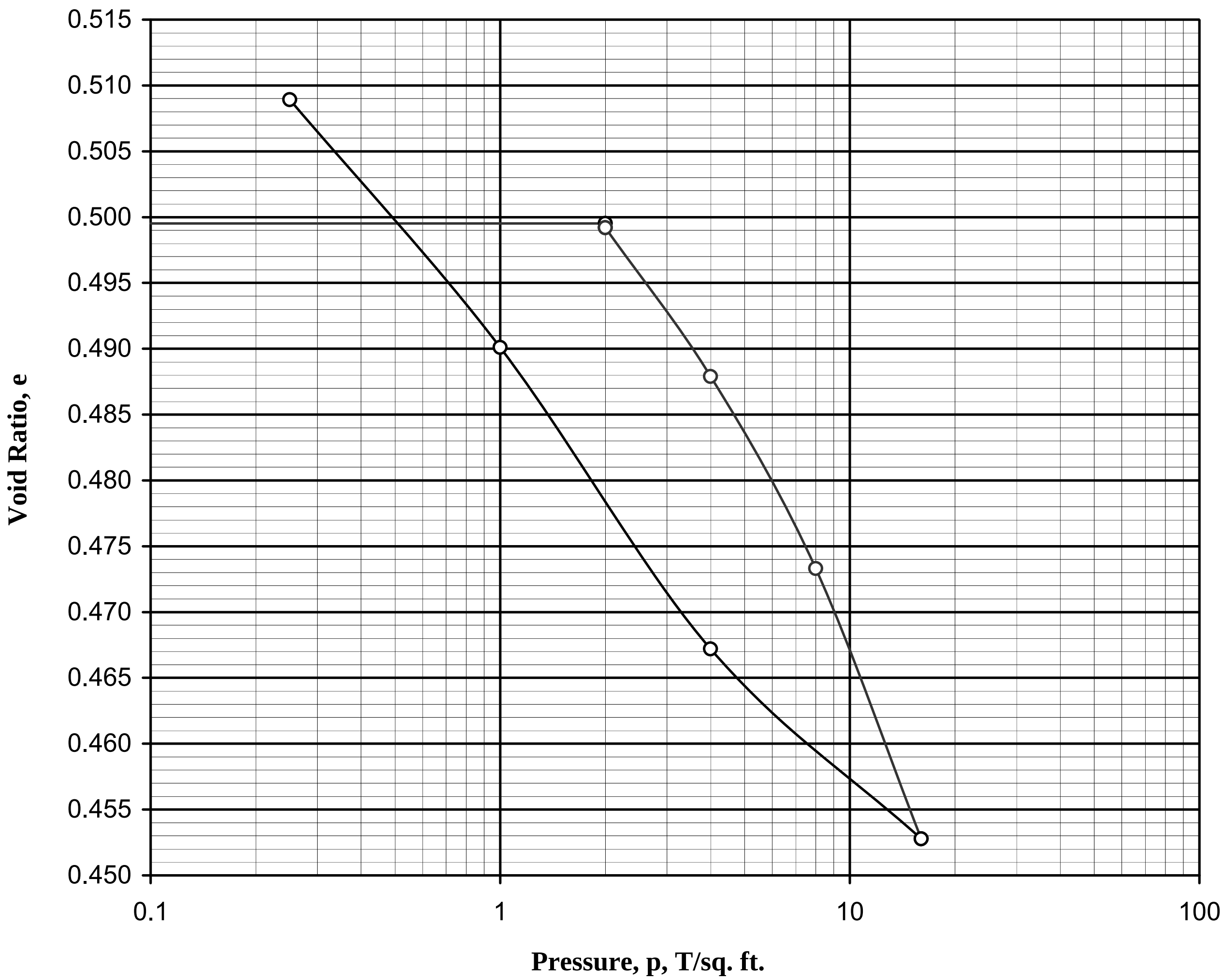
LABORATORY TESTING SERVICES
ADVANCED INDIVIDUAL TRAINING (AIT) BARRACKS COMPLEX
FORT SAM HOUSTON, TEXAS

Boring No.	Sample No.	Sample Depth (ft.)	Visual Description & Unified Soil Classification (ASTM D-2488)		Moisture Content (%)	Unit Dry Weight (pcf)	Confining Pressure (tsf)	Q (tsf)	Strain @ Failure (%)	Type Failure
8A4C-1287	ST-1	2-4	Dark brown clay	CH	18.0	97.6	---	---	---	
	ST-2	9-11	Light brown clay	CH	19.3	112.1	---	---	---	
	ST-3	19-21	Tan and light gray clay with sand	CL	15.2	115.9	---	---	---	
	C-1	35.6-36.5	Tan weathered shale	N/A	24.4	101.2	2.253	4.92	4.3	Angular (45°)
	C-2	43.2-44	Tan weathered shale	N/A	19.9	108.7	2.725	18.87	10.1	Internal
	C-3	49.1-50	Tan weathered shale	N/A	21.0	107.3	3.097	8.90	6.0	Angular (50°)
	C-4	55.1-56	Tan weathered shale	N/A	20.1	108.8	3.472	9.33	6.9	Angular (70°)
	C-5	63.1-64	Dark gray shale, cemented	N/A	9.8	133.4	0*	43.04	1.6	Vertical
8A4C-1289	A	0-2.9	Dark brown clay	CH	12.6	---	---	---	---	
	B	6-11	Tan and light gray clay	CH	19.7	---	---	---	---	
	C	11-16	Tan and light gray clay with sand	CL	15.1	---	---	---	---	
	D	17-19	Light brown clayey gravel with sand	GC	11.9	---	---	---	---	
	C-1	25.1-26	Tan weathered shale	N/A	22.5	103.9	1.597	4.91	4.4	Angular (45°)
	C-2	32-33	Tan weathered shale	N/A	23.0	104.2	2.031	5.22	7.8	Angular (50°)
	C-3	39.1-40	Tan weathered shale	N/A	23.0	103.6	2.472	11.52	4.1	Vertical
	C-4	47.1-48	Dark gray shale	N/A	18.7	111.5	2.972	19.80	5.7	Internal
	C-5	53.1-54	Tan weathered shale with dark gray shale	N/A	21.9	106.6	3.947	16.83	5.3	Angular (70°)
	C-6	60.1-61	Dark gray shale	N/A	20.6	107.9	3.784	14.62	6.0	Internal
10A-1292	A	0-4.5	Dark brown clay	CH	16.2	---	---	---	---	
	B	4.5-6.7	Light brown sandy clay	CL	15.6	---	---	---	---	
10A-1294	A	0.5-5.5	Light brown clay	CH	16.3	---	---	---	---	
10A-1296	A	0.4-5	Dark brown clay	CH	22.7	---	---	---	---	
	B	5-10	Light brown silty clay	CH	17.1	---	---	---	---	
8A4C-1297	ST-1	1-3	Dark brown clay	CH	7.7	106.7	---	---	---	
	ST-2	8-10	Light brown silty clay	CH	17.8	111.5	0.562	9.04	6.2	Internal
	ST-3	15-17	Tan and light gray clay	CH	20.7	108.0	1.000	6.55	11.1	Internal
	ST-4	23-25	Tan and light gray silty clay	CH	17.2	110.8	1.500	8.25	5.8	Angular (60°)
	C-1	42.1-43	Tan weathered shale	N/A	22.2	106.1	2.659	5.45	7.5	Multi-Angular (50°)

* This sample was tested for strength in an unconfined condition, as the anticipated strength of the sample was likely to exceed the rated capacity of standard Triaxial Test equipment.

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing



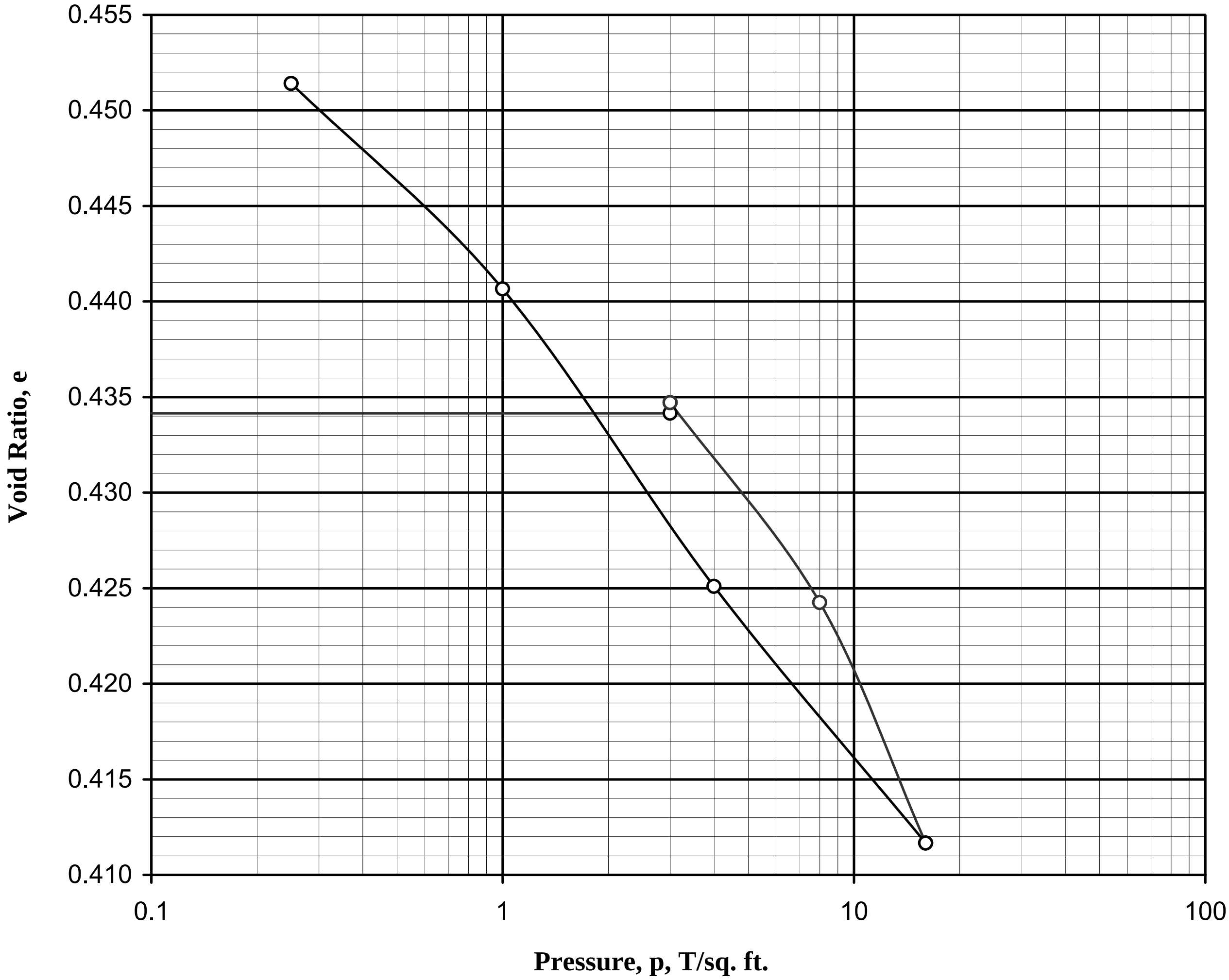
Type of specimen: Undisturbed		Before Test		After Test	
Diam. 2.50 in.	Ht. 0.478 in.	Water Content, w_o	17.86%	W_f	18.84%
Overburden Pressure, P_o T/sq. ft.		Void Ratio, e_o	0.4995	e_f	0.5089
Preconsol. Pressure, P_c T/sq. ft.		Saturation, S_o	96.5%	S_f	99.9%
Compression Index, C_c		Dry Density, γd	112.4 lb/ft^3		
Classification Tan weathered shale					

LL 57	G_s 2.700 (assumed)	Project	Fort Sam Houston AIT
PL 20			Team Project No.: 082047
Remarks		Boring No: 8A4C-1277	Sample No.: C-1
		Depth: 27-28	Date: 8/26/08
		CONSOLIDATION TEST REPORT	

Tuesday, November 09, 2010

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

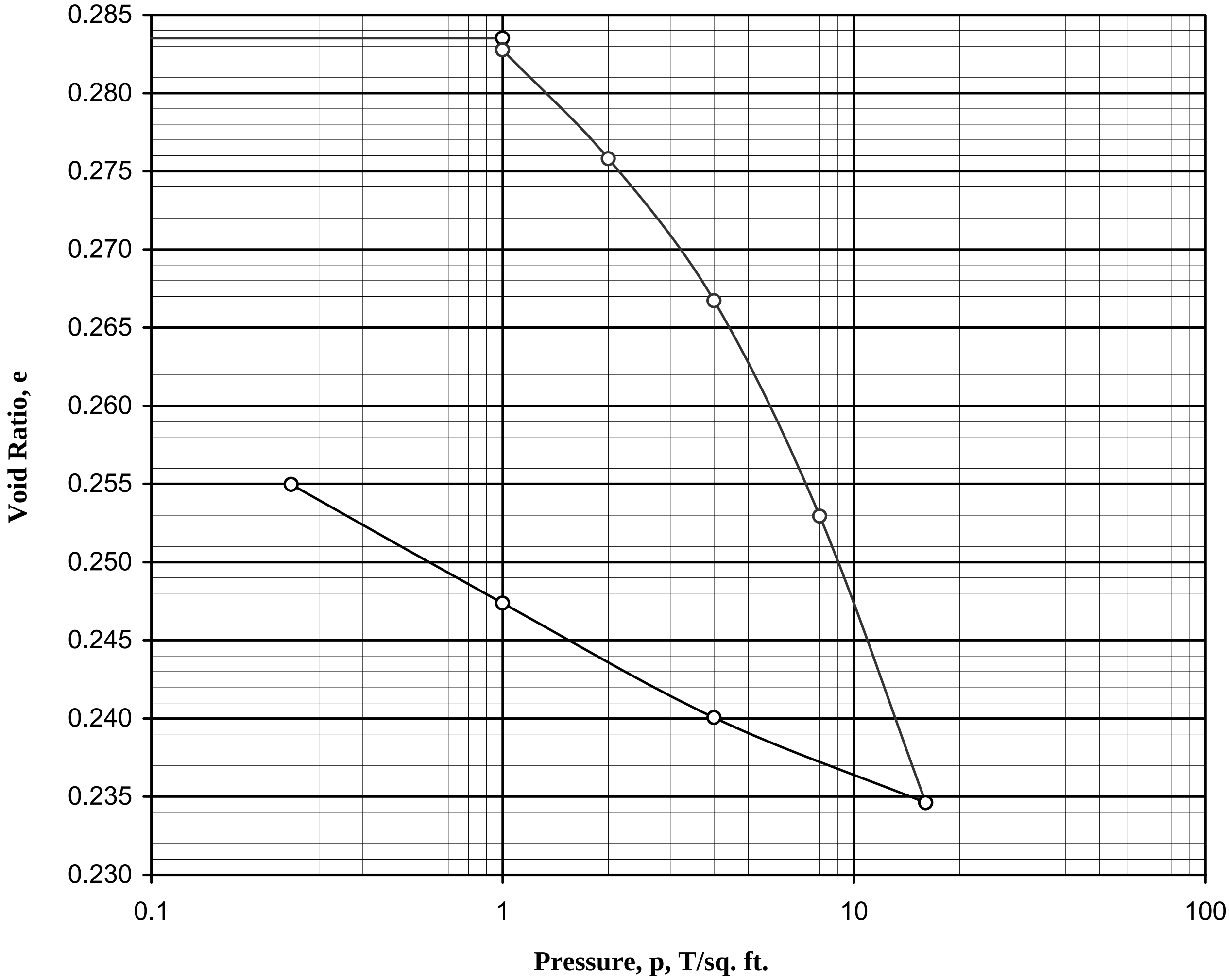


Type of specimen: Undisturbed		Before Test		After Test	
Diam. 2.50 in.	Ht. 0.507 in.	Water Content, w_o	15.65%	W_f	16.74%
Overburden Pressure, P_o T/sq. ft.		Void Ratio, e_o	0.4341	e_f	0.4514
Preconsol. Pressure, P_c T/sq. ft.		Saturation, S_o	97.3%	S_f	100.1%
Compression Index, C_c		Dry Density, γd	117.5 lb/ft^3		
Classification Dark gray shale					
LL 53	G_s 2.700 (assumed)	Project	Fort Sam Houston AIT		
PL 21			Team Project No.: 082047		
Remarks					
		Boring No: 8A4C-1277		Sample No.: C-5	
		Depth: 52.1-53		Date: 8/26/08	
		CONSOLIDATION TEST REPORT			

Tuesday, November 09, 2010

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

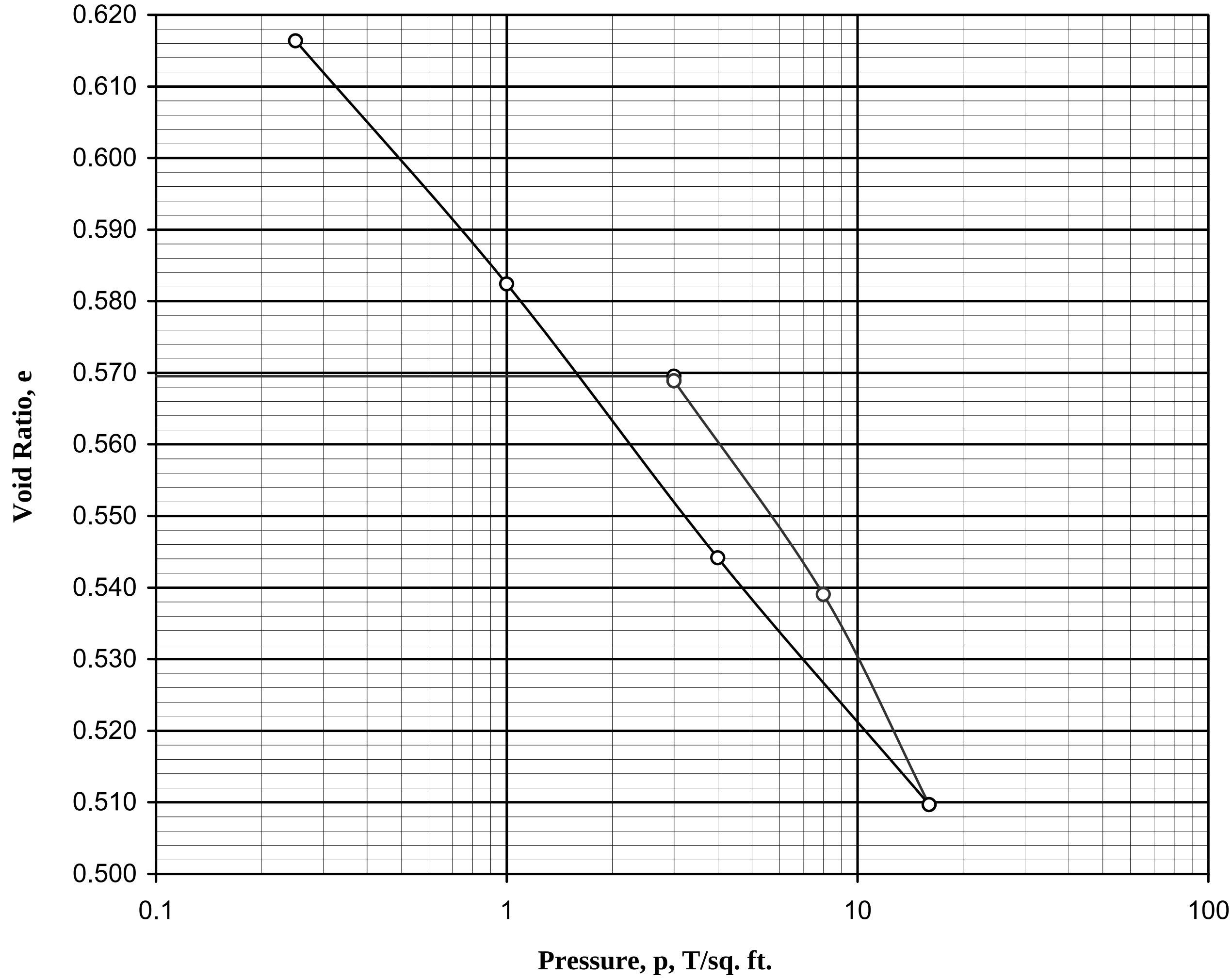


Type of specimen:	Undisturbed		Before Test			After Test	
Diam. 2.50 in.	Ht. 0.508 in.		Water Content, w_o	9.87%		W_f	9.27%
Overburden Pressure, P_o		T/sq. ft.	Void Ratio, e_o	0.2835		e_f	0.2550
Preconsol. Pressure, P_c		T/sq. ft.	Saturation, S_o	95.8%		S_f	100.0%
Compression Index, C_c			Dry Density, γd	133.7	lb/ft^3		
Classification	Dark gray shale, cemented						
LL 42	G_s 2.700 (assumed)		Project	Fort Sam Houston AIT			
PL 19				Team Project No.:	082047		
Remarks			Boring No:	8A4C-1277	Sample No.:	C-6	
			Depth:	59.1-60	Date:	8/26/08	
			CONSOLIDATION TEST REPORT				

Tuesday, November 09, 2010

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

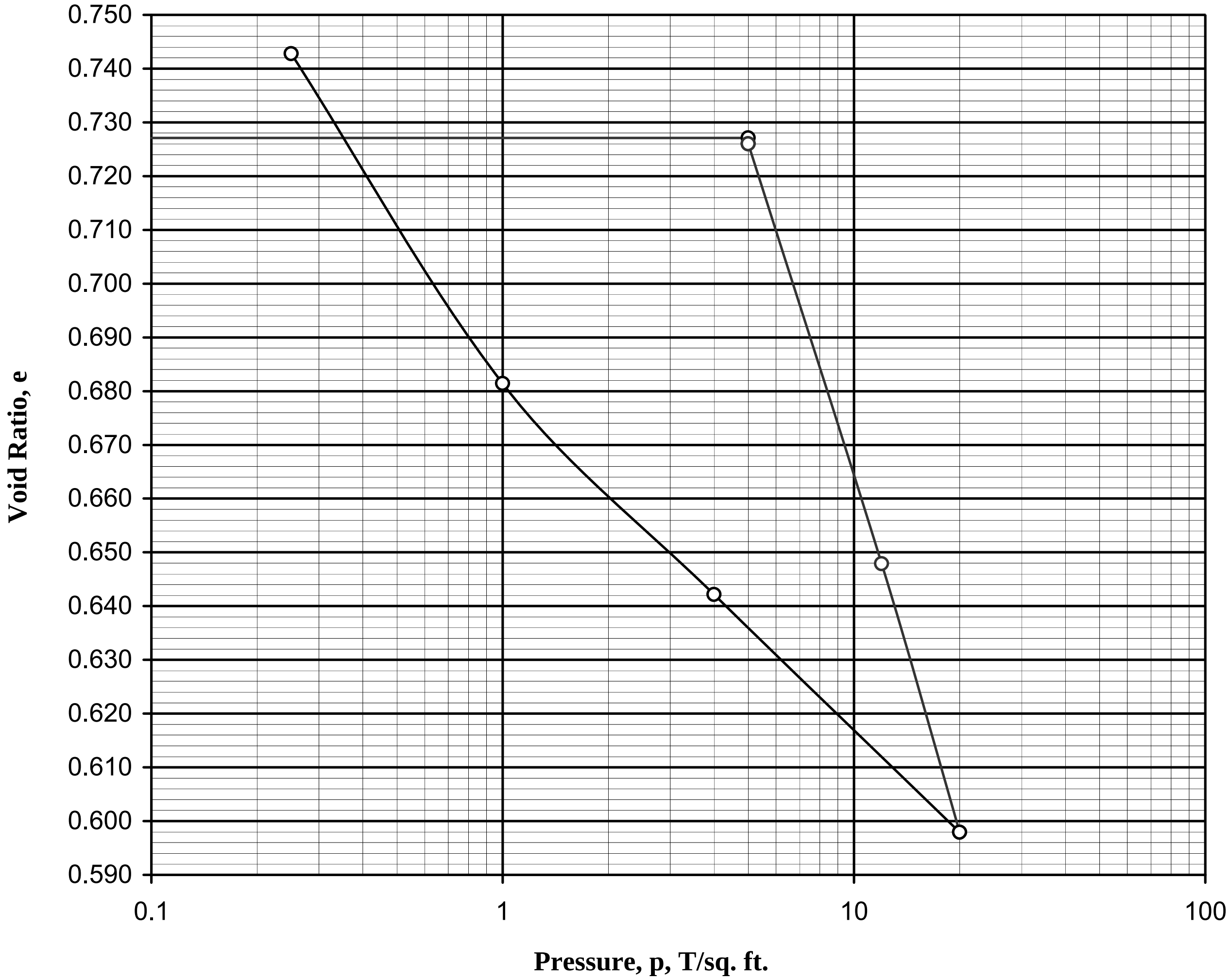


Type of specimen:	Undisturbed			Before Test		After Test	
Diam. 2.50 in.		Ht. 0.476 in.		Water Content, w_o	21.00%	W_f	22.82%
Overburden Pressure, P_o			T/sq. ft.	Void Ratio, e_o	0.5695	e_f	0.6164
Preconsol. Pressure, P_c			T/sq. ft.	Saturation, S_o	99.5%	S_f	100.0%
Compression Index, C_c				Dry Density, γd	107.3 lb/ft^3		
Classification	Tan weathered shale						
LL	63	G_s	2.700 (assumed)	Project	Fort Sam Houston AIT		
PL	20				Team Project No.:	082047	
Remarks				Boring No:	8A4C-1287	Sample No.:	C-3
				Depth:	49.1-50	Date:	9/1/08
				CONSOLIDATION TEST REPORT			

Tuesday, November 09, 2010

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing

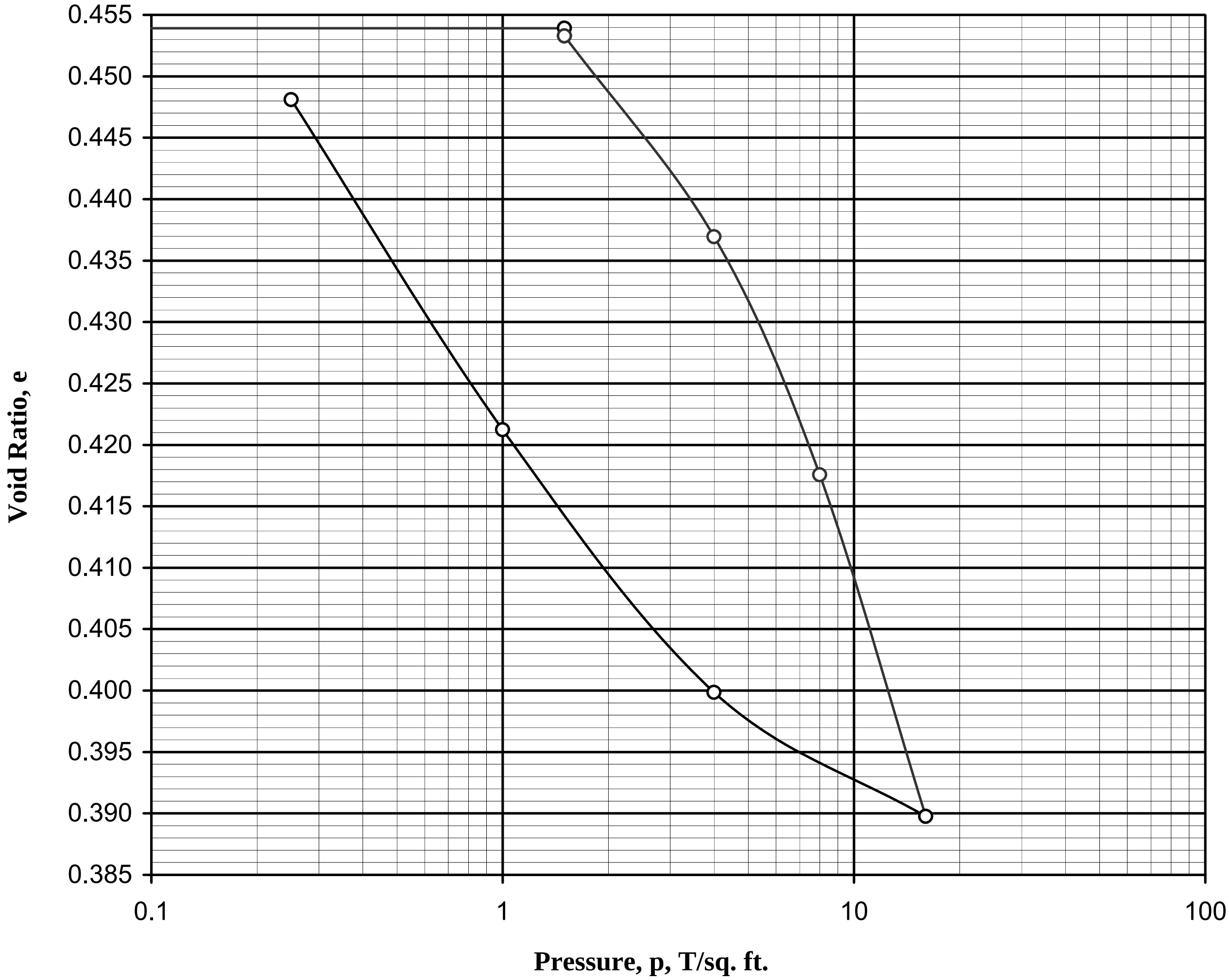


Type of specimen: Undisturbed		Before Test		After Test	
Diam. 2.50 in.	Ht. 0.484 in.	Water Content, w_o	17.96%	W_f	27.35%
Overburden Pressure, P_o T/sq. ft.		Void Ratio, e_o	0.7271	e_f	0.7428
Preconsol. Pressure, P_c T/sq. ft.		Saturation, S_o	66.7%	S_f	99.4%
Compression Index, C_c		Dry Density, γd	97.6 lb/ft^3		
Classification Dark brown clay					
LL 72	G_s 2.700 (assumed)	Project	Fort Sam Houston AIT		
PL 25			Team Project No.: 082047		
Remarks					
		Boring No:	8A4C-1287	Sample No.:	ST-1
		Depth:	2-4	Date:	8/22/08
		CONSOLIDATION TEST REPORT			

Tuesday, November 09, 2010

TEAM Consultants, Inc.

Geotechnical, Environmental, Construction Materials Testing



Type of specimen: Undisturbed		Before Test		After Test	
Diam. 2.50 in.	Ht. 0.476 in.	Water Content, w_o	15.18%	W_f	16.68%
Overburden Pressure, P_o T/sq. ft.		Void Ratio, e_o	0.4539	e_f	0.4481
Preconsol. Pressure, P_c T/sq. ft.		Saturation, S_o	90.3%	S_f	100.5%
Compression Index, C_c		Dry Density, γd	115.9 lb/ft^3		
Classification	Tan and light gray clay with sand				

LL 39	G_s 2.700 (assumed)	Project	Fort Sam Houston AIT
PL 15			Team Project No.: 082047
Remarks		Boring No: 8A4C-1287	Sample No.: ST-3
		Depth: 19-21	Date: 8/26/08
		CONSOLIDATION TEST REPORT	

Tuesday, November 09, 2010

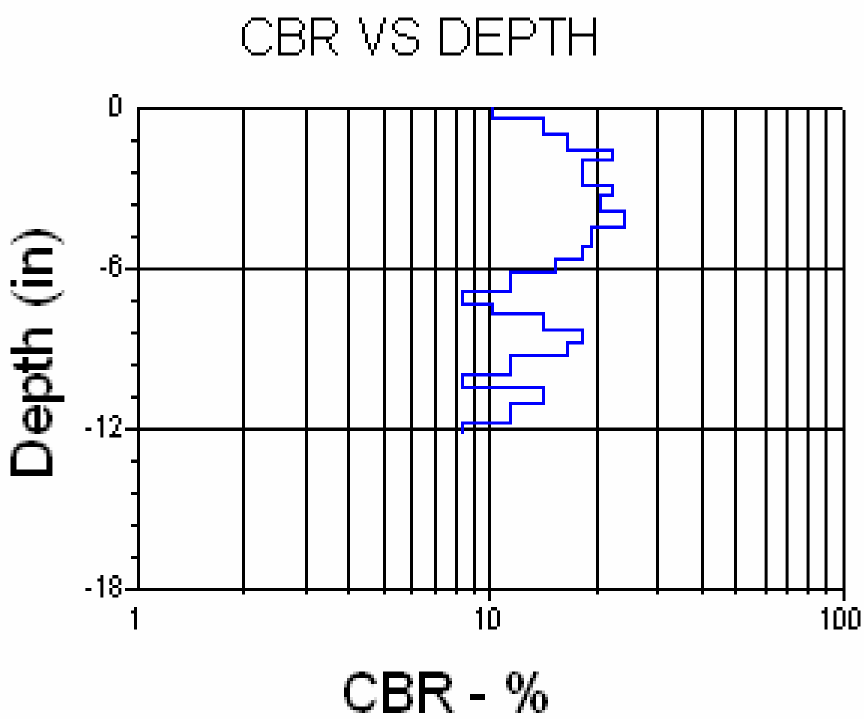
APPENDIX D

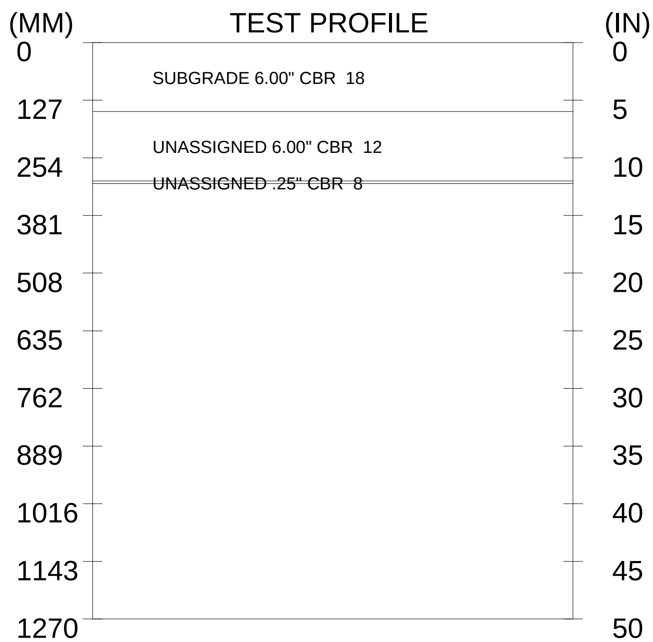
DYNAMIC CONE PENETROMETER (DCP) TESTING DATA PLOTS

DCP TEST DATA

Project: Advanced Individual Training Barracks Complex — Date: 26 June 2008

Feature: 10A-1273 — Station: 10A-1273

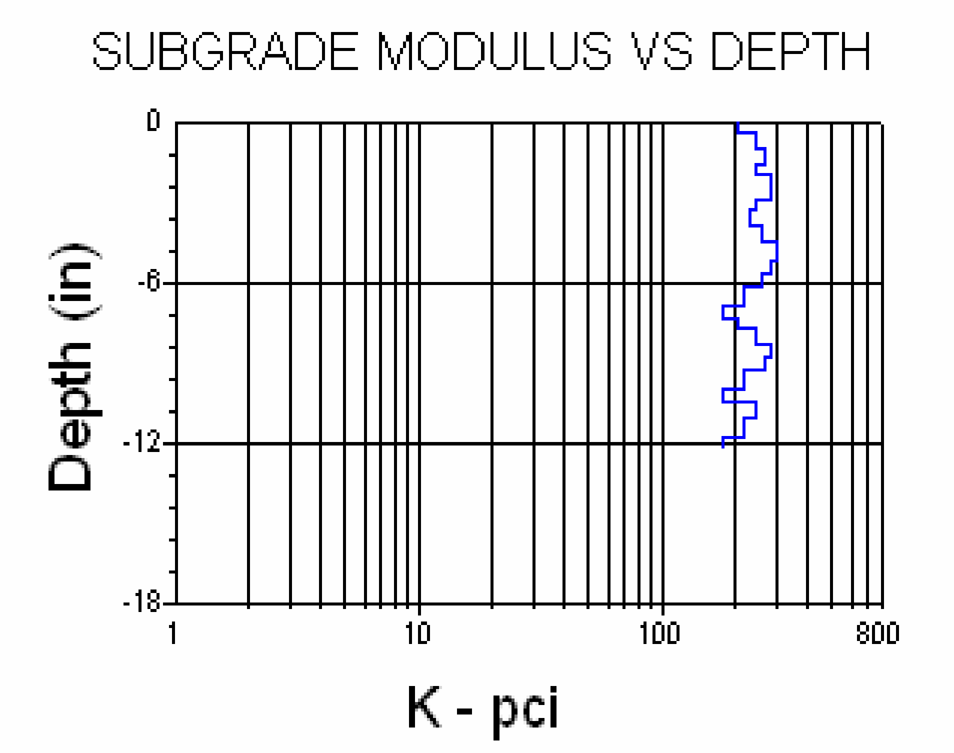


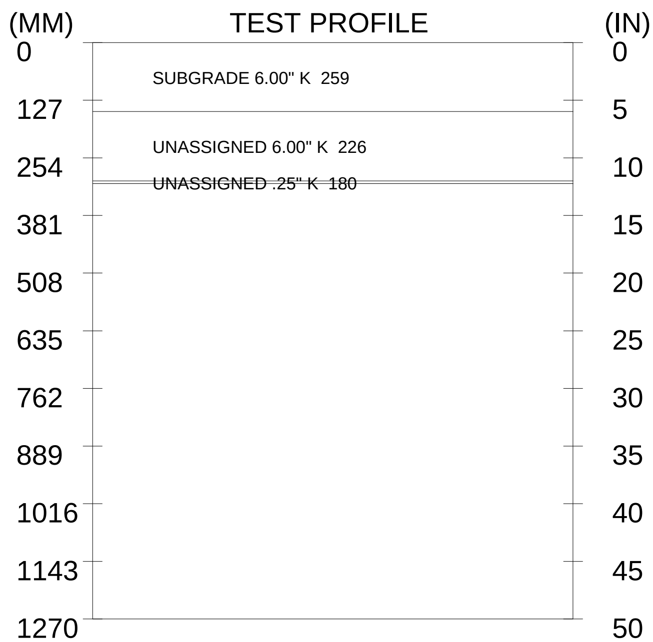


DCP TEST DATA

Project: Advanced Individual Training Barracks Complex Date: 26 June 2008

Feature: 10A-1273 Station: 10A-1273

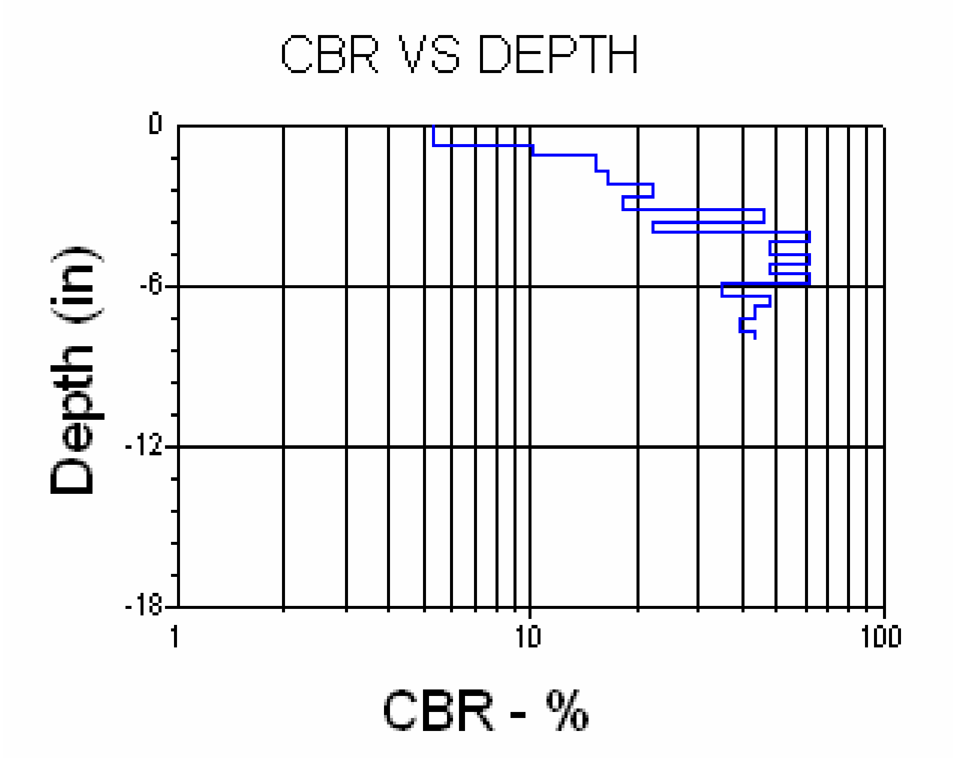


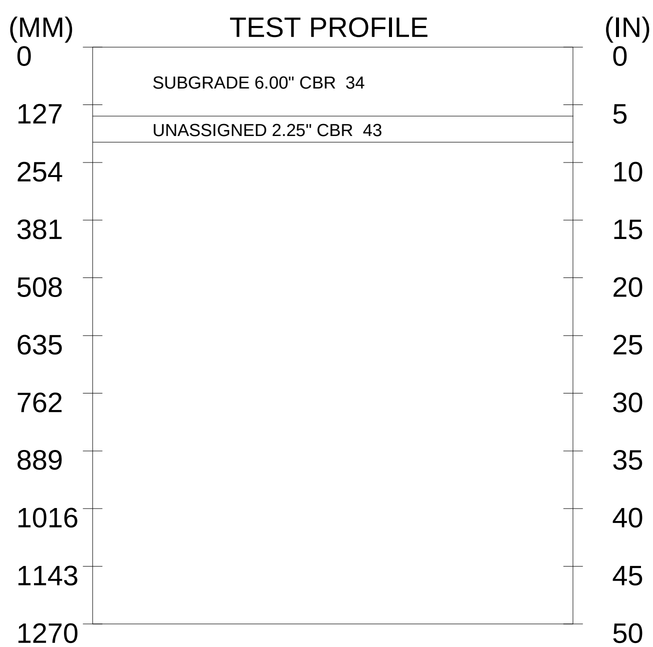


DCP TEST DATA

Project: Advanced Individual Training Barracks Complex   Date: 26 June 2008

Feature: 10A-1278   Station: 10A-1278





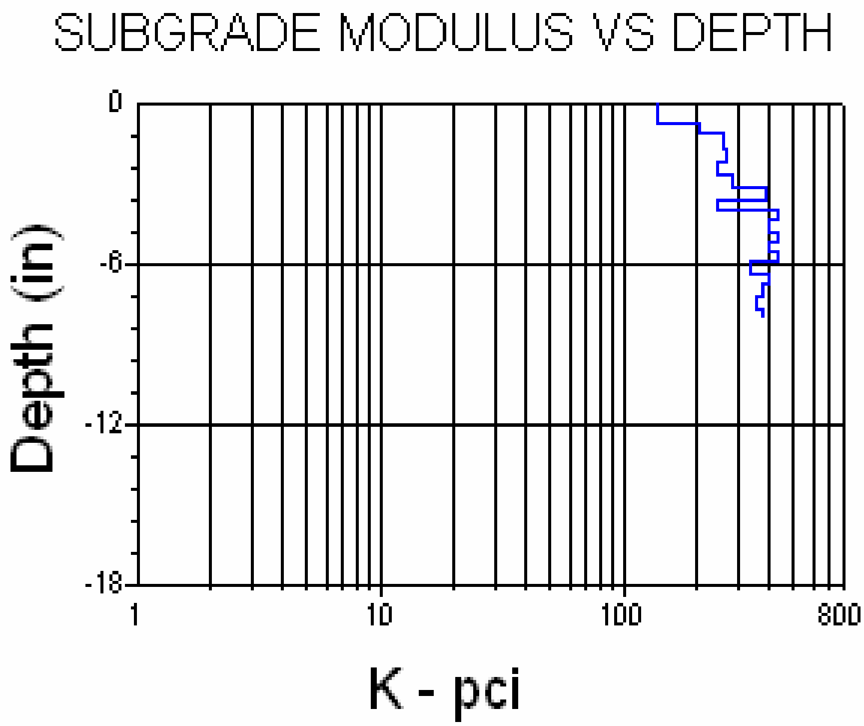
DCP TEST DATA

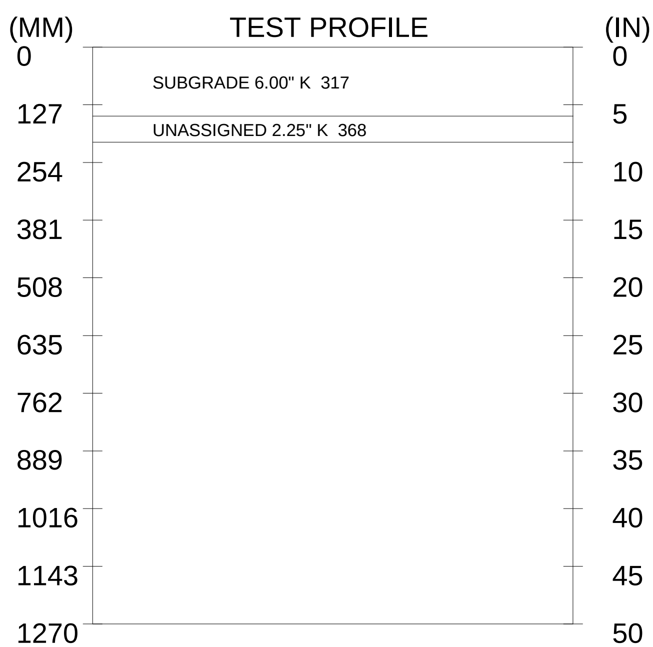
Project: Advanced Individual Training Barracks Complex

Date: 26 June 2008

Feature: 10A-1278

Station: 10A-1278





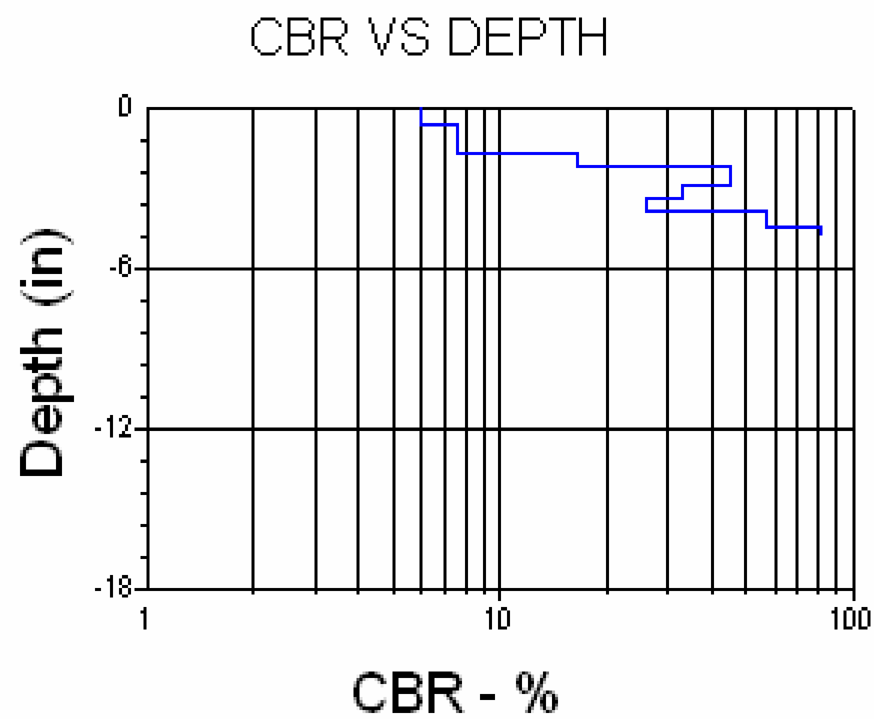
DCP TEST DATA

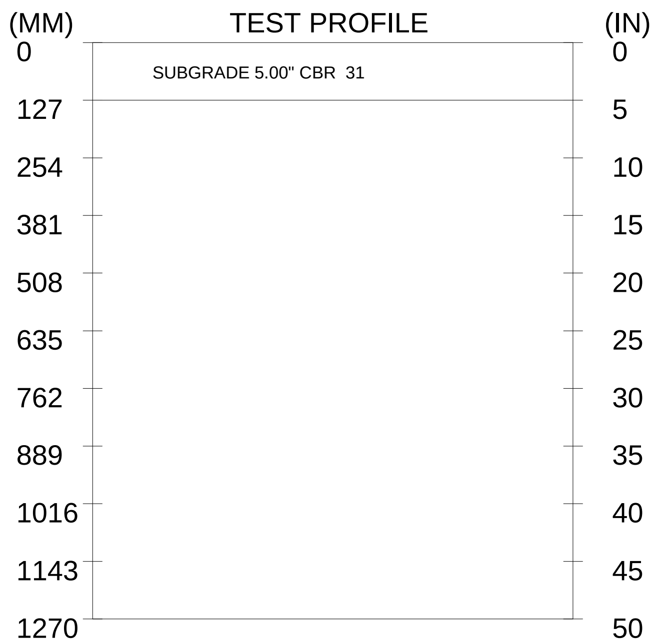
Project: Advanced Individual Training Barracks Complex

Date: 26 June 2008

Feature: 10A-1282

Station: 10A-1282





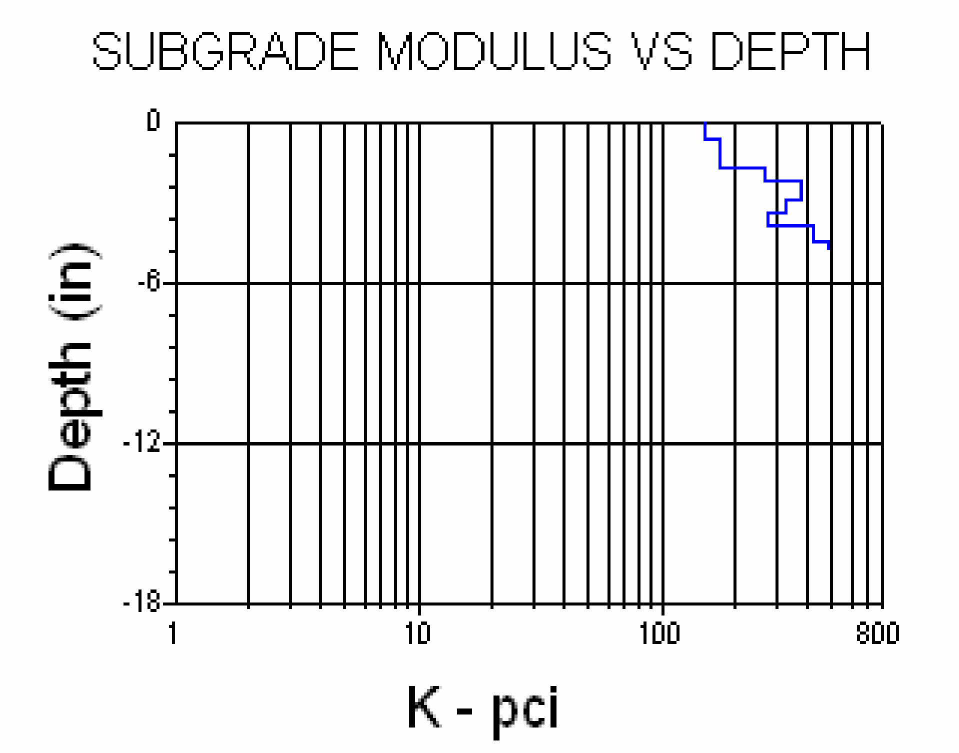
DCP TEST DATA

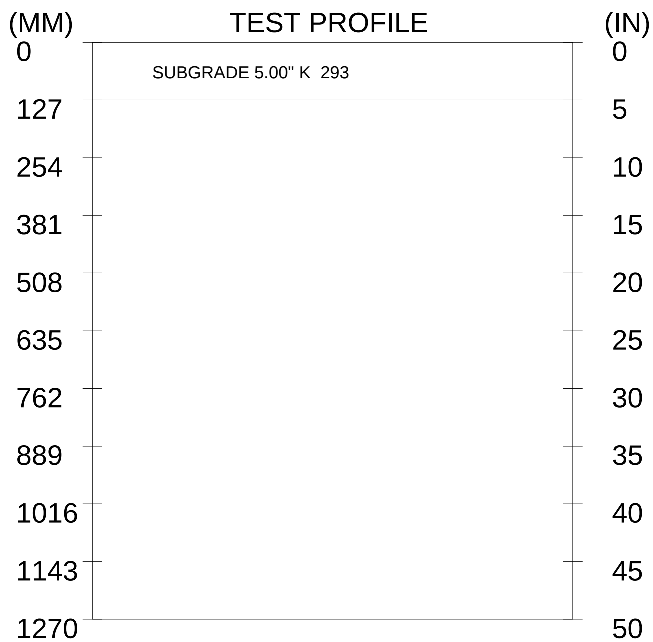
Project: Advanced Individual Training Barracks Complex

Date: 26 June 2008

Feature: 10A-1282

Station: 10A-1282

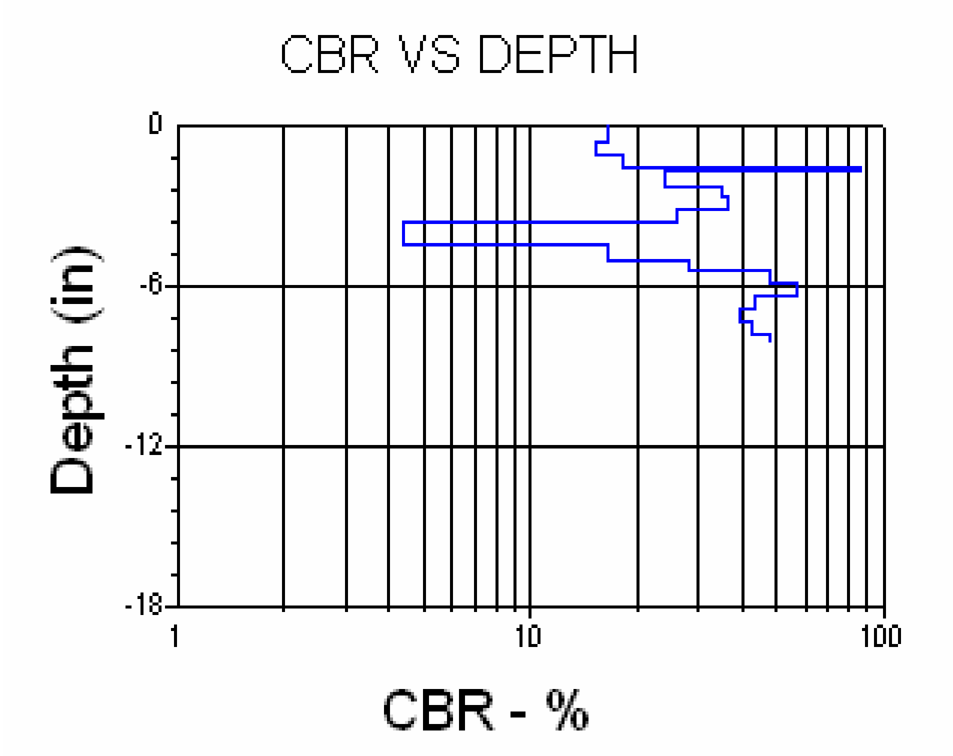


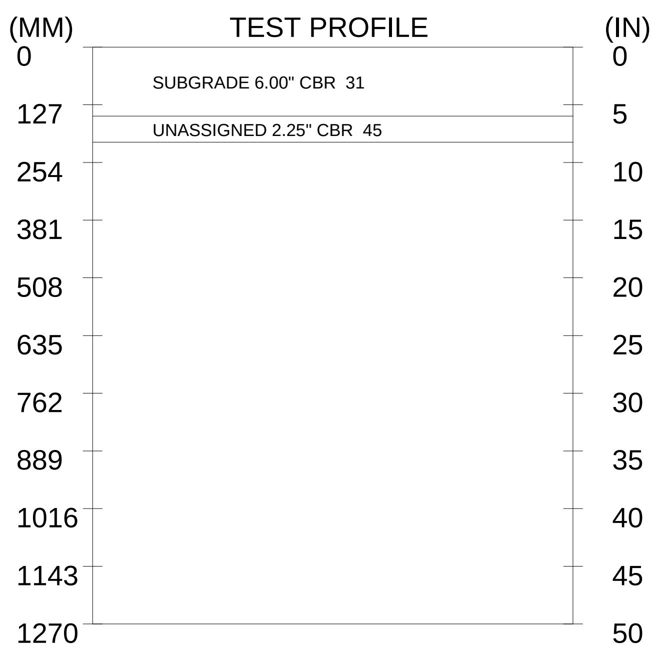


DCP TEST DATA

Project: Advanced Individual Training Barracks Complex | Date: 26 June 2008

Feature: 6A-1283 | Station: 6A-1283





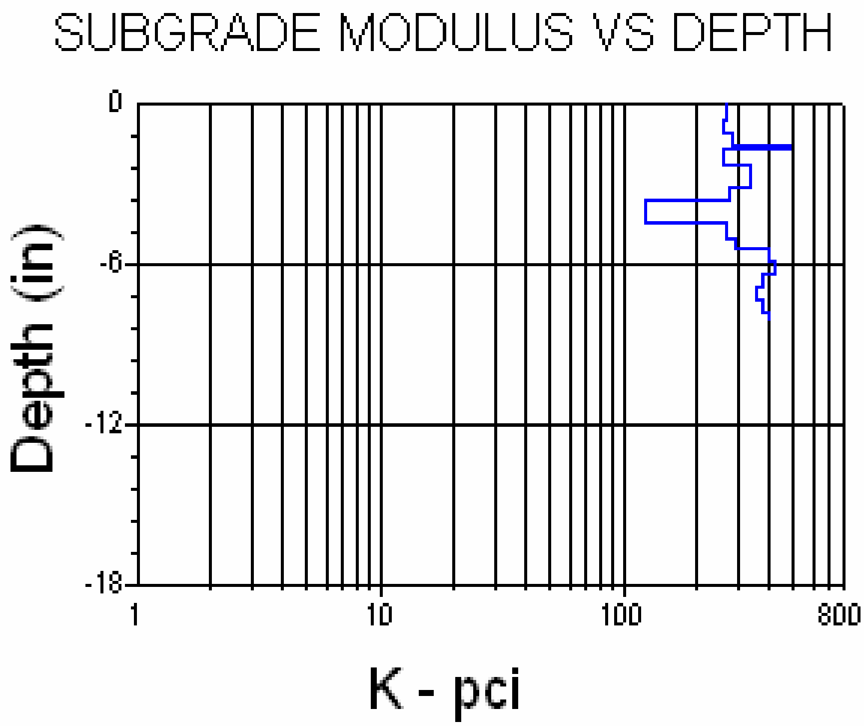
DCP TEST DATA

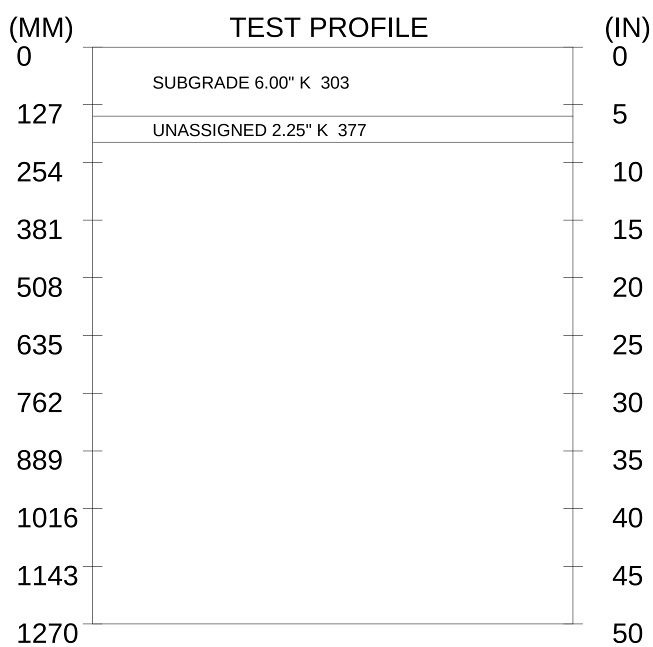
Project: Advanced Individual Training Barracks Complex

Date: 26 June 2008

Feature: 6A-1283

Station: 6A-1283





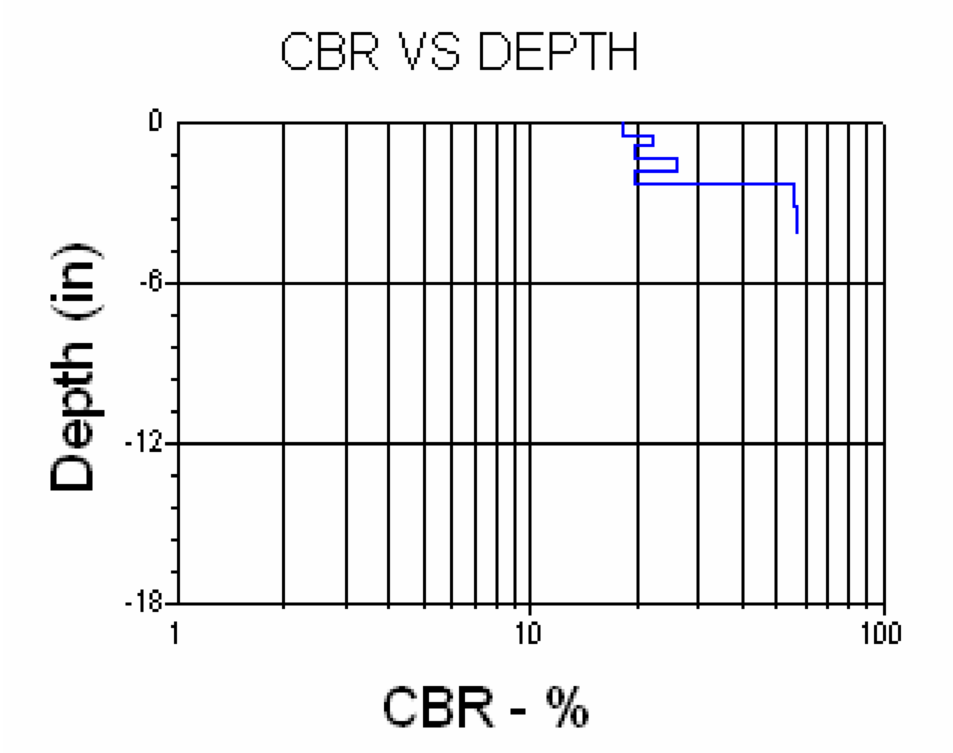
DCP TEST DATA

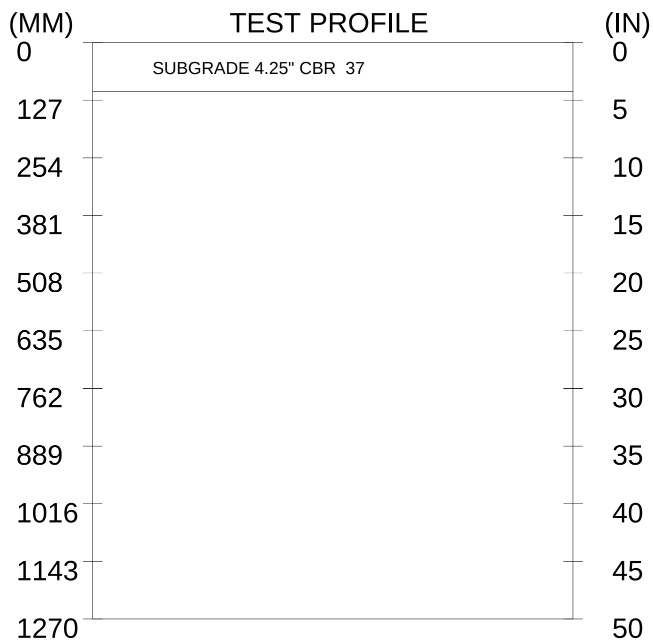
Project: Advanced Individual Training Barracks Complex

Date: 26 June 2008

Feature: 10A-1290

Station: 10A-1290

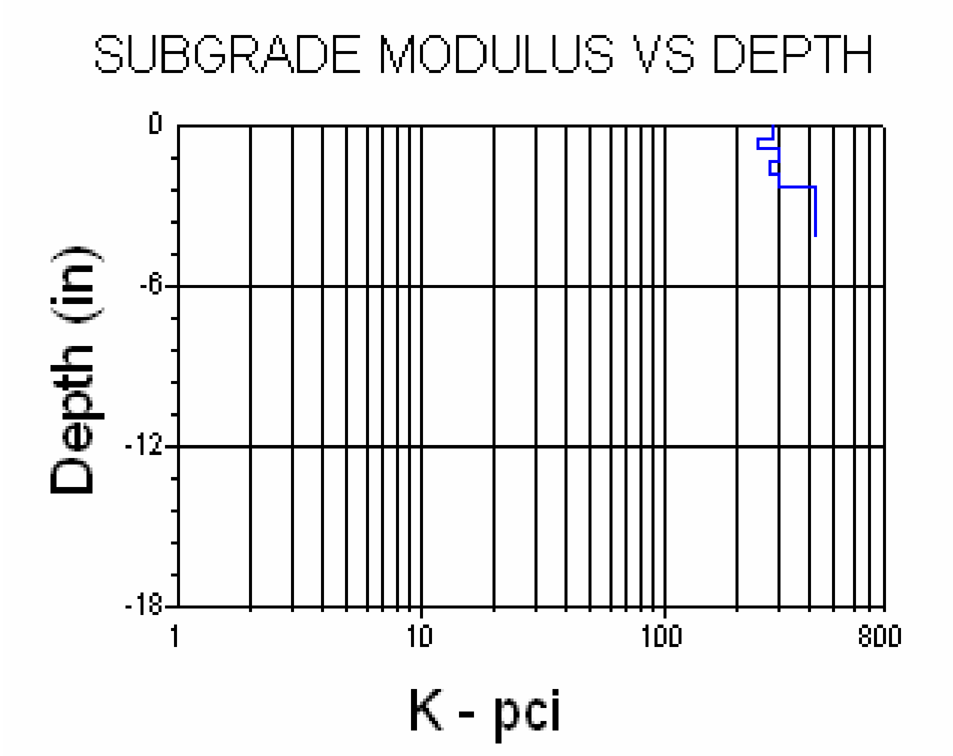


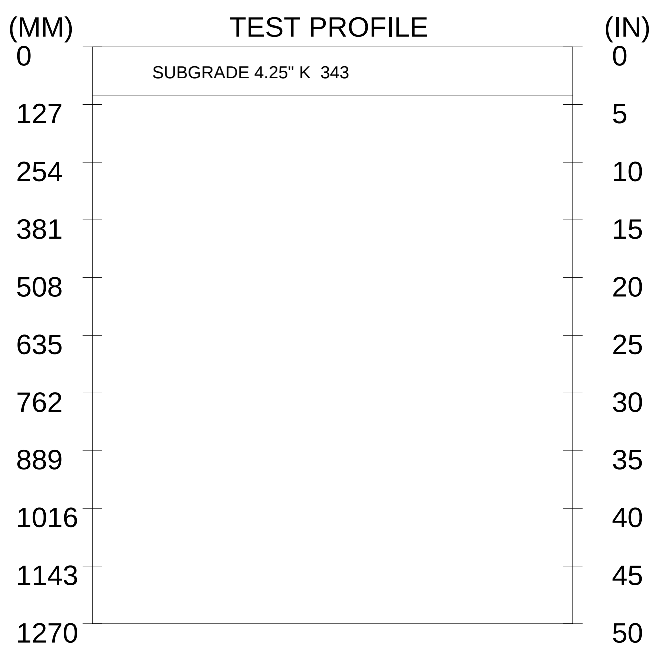


DCP TEST DATA

Project: Advanced Individual Training Barracks Complex Date: 26 June 2008

Feature: 10A-1290 Station: 10A-1290

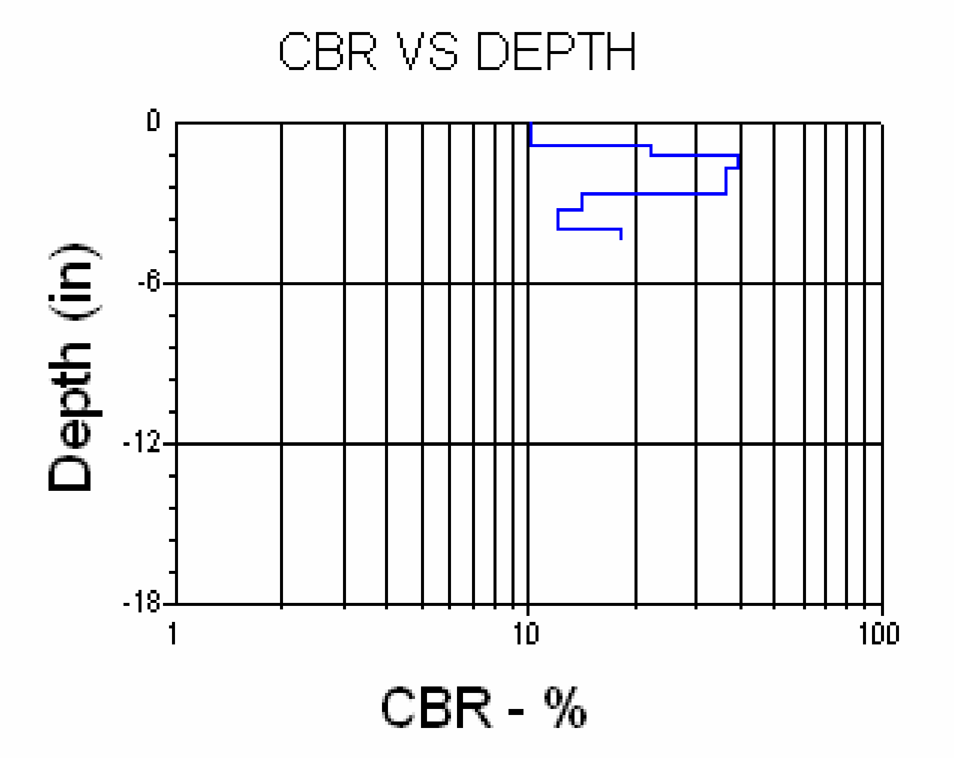


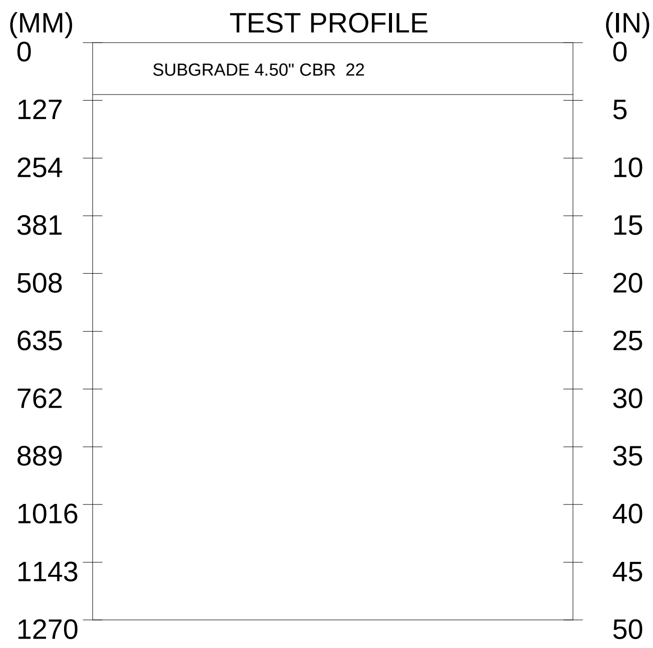


DCP TEST DATA

Project: Advanced Individual Training Barracks Complex Date: 26 June 2008

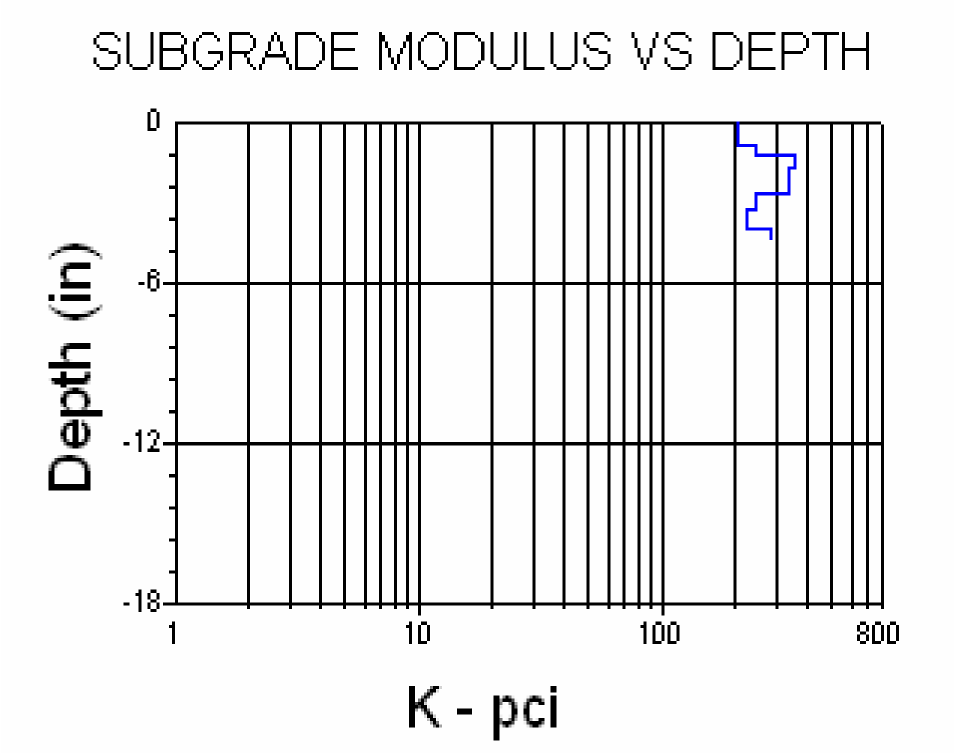
Feature: 10A-1292 Station: 10A-1292

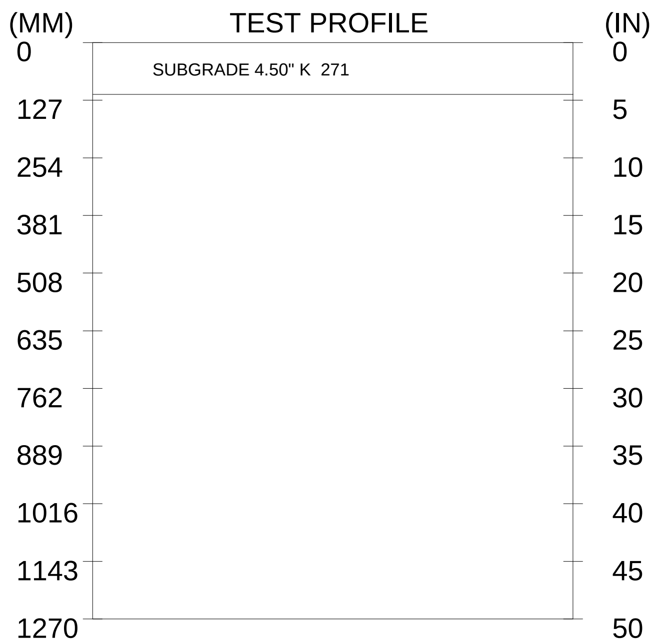




DCP TEST DATA

Project: Advanced Individual Training Barracks Complex
Date: 26 June 2008
Feature: 10A-1292
Station: 10A-1292





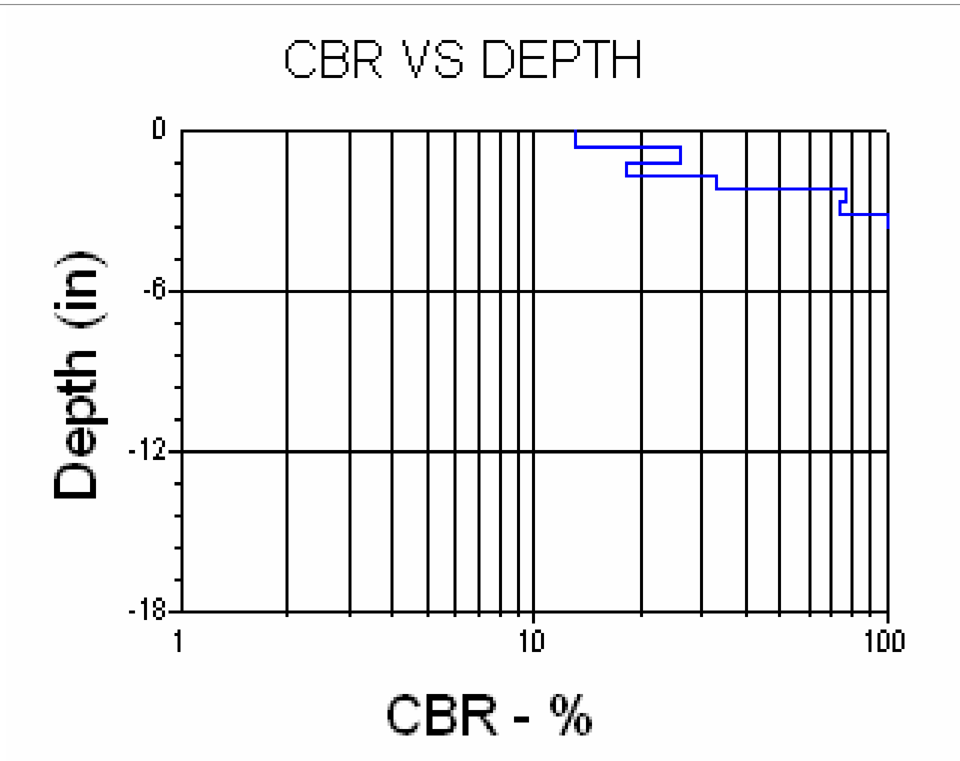
DCP TEST DATA

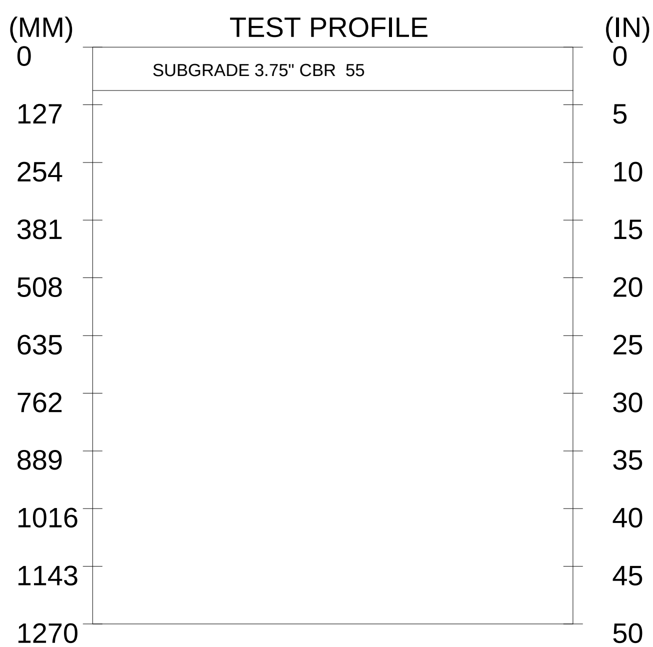
Project: Advanced Individual Training Barracks Complex

Date: 13 June 2008

Feature: 6A-1294

Station: 6A-1294





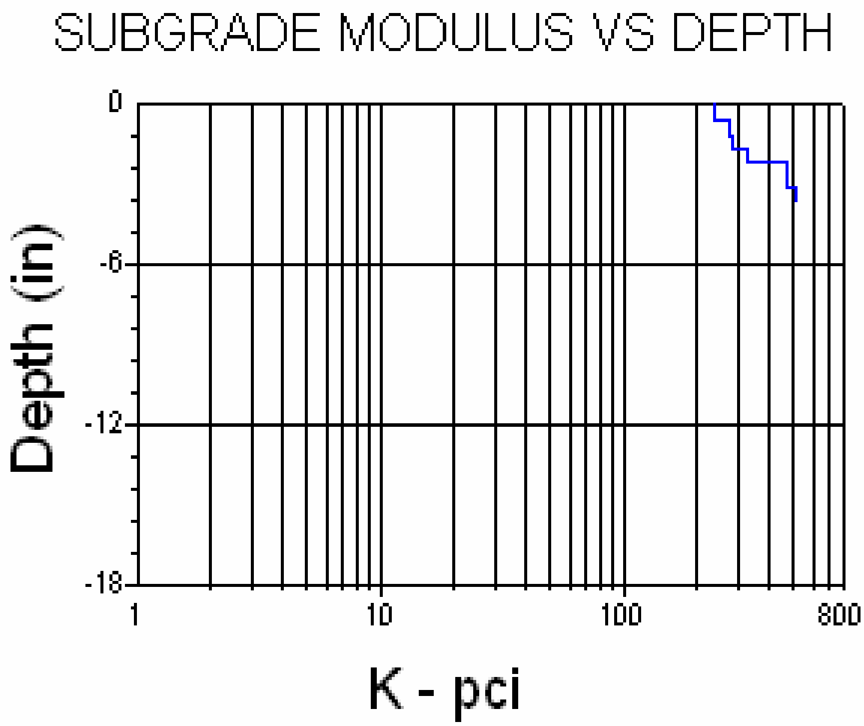
DCP TEST DATA

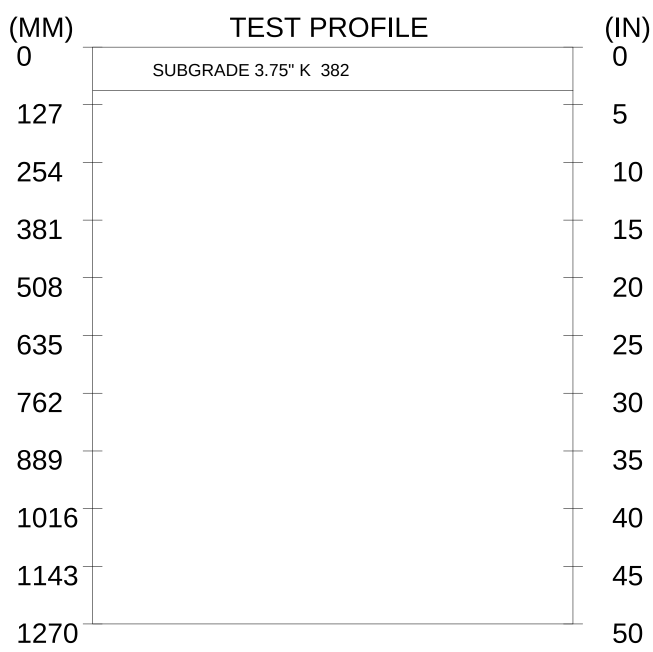
Project: Advanced Individual Training Barracks Complex

Date: 13 June 2008

Feature: 6A-1294

Station: 6A-1294





APPENDIX E

MAT FOUNDATION DESIGN CRITERIA

WALLACE

DEPARTMENT OF THE ARMY
SOUTHWESTERN DIVISION, CORPS OF ENGINEERS
1114 COMMERCE STREET
DALLAS, TEXAS 75242-0216

REPLY TO
ATTENTION OF

CESWD-ED-TS/G (415a)

29 JAN 1988

MEMORANDUM FOR:

Commander, Albuquerque District, ATTN: CESWA-ED
Commander, Fort Worth District, ATTN: CESWF-ED-DT
Commander, Galveston District, ATTN: CESWG-ED
Commander, Little Rock District, ATTN: CESWL-ED
Commander, Tulsa District, ATTN: CESWT-ED

SUBJECT: Design Criteria for Ribbed Mat Foundations

1. This letter supersedes criteria letter, SWDED-TS/G, 23 Dec 1986, SAB.

2. The enclosed criteria shall be used for design of all ribbed mat foundations. This criteria has been revised to conform with the definition of swell pressure (soil-beam interface pressure) as presented in criteria letter, SWDED-G, 16 Apr 1987, subject: Criteria for Developing Geotechnical Design Parameters for SWD Ribbed Mat Design Methodology. Also, clarification has been provided for application of the PTI design method to family housing.

3. This criteria is furnished to addressees only.

FOR THE COMMANDER:

William Jolus

Encl

ARTHUR D. DENYS, P.E.
Chief, Engineering Division

DESIGN OF RIBBED MAT FOUNDATIONS

BY

JOSEPH P. HARTMAN

AND

B. H. JAMES

U.S. ARMY CORPS OF ENGINEERS

SOUTHWESTERN DIVISION

DALLAS, TEXAS

REVISED

JANUARY 1988

CONTENTS

PART I - GENERAL REQUIREMENTS FOR RIBBED MATS

1. REFERENCES.

1.1 Engineering Instruction Manual, Corps of Engineers, Southwestern Division, (latest edition).

1.2 "Criteria for Selection and Design of Residential Slabs-on-Ground," Building Research Advisory Board (BRAB), Report No. 33 to the Federal Housing Administration, 1968.

1.3 "Design and Construction of Post-Tensioned Slabs-on-Ground," Post Tensioning Institute (PTI), 1980.

1.4 TM 5-818-7, Foundations in Expansive Soils, Corps of Engineers, 1983.

1.5 Letter, SWDED-G, 16 April 1987, Criteria for Developing Geotechnical Design Parameters for Ribbed Mat Design Methodology (Criteria Letter XV 7-12).

2. BACKGROUND. Ribbed mat foundations consist of a thin slab on grade which acts monolithically with a grid of stiffening beams beneath the slab. The beams (ribs) are cast in trenches dug in the foundation soil. Ribbed mats combine the economic advantages of shallow foundations with the performance advantages of monolithic floors. Ribbed mats are especially useful for minimizing differential foundation movements in areas with expansive soils.

3. DESIGN METHODS.

3.1 EXPANSIVE SOILS.

3.1.1 Behavior.

3.1.1.1 Center Lift. In the center lift condition the soil near the edge of the slab drops in relation to the soil near the center. This is due to moisture retention by the interior soils and the drying and shrinking of perimeter soils. As this occurs, the perimeter soil provides less support for the edge of the slab which then acts as a cantilever. This is illustrated in Figure A1 of Appendix A.

3.1.1.2 Edge Lift. In the edge lift condition the soil near the edge of the slab rises in relation to the soil near the center. This is due to the increasing moisture content and subsequent swelling of soil near the edge. The swelling soil raises the edge of the slab, causing some of the slab to lift off the soil. Interior loads cause the slab to sag and recontact the soil at some interior location. The slab thus tends to act as a beam, simply supported by the soil at the edge, and by soil towards the center of the slab. The amount of support at the center depends on numerous parameters such as interior loads, rib bending stiffness, soil swell pressures, and the magnitude of soil swelling. Typical edge lift behavior is illustrated in Figure A3 of Appendix A.

3.1.2 **SWD Method.** All ribbed mats on expansive soils, except for family housing, shall be designed in accordance with the provisions of Part II of this report. Ribbed mats for family housing may be designed in accordance with Part II or paragraphs 3.1.3 or 3.1.4.

3.1.3 **PTI Method.** The PTI method (reference 1.3) may only be used for design of family housing foundations on expansive soils. Specifically, slab width (short dimension) should not exceed 40 feet, rib depths should not exceed 30 inches, loading should consist only of perimeter loads and light interior distributed loads ($DL+LL \leq 100$ psf), soils should be fairly weak in-situ materials with no extensive substitution of non-expansive fill. When using the PTI method, the following provisions shall apply: Rib spacing shall not exceed 15 feet; concrete tensile stress shall not exceed $4\sqrt{f'c}$; the minimum effective prestress shall be 100 psi.

3.1.4 **BRAB Method.** The BRAB report (reference 1.2) may only be used for design of foundations for family housing. However, the PTI method is preferred, since the BRAB method may produce unreasonable results for large foundations.

3.1.5 Computer Method. In lieu of paragraph 3.1.2, ribbed mats may be designed using appropriate computer programs. Such programs must be capable of modeling the variable soil swell due to moisture changes, and the non-linear soil-structure interaction near the perimeter of the foundation. One such computer program is CBEAMC, program X0050 in the Corps of Engineers Civil Engineering Library.

3.1.6 Load Factors. When using the above methods to design ribbed mats for center lift and edge lift conditions, load factors may be multiplied by .75 (strength method) or allowable stresses may be increased by one-third (working stress method). This provision does not apply to the allowables given for the PTI method, since those allowables have already been increased from the usual provisions of ACI.

3.2 NON-EXPANSIVE SOILS. Ribbed mat slabs on non-expansive soils need not be designed for bending due to center lift or edge lift conditions. Beam on elastic foundation analyses may be used to determine the effects of concentrated loads on ribs, or ribs may be designed as conventional strip or spot footings.

3.3 SOIL PROPERTIES. Soil properties for design of ribbed mats will be provided in the Foundation Design Analysis by the Corps of Engineers. Criteria for developing these properties is included in reference 1.5. The properties necessary for design in accordance with paragraph 3.1.2 consist of the following, which are defined in Appendix A:

qa - allowable bearing pressure
k - subgrade modulus
Ym - soil heave
Lm - edge moisture variation distance
Psw - pressure of swelling soil acting on perimeter rib

4. MINIMUM REQUIREMENTS.

4.1 SUBGRADE PREPARATION. A vapor barrier, capillary water barrier, and a minimum of 18 inches of non-expansive fill will normally be used beneath ribbed mats. Additional non-expansive fill will often be used to lessen the effects of highly expansive soils. These requirements will be detailed in the Foundation Design Analysis.

4.2 SLAB. For family housing and other small lightly loaded buildings a 4 inch slab may be used. For other buildings the minimum slab thickness will be 5 inches. Minimum slab reinforcing shall be 0.2 percent. Where slabs are subjected to vehicular loading they must be designed for the maximum wheel load, similar to paving. Use 650 psi flexural strength concrete for slabs subject to wheel loads.

4.3 GRID GEOMETRY. Ribs should be located to form a continuous grid. Rib spacing should not exceed 20 feet in expansive soils, or 25 feet in non-expansive soils. Locations of ribs should conform to significant wall and column loads, and may be used to resist thrusts from rigid frame reactions. Ribs should be provided around large openings in the slab. In expansive soils diagonal ribs are required at exterior corners.

Expansion joints should be provided at 250 foot intervals, and should also be used to break irregularly shaped buildings into rectangular segments. Foundations for family housing do not require expansion joints due to irregular shapes.

4.4 RIB SIZE. Minimum rib depth is 20 inches. Rib depths should usually not exceed 3 feet to minimize construction difficulties related to placing reinforcement and maintaining trench walls. If deeper ribs are used, rib width should also be increased. Minimum rib width is 12 inches except for family housing foundations, where 10 inch ribs may be used. Sufficient rib width must also be provided to transfer wall and column loads to the soil as strip footings. The allowable soil bearing capacity may not be exceeded when considering the width of the rib plus an effective slab width on each side of the rib. The effective slab width for bearing is limited to the thickness of the slab. At column locations an alternate is to provide fillets at rib intersections, sufficient to act as spot footings for column loads.

4.5 RIB CAPACITY. Concrete should have a minimum compressive strength of f'c=3000 psi at 28 days. Reinforcing shall be grade 60, except ties may be grade 40. Minimum reinforcing ratio (As/Ag) shall be .0033 top and .0033 bottom, this may be reduced to .005 total in non-expansive soils. Use #3 ties at 24 inches, minimum. These minimums should be sufficient for shrinkage stresses and for unpredictable soil behavior.

4.6 PRESTRESSED MATS. For prestressed ribbed mats, not designed per PTI, all the above minimum requirements apply except that slab and rib top reinforcement may be deleted and replaced by appropriate post-tensioning strands. Mild steel shall still be provided in the bottom of ribs. Minimum effective prestress shall be 100 psi on the gross area of the slab, including effects of subgrade friction as calculated by the PTI method, reference 1.3. Concrete tensile stress shall be limited to $3\sqrt{f'c}$ and shear stress limited to $1.1\sqrt{f'c}$. A one-third overstress may be allowed per paragraph 3.1.6.

4.7 CONSTRUCTION DETAILS.

4.7.1 Conventionally Reinforced. Construction joint spacing should not exceed 50 feet in either direction. A horizontal construction joint may be provided in the ribs at the base of the capillary water barrier when unstable trench walls may cause construction difficulties. However, this joint is discouraged because of increased potential for shrinkage cracks in the slab.

4.7.2 Prestressed. Construction joint spacing shall not exceed 75 feet in either direction. Tendons within each placement shall be stressed to 15 percent of the final prestress not more than 24 hours after the concrete has attained sufficient strength to withstand the partial prestress. Other construction procedures for prestressed ribbed mats shall conform to reference 1.3.

4.7.3 Contractor Designs. Ribbed mat foundations may be designed as prestressed or conventionally reinforced as selected by the engineer. The plans and specifications shall not include the option of changing the ribbed mat from one type to another. The reason for this prohibition is that design parameters (e.g., moments of inertia) may be dependent on the type of ribbed mat being designed and may affect calculated shears and moments. This does not prohibit revisions of the slab type as a result of contractor value engineering proposals. However, such revisions must include a complete design of the ribbed mat foundation using appropriate design parameters in accordance with this report.

PART II - ANALYSIS OF RIBBED MAT FOUNDATIONS ON EXPANSIVE SOILS

1. SCOPE. This part of the report contains the basic rules for design of ribbed mats in expansive soils. This method may be used to predict shears, moments and deflections in ribs subject to soil movement due to changing moisture content. For a commentary on the design method refer to Appendix A; for example design calculations refer to Appendix B. The design method from Part II should be used in conjunction with the "minimum requirements" for ribbed mats, as presented in Part I.

2. GENERAL

2.1 NOTATION.

C = Correction factor for equivalent cantilever length
D = Beam deflection (IN)
I = Moment of inertia per foot, I=Ir/S (IN^4/FT)
Ir = Moment of inertia of rib (IN^4)
* k = Modulus of subgrade reaction (PCI)
Lo = Basic length of cantilever (FT)
Lc = Equivalent length of cantilever, center lift (FT)
Le = Equivalent length of simple beam, edge lift (FT)
Li = Distance from perimeter to location of interior load (FT)
* Lm = Edge moisture variation distance (FT)
Lb = Width of soil bearing at perimeter, edge lift (FT)
M = Bending moment per foot (FT-LB/FT)
Mr = Bending moment per rib, Mr=MxS (FT-LB)
Pi = Interior load (PLF)
Pp = Perimeter load (PLF)
* Psw = Pressure of swelling soil on perimeter rib (PSF)
R = End reaction at perimeter for equivalent simple beam (PLF)
S = Rib spacing (FT)
w = Uniform load (PSF)
V = Shear per foot (LB/FT)
Vr = Shear per rib, Vr=VxS (LB)
* Ym = Soil heave (IN)
θ = Rotation of support of equivalent cantilever (RAD)

* q_a = ALLOWABLE BEARING PRESSURE (PSF)

2.2 UNITS. The equations presented in section 3 are written for units as defined in the above notation. If other units are used the equations must be modified appropriately.

2.3 RIB DEFINITIONS. Ribs are defined as perimeter, transverse or diagonal as shown in Figure 1. Note that transverse refers to ribs parallel to either axis of the building.

* VALUES NEEDED FROM GEOTECH

FIGURE 1 - RIB DEFINITIONS

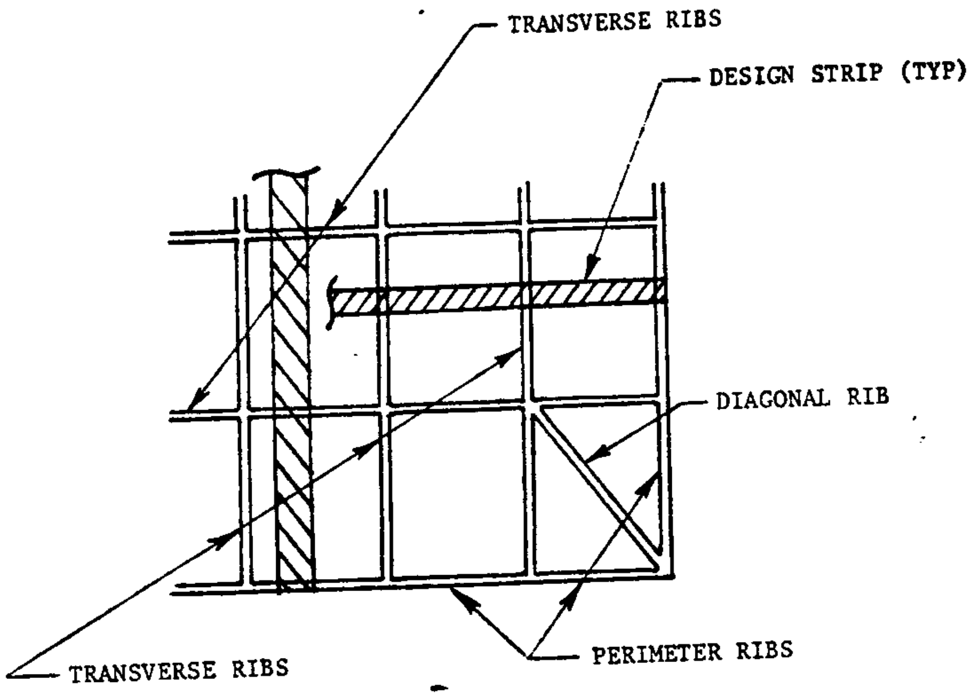
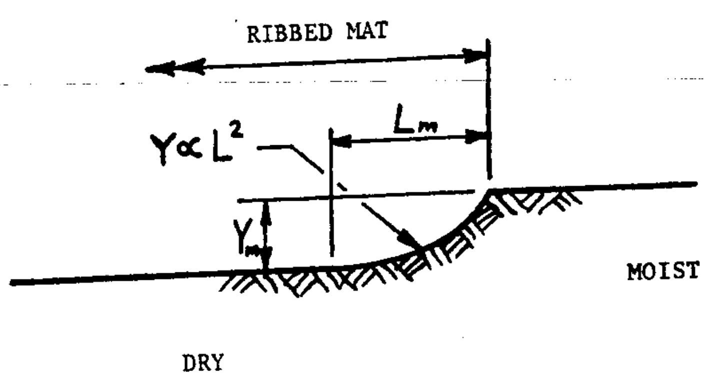


FIGURE 2 - SOIL EDGE PROFILE



2.4 STRIP ANALYSIS. The analysis is based on a strip assumption, ignoring the effects of the grid configuration of the ribs. The formulas and examples presented below are for an equivalent 1-foot strip, using "per foot" values for loads and stiffness.

2.5 SOIL EDGE PROFILE. For edge lift the maximum swell occurs at the perimeter and decreases rapidly toward the interior. The soil profile is assumed to be parabolic (in the unloaded condition) and is illustrated in Figure 2.

3. ANALYSIS METHOD.

3.1 TRANSVERSE RIB - CENTER LIFT.

3.1.1 General. Center lift analysis is based on an equivalent cantilever beam to determine moments, shears and deflections.

3.1.2 Moment. The length of the equivalent cantilever can be calculated as:

$$Lc = C \times Lo$$

where:

$$Lo = 2.3 + .4\ Lm$$

$$C = .8\ Ym^{.12}\ I^{.16} / Pp^{.12}$$

The maximum moment may then be calculated from statics using conventional cantilever formulas such as:

$$M = Pp\ Lc + 1/2\ w\ Lc^2$$

The moment can then be assumed to be constant for a distance Lc/2 and then to decrease linearly to zero at a distance 5Lc from the perimeter. To obtain the design moment for a given rib, multiply the calculated per-foot moment by the appropriate rib spacing (Mr = M x S).

3.1.3 Shear. The maximum shear may be calculated from statics using the same equivalent cantilever as for moment.

$$V = Pp + w\ Lc$$

The shear may then be assumed to decrease linearly from V at the cantilever support, to zero at a distance 5Lc from the perimeter. To obtain the design shear for a given rib, multiply the calculated per-foot shears by the appropriate rib spacing (Vr = V x S).

3.1.4 Deflection. Deflection at the perimeter is the sum of three components: bending deflection of the equivalent cantilever, vertical translation of the cantilever support, and rotation of the cantilever support. Rotation of the support may be calculated as:

$$\theta = M^{1.4} / 9800 \, I \, k^{.5}$$

The perimeter deflection is then:

$$D = .11 + 12 \, Lc \, \theta$$

where .11 inches is an approximation for the support translation plus the cantilever bending, and (12 Lc) is the length in inches.

Use the deflection calculated above to compare with allowable deflection. The allowable deflection may be determined by using 4Lc as the length between points of zero and maximum deflection.

3.2 TRANSVERSE RIB - EDGE LIFT.

3.2.1 General. Edge lift analysis is based on an equivalent simple beam, supported at the perimeter and at some interior location.

3.2.2 Deflection. The first step in calculating deflection is to determine the length of the equivalent simple beam. The appropriate length depends on many parameters, including the deflection. Therefore, deflection must first be estimated to determine equivalent length, then a deflection is calculated based on that length. The process is repeated until calculated deflection matches the assumed deflection. The equivalent simple beam length may be calculated as:

$$Le = 7.5 \, I^{.17} \, Li^{.37} \, D^{.12} / w^{.07} \, Pi^{.11}$$

The perimeter end reaction for this beam may be calculated from statics. For a given case the reaction may be:

$$R = Pp + 1/2 \, w \, Le + Pi(Le-Li)/Le$$

The width of soil bearing at the perimeter can be approximated as:

$$Lb = 1.1 \, (R/Psw)$$

where Psw is selected from a curve of heave versus bearing pressure, corresponding to the estimated deflection used during this iteration (see reference 1.5).

The edge deflection is found by determining the soil swell at a distance Lb from the perimeter, based on the parabolic swell profile:

$$D = Ym(Lm-Lb)^2/Lm^2$$

When satisfying deflection criteria, use the calculated deflection and equivalent simple beam length.

3.2.3 Moment. Once the simple beam equivalent length has been determined, the bending moments may be calculated based on statics. To obtain rib design moments, multiply per-foot moments by the rib spacing.

3.2.4 Shear. Once the simple beam equivalent length has been determined, the shears may be calculated based on statics. To obtain rib design shears, multiply per-foot shears by the rib spacing. Near the interior support the design shear need not exceed:

$$V = Pi + w(Le-Li)$$

This is due to the effects of the actual distributed soil support, rather than the point support assumed in the simple beam analysis.

3.2.5 Special Cases. If Pi=0 or if Li>Le make the following substitution in the equation for Le:

$$1.4 = Li^{.37} / Pi^{.11}$$

The equation for the simple beam length then becomes:

$$Le = 10.5\ I^{.17}\ D^{.12} / w^{.07}$$

3.3 PERIMETER RIB.

3.3.1 Center Lift. For center lift the perimeter rib will have no support from the soil and must be designed to span between transverse ribs for the perimeter wall loads.

3.3.2 Edge Lift. For edge lift the soil pressure on the perimeter rib will exceed the applied perimeter loads. The perimeter rib must designed to span between transverse ribs for this net upward force.

3.4 DIAGONAL RIB. Diagonal ribs are used to support exterior corners for center lift conditions, if loss of support occurs under both perimeter ribs. Diagonal ribs must be designed to provide the same moment and shear capacity as the larger of the two adjacent transverse ribs.

3.5 INTERIOR RIB. Interior ribs and rib intersections should be located at significant wall and column loads. The ribs can be designed for these loads as strip or spot footings, using beam-on-elastic-foundation methods. Differential soil movement due to moisture change is assumed not to occur except at the perimeter. However, to account for unpredictable interior soil movements, interior ribs must have the minimum size and capacity as required in Part I.

APPENDIX A - COMMENTARY ON PART II

1. SCOPE. Actual behavior of ribbed mats in expansive soils involves complex, non-linear, soil-structure interaction. The best solution for such behavior is provided by computer programs. The hand design method has been developed to approximate such computer results. Hand solutions have been checked by computer analyses; results have been within acceptable limits of error. However, such checks have been made only for a limited range for each design parameter, as shown in Table A1, corresponding to the usual values for military construction within Southwestern Division. If a wider range of parameters is applied to the hand design formulas, the results may be less accurate.

TABLE A1

Parameter	Units	Minimum	Maximum
k	pci	50	200
Ym	in	0.5	3.0
Lm	ft	2	8
I	in^4/ft	750	6000
Pp	lb/ft	1000	5000
Pi	lb/ft	0	5000
Li	ft	6	20
w	psf	100	250
Psw	psf	2000	8000

2. GENERAL.

2.1 NOTATION.

Ir = moment of inertia of rib. For non-prestressed rib mats Ir should be the effective moment of inertia, calculated per ACI 318, Section 9.5.2.3.

k = Modulus of subgrade reaction. This parameter is the ratio of the soil pressure at the base of the concrete and the corresponding settlement. Since modulus values are typically determined by plate-load test at the ground surface, they should be corrected for depth and for footing size (expected high pressure area between concrete and soil). Analyses have indicated that the high bearing pressure area for center lift conditions will occur in an area several feet long parallel to the transverse rib and several feet on each side of the rib. A crude approximation for this area would be 5 feet square. This approximation should be adequate for design, since calcualations are not sensitive to small changes in the modulus of subgrade reaction.

qa = Allowable bearing pressure. This is the safe bearing capacity of the soil at the base of the ribs. A factor of safety of 3.0 is recommended for computing this value.

Lm = Edge moisture variation distance. This represents the distance, inward from the edge of the slab, over which the moisture content of the soil changes. Much judgement is required in determining this value.

Psw = Pressure of swelling soil on perimeter rib. This is the interface pressure between the soil and the base of the exterior rib, due to an increase in soil moisture content. The pressure which can be exerted by the swelling soil is dependent on the amount the surface of the soil is allowed to rise. Therefore Psw is usually presented as a curve of pressure versus heave, as described in reference 1.5 of Part I. The actual upward deflection of the edge of the slab is a complex interaction between swell potential, structural loads, and mat stiffness, all of which combine to determine the interface pressure near the perimeter.

Ym = Soil heave. This is the differential vertical movement of the soil representing either soil heave (edge lift) or soil shrinkage (center lift). The magnitude of Ym is the computed vertical movement of a particle of soil at the ground surface due to a change in moisture content. This value should be based on the accumulation of potential volume changes for the full thickness of the active zone (Za), with no significant loads applied to the foundation. The value of Ym may differ for edge lift and center lift conditions.

Pi, Pp, w = Applied loads. Loads should consist of full dead plus live loads, including dead load of the slab and ribs.

2.2 UNITS.

2.3 RIB DEFINITIONS.

2.4 STRIP ANALYSIS. The hand solution formulas have been developed for analysis of an equivalent 1 foot strip. This is convenient for uniform loads and for soil properties, but requires some calculations for appropriate concentrated loads and bending stiffness. Rib stiffness must be divided by rib spacing to get the per-foot stiffness. If column loads exist they must also be divided by the rib or column spacing to provide an equivalent load per foot. If interior wall loads are parallel to the transverse rib, they must be divided by the rib spacing. These calculations are illustrated in Appendix B.

2.5 SOIL EDGE PROFILE. The edge lift condition occurs when increased moisture content swells exterior soils, and this effect extends under the edge of the slab. The center lift condition occurs when soils under the slab are generally moist and seasonal drying occurs on the exterior, again extending under the slab. This causes the soil to shrink away from the edge of the slab.

The analysis method is based on an assumed parabolic swell profile which occurs uniformly along the perimeter. This is a convenient idealization of actual soil behavior, which is certainly more erratic. However, the parabolic profile has better correlation with measured swells than do other possible edge profile assumptions. Note that the soil profile is not used in the hand design formulas for center lift. However, a parabolic profile was used in the computer analyses for center lift, which formed the basis for the hand design forumlas.

3. ANALYSIS METHOD. Many of the formulas for shears, moments and reactions are idealized, assuming Pp and R are exactly at the perimeter and that w extends to the perimeter. These approximations should usually be acceptable, but the formulas may be modified to account for actual load patterns.

3.1 TRANSVERSE RIB - CENTER LIFT

3.1.1 General. Typical behavior of a transverse rib for center lift conditions is shown in Figure A1. This illustrates the soil bearing pressure and the shear, moment and deflection. Note that the effects of the soil movement extend much farther than the moisture variation distance. The moment and shear distribution close to the edge resemble cantilever behavior.

3.1.2 Moment. The extent of significant moments is illustrated in Figure A1. The length of the equivalent cantilever can be taken as a basic length (Lo) which is dependent on the moisture variation distance, times a correction factor (C) which accounts for secondary effects of several parameters. The value of the correction factor will usually be slightly greater or less than unity. The correction factor was developed to permit accurate approximations of computer results. It was developed from the ratios of actual values to usual values for significant parameters. For example, the "usual" values are: Ym = 1 in, I = 1500 in^4/ft, Pp = 3000 lb/ft. Thus:

$$C = (Ym/1.0)^{.12} (I/1500)^{.16} (3000/Pp)^{.12}$$

$$C = .8\ Ym^{.12}\ I^{.16} / Pp^{.12}$$

A similar approach was used to develop all the formulas in Part II which have an exponential format.

3.1.3 Shear. Maximum shear occurs near the support of the equivalent cantilever. The extent of significant shears is illustrated in Figure A1.

3.1.4 Deflection. Formulas for deflection include an assumed concrete modulus of elasticity Ec = 3,320,000 psi, for both center lift and edge lift.

Vertical movement at the perimeter is much greater than the bending deflection of the equivalent cantilever. To predict the deflection it is necessary to consider translation and rotation at the support of the equivalent beam. The most significant component is due to rotation at the support. These components of deflection are shown in Figure A2. The sum of the cantilever bending and the support translation are approximated by the value 0.11 inch. The percent error due to this approximation is negligible when total deflections are large. The percent error is greater when total deflections are small, but then the deflections are not significant anyway.

Allowable deflections (see Part I, reference 1.1) are expressed as a ratio of the difference in vertical movement at any two points, compared to the distance between those points. For example: $D \leq L/600$, where D is the differential displacement. In such formulas it is appropriate to use the point of maximum deflection and a point of near-zero deflection as the two measuring points. For center lift behavior the maximum deflection occurs at the perimeter, and deflections tend to die out at approximately 4Lc (four times the equivalent cantilever length) from the perimeter. Therefore, the ratio D/4Lc is appropriate for comparison with allowable deflections.

3.2 TRANSVERSE RIB - EDGE LIFT.

3.2.1 General. Typical behavior of a transverse rib for edge lift conditions is shown in Figure A3. This illustrates the soil bearing pressure and the shear, moment and deflection. Soil swell lifts the edge of the ribbed mat, which actually rises off the soil for some distance from the perimeter. For shear and moment, this portion of the rib acts as a simply supported beam spanning between soil support at the perimeter and at an interior location.

3.2.2 Deflection. Vertical movement at the perimeter is driven by the tendency of the soil to swell, and is resisted by the downward loads applied on the soil. As the soil swells at the perimeter the slab is lifted off the interior soil. This concentrates soil reactions near the edge, causing very high pressures. The pressures rise so high that they limit the capacity of the soil to swell. Thus, the soil cannot swell as much as it would if not loaded. Deflections can be predicted by balancing the upward force of the soil (the swell pressure times the bearing width) with the downward force of applied loads. This downward force can be determined from statics once an equivalent simple beam length is determined. The method for determining the deflection is shown in Figure A4.

Allowable deflections are expressed as ratios, as discussed in the commentary on paragraph 3.1.4. From Figure A3 it can be seen that the appropriate values for this ratio are the edge deflection and the equivalent simple beam length (D/Lc).

Edge lift deflections are mainly a function of soil properties and applied loads, bending stiffness of the ribs has only a secondary effect. Therefore, it may not be possible to control deflections by increasing the rib stiffness. It may be necessary to accommodate calculated deflections by using a less brittle superstructure or by detailing the superstructure to make it less sensitive to deflections. Or it may be necessary to modify soil properties to minimize the edge heave.

3.2.3 Moment. The moments can be calculated by statics, using the equivalent simple beam. The maximum moment will occur at the point of zero shear. Note that the maximum moment is quite sensitive to the beam length, therefore the iterative solution for deflection and appropriate swell pressure must converge accurately before calculating moments.

3.2.4 Shear. Shears can also be calculated by statics from the equivalent simple beam. Note that shears will reduce gradually to near-zero around the interior end of the beam because of the distributed soil support.

3.2.5 Special Cases. If no concentrated interior load exists, or if it is very far from the perimeter, the formula for the simple beam length must be adjusted as shown. This adjusted formula was also developed to duplicate results from computer solutions.

3.3 PERIMETER RIB.

3.4 DIAGONAL RIB.

3.5 INTERIOR RIB. Potential soil heaves in the interior are unpredicatable and are generally due to localized moisture conditions, for example, due to a leaking pipe. Such conditions cannot be accounted for by design forumlas. Adequate strength and stiffness for such unpredictable heaves should be supplied by the minimum requirements listed in Part I of the report. For interior wall or column loads the interior ribs should be designed in accordance with Part I, section 3.2.

FIGURE A1 - CENTER LIFT BEHAVIOR

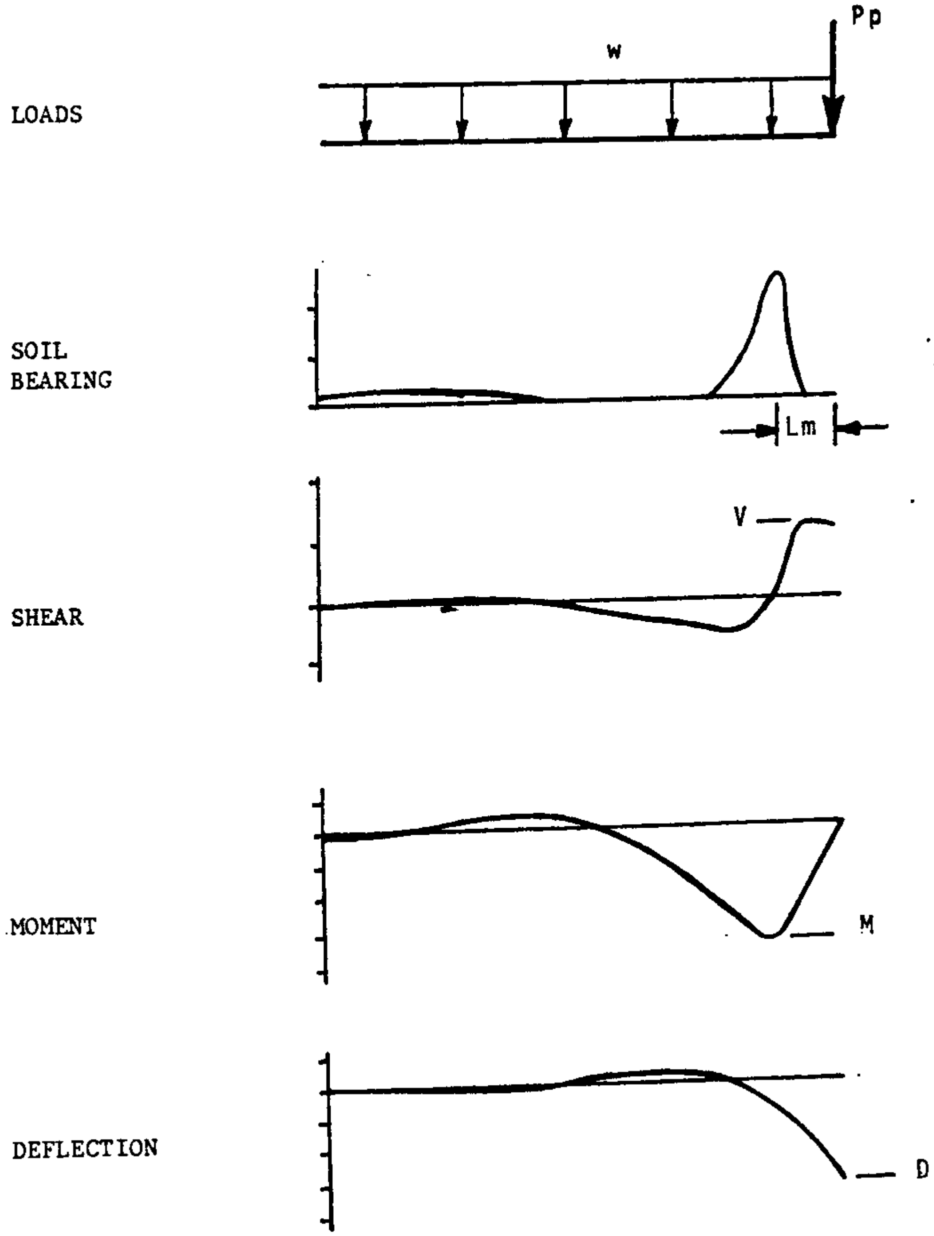
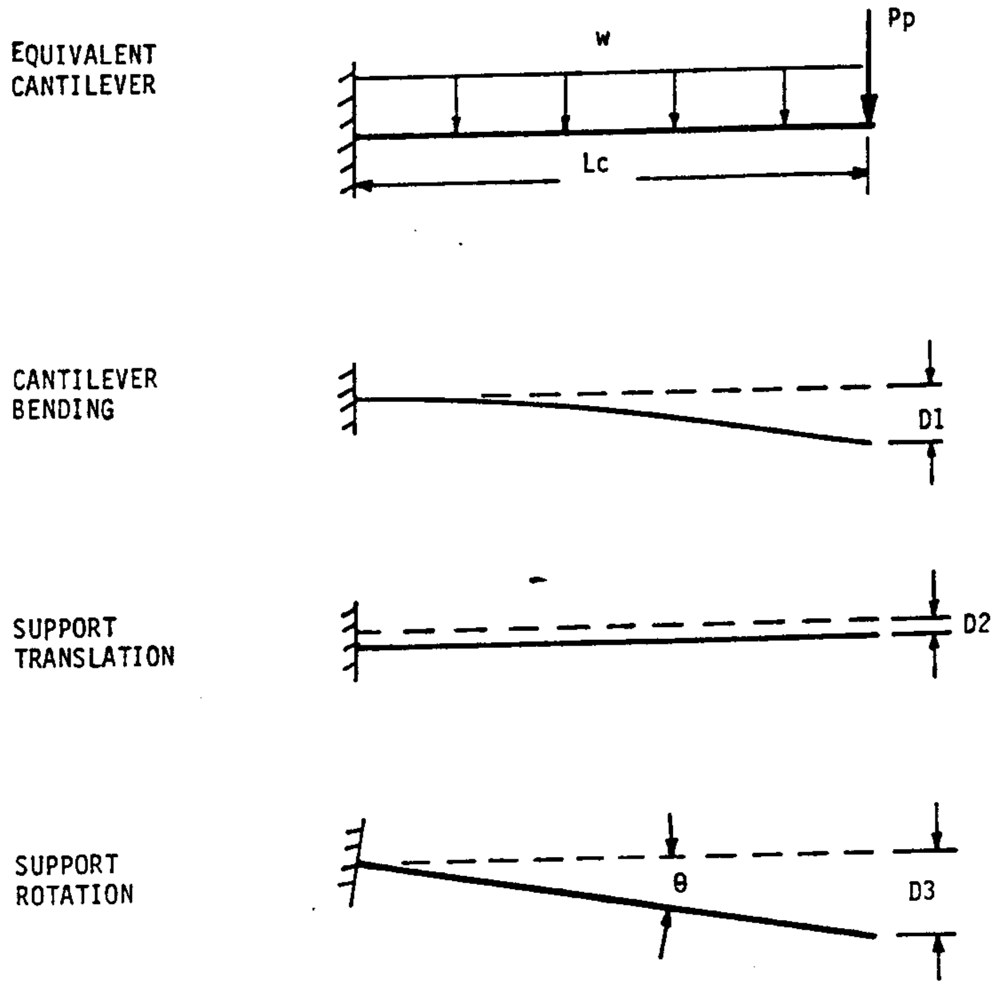


FIGURE A2 - CENTER LIFT DEFLECTION



$$D = D1 + D2 + D3$$

$$D1 + D2 = .11$$

$$D3 = 12\ Lc\ \theta$$

FIGURE A3 - EDGE LIFT BEHAVIOR

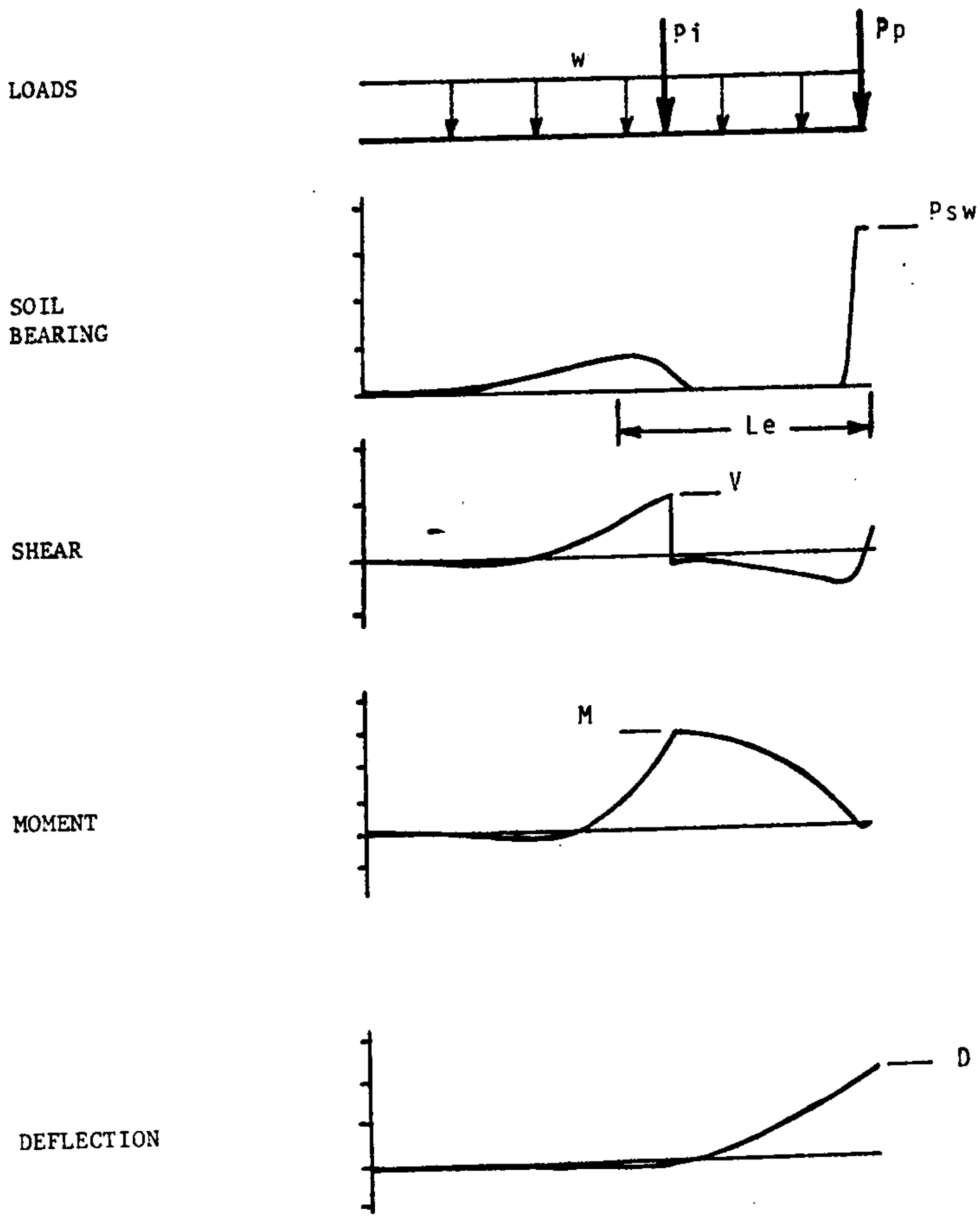
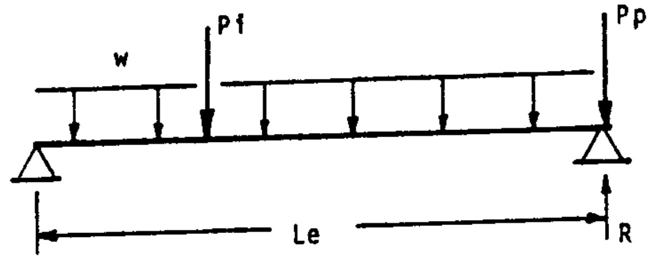
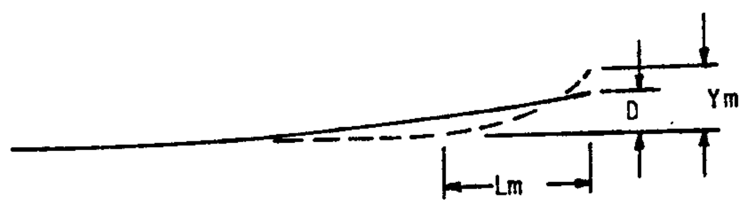


FIGURE A4 - EDGE LIFT DEFLECTION

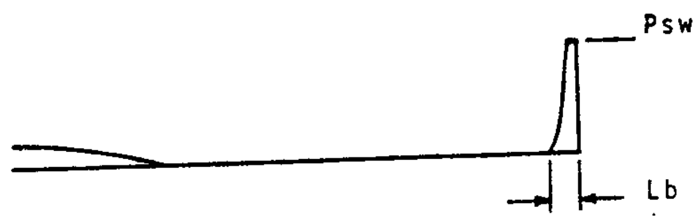
EQUIVALENT SIMPLE BEAM



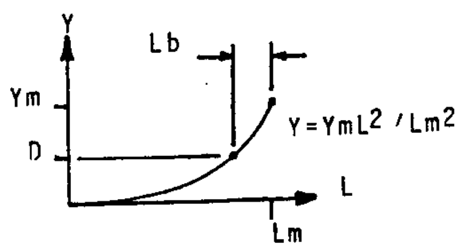
DEFLECTED SHAPE



BEARING PRESSURE



SOIL EDGE PROFILE



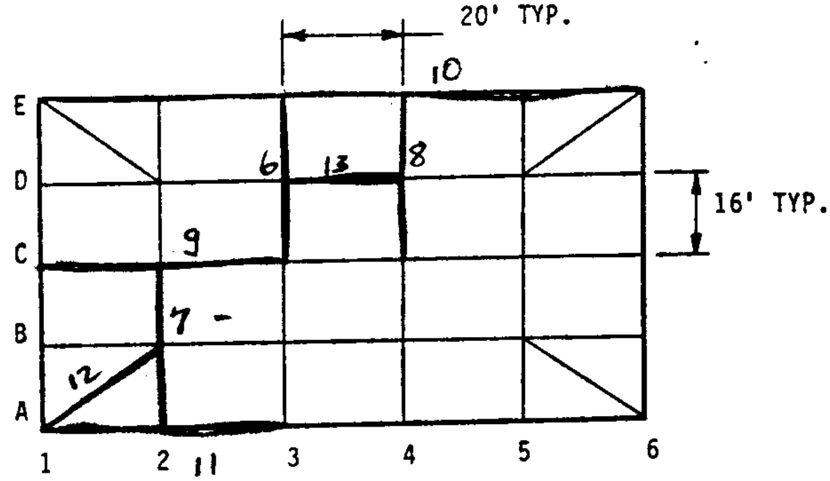
APPENDIX B - DESIGN EXAMPLE

(RIBBED MAT DESIGN IN EXPANSIVE SOIL)

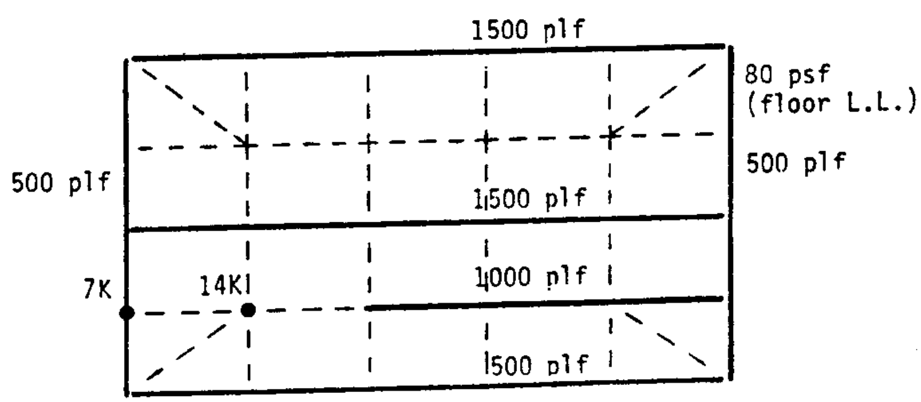
1. SOIL DATA (ref. Part I - 3.3)

qa = 2000 psf
Psw = (see page B9)
k = 100 pci
Lm = 6 ft
Ym = 1.5 in for center lift
Ym = 1.0 in for edge lift

2. FOUNDATION PLAN (ref. Part I - 4.3)



3. LOADS



4. BEARING DESIGN FOR RIBS (ref. Part I - 4.4)

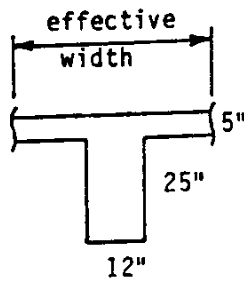
Maximum wall load (P) = 1500 plf

Width $\geq$ P/qa = 1500/2000 = .75 ft

Use 12 inch wide ribs (minimum)

5. INTERIOR RIB PROPERTIES (ref. Appendix A - 2.1)

Ec = 3,320,000 psi



(effective flange width
per ACI 318, section 8.10.2
For "span length" use 4Lc
for center lift or Le for
edge lift)

Let Ir = 36,000 in^4 for center lift
Ir = 24,000 in^4 for edge lift
(ref. ACI 318, section 9.5.2.3, verify Ir after
calculating M)

I = Ir/S (in^4/ft):

Rib spacing	16 ft	20 ft
Center lift Edge lift	2250 1500	1800 1200

6. CENTER LIFT DESIGN - RIB E3/C3

6.1 Loads (ref. Appendix A - 2.1)

slab weight = 150 pcf x 5/12 ft = 62 psf

w = DL + LL = 62 + 80 = 142 psf

rib weight = 150 pcf x 2.5 ft x 1.0 ft = 375 plf

Pp = rib + wall = 375 + 1500 = 1875 plf

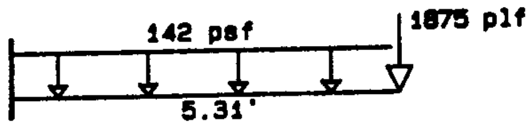
6.2 Equivalent cantilever (ref. Part II - 3.1)

$Lo = 2.3 + .4\ Lm = 2.3 + (.4 \times 6) = 4.7$ ft

$C = .8\ Ym^{.12}\ I^{.16} / Pp^{.12}$

$C = .8 \times 1.5^{.12} \times 1800^{.16} / 1875^{.12} = 1.13$

$Lc = Lo\ C = 4.7 \times 1.13 = 5.31$ ft



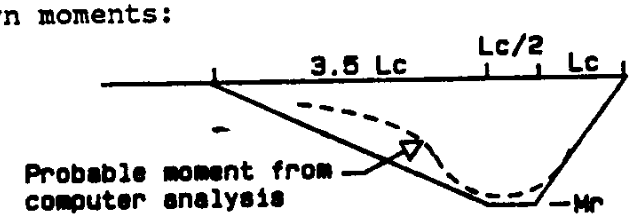
6.3 Moment (ref. Part II - 3.1.2)

$M = Pp\ Lc + 1/2\ w\ Lc^2$

$M = 1875 \times 5.31 + 1/2 \times 142 \times 5.31^2 = 12{,}000$ ft-lb/ft

$Mr = M \times S = 12000 \times 20 = 240{,}000$ ft-lb/rib

Design moments:

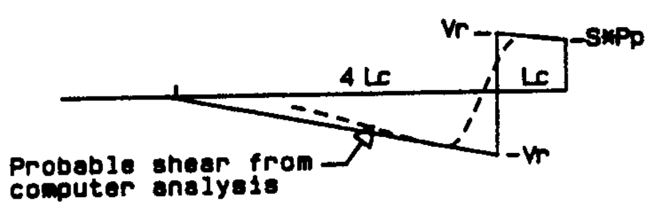


6.4 Shear (ref. Part II - 3.1.3)

$V = Pp + w\ Lc = 1875 + 142 \times 5.31 = 2630$ lb/ft

$Vr = V \times S = 2630 \times 20 = 52{,}600$ lb/rib

Design shears:



6.5 Reinforcing in rib (ref. Part I - 3.1.6 and 4.5)

As = (Mr/ad)/1.33

As = 240 / (1.76 x 28 x 1.33) = 3.66 in^2 (top)

use 3 #10 bars

v = Vr/bd = 52600 / (12 x 28) = 157 psi

vc = $(1.1\sqrt{f'c})1.33$ = 80 psi

Av = (v-vc)b s/(fs 1.33)

Av = (157-80) 12 x 12 / (24000 x 1.33) = .35 in^2/ft

use #4 stirrups @ 12 in

6.6 Deflection (ref. Part II - 3.1.4)

$\theta = M^{1.4} / 9800\ I\ k^{.5}$

.0021

$\theta = 12000^{1.4} / (9800 \times 1800 \times 100^{.5})$ = .0029 radians

D = .11 + 12 Lc θ = .11 + 12 x 5.31 x .0029 = .29 in

.24

D/4Lc = .29 / (4 x 5.31 x 12) = 1/879 O.K.

1/1062

7. EDGE LIFT DESIGN - RIB A2/C2

7.1 Loads

w = 142 psf (same as above)

Pp = rib + wall = 375 + 500 = 875 plf

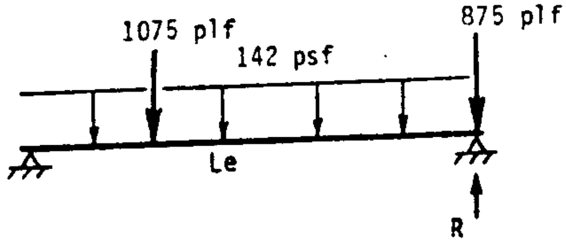
Pi = rib + wall* = 375 + 700 = 1075 plf

* equivalent wall load = column load / rib spacing

14000/20 = 700 plf (ref. Appendix A - 2.4)

Li = 16 ft

7.2 Equivalent simple beam (ref. Appendix A - 3.2.1)



7.3 Deflection (ref. Part II - 3.2.2)

$Le = 7.5\ I^{.17}\ Li^{.37}\ D^{.12} /\ w^{.07}\ Pi^{.11}$

$Le = 7.5 \times 1200^{.17} \times 16^{.37} \times D^{.12} /\ 142^{.07} \times 1075^{.11}$

$Le = 22.9\ D^{.12}$

assume D = .50 in (somewhat less than Ym = 1.0 in)

$Le = 22.9 \times .50^{.12} = 21.1$ ft

R = Pp + 1/2 w Le + Pi(Le-Li)/Le

R = 875 + (142x21.1)/2 + 1075(21.1-16.0)/21.1 = 2633 plf

from heave/pressure curve (p B9), for D=.50 find Psw=2000

Lb = 1.1(R/Psw) = 1.1(2633/2000) = 1.45 ft

$D = Ym(Lm-Lb)^2/Lm^2$

$D = 1.0(6.0-1.45)^2/6.0^2 = .575$ in $\neq$ .50 inch assumed!

assume D = .54 in

$Le = 22.9 \times .54^{.12} = 21.3$ ft

R = Pp + 1/2 w Le + Pi(Le-Li)/Le

R = 875 + (142x21.3)/2 + 1075(21.3-16.0)/21.3 = 2655 plf

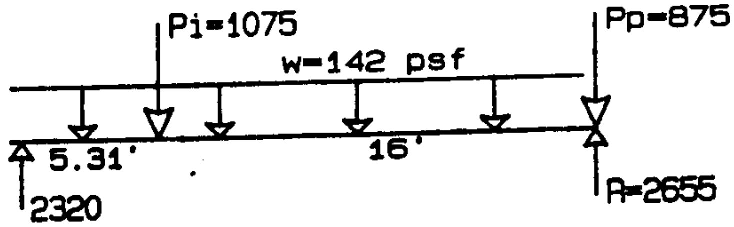
from heave/pressure curve, for D=.54 find Psw=1800 psf

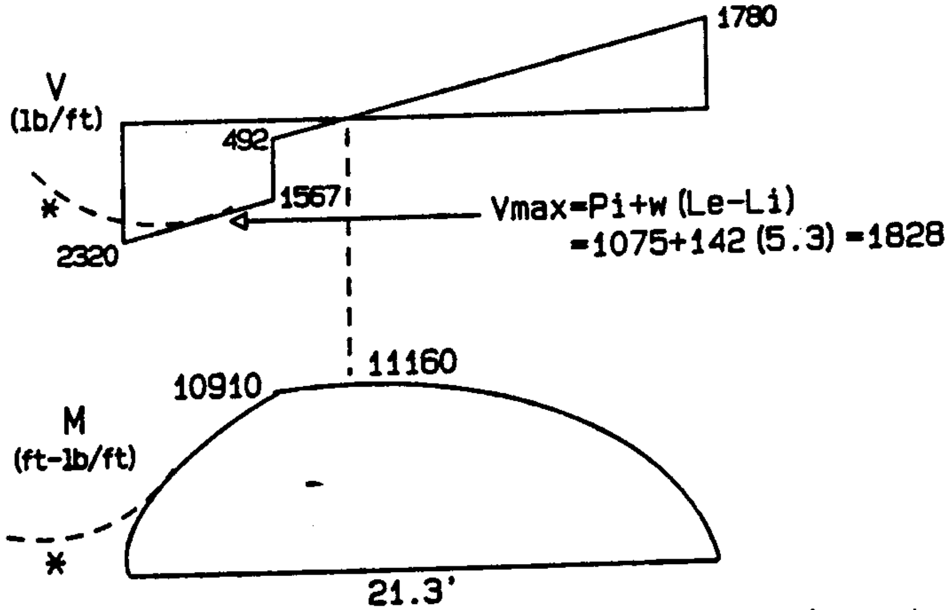
Lb = 1.1(R/Psw) = 1.1(2655/1800) = 1.62 ft

$D = 1.0(6.0-1.62)^2/6.0^2 = .533$ in CONVERGED!

D/Le = .54/(21.3x12) = 1/473 O.K. for non-brittle walls

7.4 Moment and shear (ref. Part II - 3.2.3 and 3.2.4)





* probable shear and moment from computer analysis, note that calculated V=2320 lb will not occur, due to the effects of distributed support from the soil

8. EDGE LIFT DESIGN - RIB E4/C4

8.1 Loads

w = 142 psf (same as above)

Pp = 1875 plf (same as rib E3/C3)

Li = 32 ft (wall along rib C1/C6)

8.2 Deflection

since Li>Le use:

$Le = 10.5\ I^{.17}\ D^{.12}/\ w^{.07}$ (ref. Part II - 3.2.5)

$Le = 10.5 \times 1200^{.17} \times D^{.12}/\ 142^{.07} = 24.77\ D^{.12}$

assume D = .48 in

then $Le = 24.77 \times .48^{.12} = 22.7$ ft

R = Pp + 1/2 w Le = 1875 + (142x22.7)/2 = 3485 plf

from heave/pressure curve, for D=.48 find Psw=2100 psf

Lb = 1.1(R/Psw) = 1.1(3485/2100) = 1.825 ft

$D = Ym(Lm-Lb)^2/Lm^2$

$D = 1.0(6.0-1.825)^2/6.0^2 = .484$ inch CONVERGED!

8.3 Find shears and moments by statics, similar to rib A2/C2.

9. CENTER LIFT DESIGN - RIB C1/C3

9.1 Loads

w = slab + LL + wall* = 62 + 80 + 94 = 236 psf

* wall = wall load / rib spacing = 1500/16 = 94 psf
(ref. Appendix A - 2.4)

Pp = rib + wall = 375 + 500 = 875 plf

9.2 Equivalent cantilever

Lo = 2.3 + .4 Lm = 2.3 + (.4 x 6) = 4.7 ft

$C = .8\ Ym^{.12}\ I^{.16}/\ Pp^{.12}$

$C = .8 \times 1.5^{.12} \times 2250^{.16}/\ 875^{.12} = 1.28$

Lc = Lo C = 4.7 x 1.28 = 6.02 ft

9.3 Moment

$M = Pp\ Lc + 1/2\ w\ Lc^2$

$M = 875 \times 6.02 + (236 \times 6.02^2)/2 = 9544$ ft-lb/ft

Mr = M x S = 9544 x 16 = 153,000 ft-lb/rib

9.4 Shear

$V = Pp + w\ Lc = 875 + (236 \times 6.02) = 2296$ plf

$Vr = V \times S = 2296 \times 16 = 36{,}700$ lb/rib

9.5 Deflection

$\theta = M^{1.4} / 9800\ I\ k^{.5}$

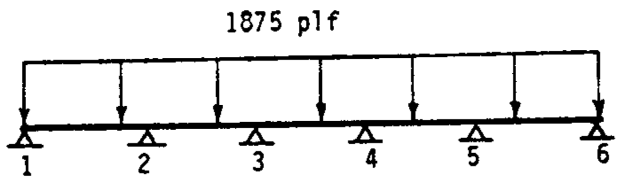
$\theta = 9544^{1.4} / 9800 \times 2250 \times 100^{.5} = .0017$ radian

$D = .11 + 12\ Lc\ \theta = .11 + (12 \times 6.02 \times .0017) = .23$ in

10. CENTER LIFT DESIGN - PERIMETER RIB E1/E6 (ref. Part II-3.3.1)

10.1 Span between transverse ribs

Pp = 1875 plf (from calculations for rib E3/C3)

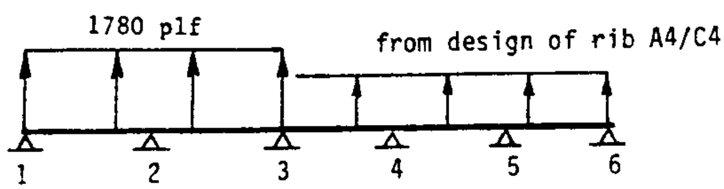


10.2 Analyze by conventional methods

11. EDGE LIFT DESIGN - PERIMETER RIB A1/A3 (ref. Part II - 3.3.2)

11.1 Span between transverse ribs for net upward force (from calculations on rib A2/C2)

R - Pp = 2655 - 875 = 1780 plf (upward)



11.2 Analyze by conventional methods

12. CENTER LIFT DESIGN - DIAGONAL RIB A1/B2 (ref. Part II - 3.4)

12.1 Provide the larger shear and moment capacity of rib B1/B2 or rib A2/B2.

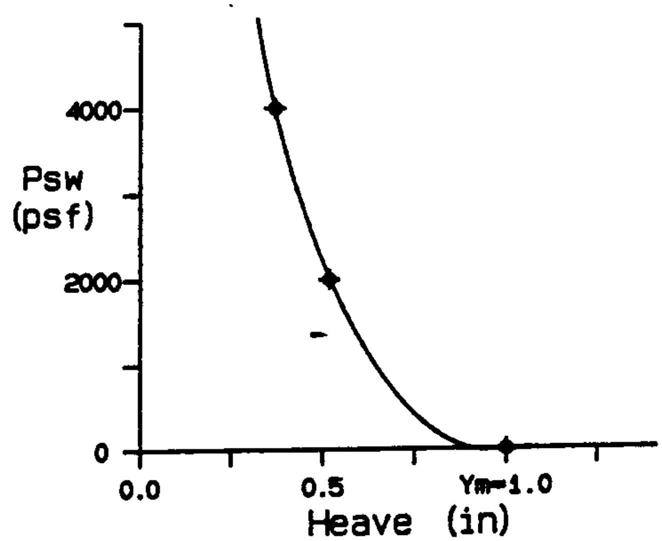
13. RIB D3/D4 (ref. Part I - 4.5)

13.1 Interior rib with no wall or column loads

$A_s \geq .0033\ A_g = .0033 \times 12 \times 30 = 1.20\ in^2$ (top and bot.)

This is the typical minimum reinforcement for the full length of all ribs.

14. HEAVE VERSUS SWELL PRESSURE CURVE (ref. Appendix A - 2.1)



DEPARTMENT OF THE ARMY
SOUTHWESTERN DIVISION, CORPS OF ENGINEERS
1114 COMMERCE STREET
DALLAS, TEXAS 75242-0216

REPLY TO ATTENTION OF

16 APR 1987

SWDED-G

SUBJECT: Criteria for Developing Geotechnical Design Parameter for SWD Ribbed Mat Design Methodology

Commander, Albuquerque District, ATTN: SWAED-TA
Commander, Fort Worth District, ATTN: SWFED-F
Commander, Galveston District, ATTN: SWGED-G
Commander, Little Rock District, ATTN: SWLED-G
Commander, Tulsa District, ATTN: SWTED-G

1. Reference is made to criteria letter SWDED-TS/G dated 23 December 1986, subject "Design Criteria for Ribbed Mat Foundation".

2. The above reference criteria letter require certain geotechnical parameters be furnished in the Foundation Design Analysis when a ribbed mat slab foundation is recommended in expansive soil areas. Enclosure 1, for addressees only, provides guidance for development of these parameters. These procedures were developed by the Ft. Worth District with review in the Southwestern Division. Questions and/or comments should be directed to either Mr. A.L. Branch, FTS 334-2117 or Mr. Jack Fletcher, FTS 729-6365.

FOR THE COMMANDER:

William Baker

Encl

for ARTHUR D. DENYS, P.E.
Chief, Engineering Division

XV

7-12

CONTENTS

DEVELOPMENT OF GEOTECHNICAL DESIGN PARAMETERS FOR RIBBED MAT FOUNDATIONS

1. REFERENCE.

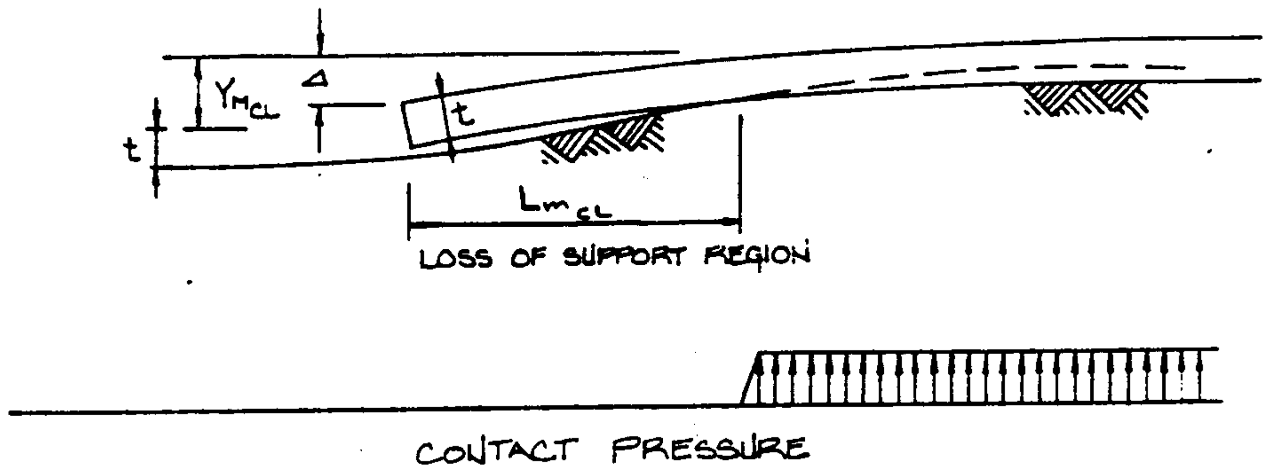
1.1 SWDED-TS/G, Design Criteria for Ribbed Mat Foundations, dated 23 Dec 86.

1.2 TM 5-818-7, Foundations in Expansive Soils, Corps of Engineers, 1983.

2. BACKGROUND. The recently developed structural design methodology (reference 1) models the interaction of a ribbed mat slab on an expansive subgrade for purposes of structural design. This method appears equally suited to stiffened mat systems such as flat mats, modified flat mats and inverted ribbed mats. Utilization of the methodology requires the expansion and refinement of the geotechnical design parameters furnished in the foundation design analysis. The purpose of this report is to (1) identify and (2) provide a rational method of determining these parameters.

3. SOIL-STRUCTURE INTERATION MODES. Two heave induced deformation conditions appropriate for ribbed mat slab structural analysis are (a) center lift and (b) edge lift.

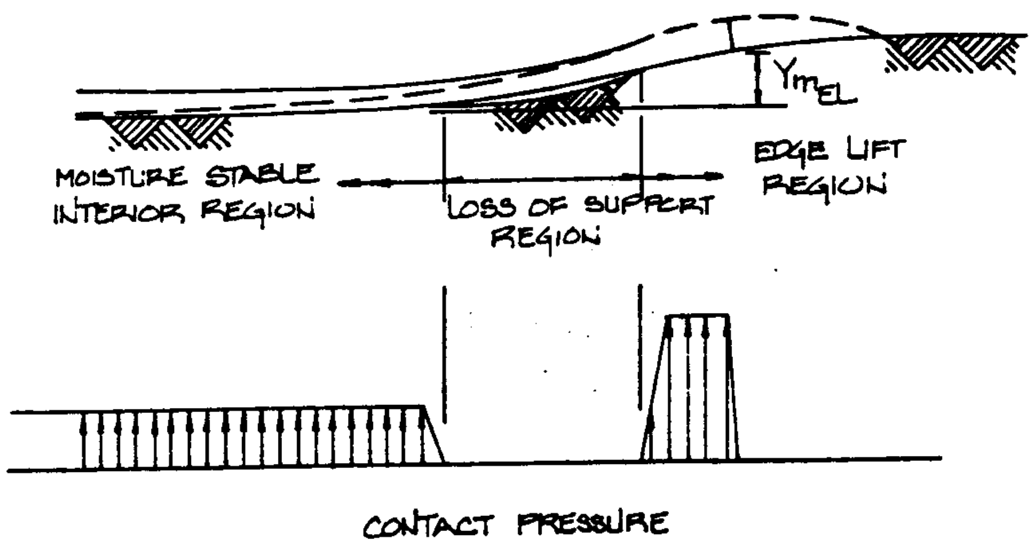
3.1 CENTER LIFT. Center lift considers doming of the foundation in the interior region of a slab on grade differentially to the perimeter region as depicted on figure 1. This may be caused either by drying of the expansive subgrade around the perimeter beam or by wetting of the dry expansive subgrade in the interior region. Perimeter drying results from (1) below average precipitation and/or (2) reduced or no landscape watering and/or



CENTER LIFT
FIGURE 1

(3) removal of old paving or hard stand. Interior wetting results from (1) disruption of the site moisture equilibrium by "capping" the site with the relatively impervious slab or by removal of thick brush or trees from the site (thus eliminating evapo-transportation) and/or (2) leaky inservice or abandoned utilities. Loss of support along perimeter and first interior transverse stiffener beam results if (1) the magnitude of center lift heave is large enough and (2) the beams are sufficiently rigid to cantilever from the supported interior region.

3.2 EDGE LIFT. Edge lift involves more complex soil-structure interactions than does center lift. In edge lift, the structure is supported by heaving subgrade in the perimeter region and in the relatively moisture stable interior region. Loss of support develops when (1) the edge lift heave deformation is large enough and (2) the spanning beam is sufficiently rigid. Edge lift mode is depicted on figure 2.



EDGE LIFT
FIGURE 2

Soil-structure interaction within the interior supported region is reasonably represented as a beam on non-linear subgrade. Soil-structure interaction in the perimeter region is somewhat more complex because the soil deflects under the structural load as a beam on non-linear subgrade, but also the swelling soil either loads and/or deflects the beam upward. To further complicate matters, the amount of edge lift heave and the soil-beam interface pressure are interrelated and unique for each specific site. Background parameter studies for reference 1 indicate that the structural analyses are particularly sensitive to edge lift parameters (edge lift heave magnitude and limiting beam-soil interface pressure). For example, large values for these may cause the solution to either fail to converge or indicate that the beam must be very deep and/or very heavily reinforced. While site conditions may sometimes dictate massive, very rigid stiffener beams, this is not generally the case. Generally, edge lift heave of less than 1.0 to 1.5 inches used in the design method given in reference 1 produce reasonable, constructable beams.

4. DETERMINATION OF CENTER LIFT AND EDGE LIFT PARAMETERS FOR STRUCTURAL DESIGN.

4.1 CENTER LIFT - Center lift parameters to be provided in the foundation design analysis includes (1) modulus of subgrade reaction (K_1), (2) design allowable bearing for beams (q_{all}), (3) magnitude of center lift (Y_{mCL}) and (4) loss of support distance around the perimeter (L_{mCL}).

4.1.1 MODULUS OF SUBGRADE REACTION - The modulus of subgrade reaction should be taken as K_1 = 200 pci for beams up to 12 inches wide bearing on compacted, nonexpansive fill. Higher values may be justified for granular nonexpansive fills consisting of gravel, crushed rock or limestone screenings or for cement stabilized materials if these materials extend significantly ($D \geq 3B$) below the stiffener beam of width B. The foundation design analysis should direct that K_1 values be factored to account for width effects such that $K_{design} = K_1/B$, where B is the effective beam width in feet for soil structure interaction. Note that the resultant effective beam width may include a significant width of the slab and is therefore significantly greater than actual beam width. Studies indicate that significant load distribution occurs over an "effective" width of approximately five. It should be noted that structural design calculations are not sensitive to K value.

4.1.2 DESIGN ALLOWABLE BEARING. A design allowable bearing value (q_{all}) has historically been assigned for sizing of stiffener beams, perimeter beams and enlarged beam intersections beneath columns. Values are typically given considering the beam to be a continuous strip footing or the beam intersection to be a spot footing (carrying either line or concentrated loads, respectively). The allowable bearing value is typically developed based on the average strength of engineered fill at shallow depth with a factor of safety of not less than 3.0. Design loads typically include full dead load plus half live load. The purpose in sizing the beams and beam intersections for this design allowable is to provide uniform contact pressures at the beam-soil interface therefore limiting inservice differential settlement. The assumptions of minimal load sharing between the slab and beams, ample safety factor on the fill strength, and minimum beam widths specified in the SWD EIM combine to limit the mobilized soil strains to low levels. This leads to very small structurally induced deflections given uniform, nominal fill depths. Actual values assigned for design bearing allowables have seldom exceeded q_{all} = 2.0 KSF although values as high as 3.0 KSF have been assigned in limited cases where required and justifiable. Seldom are there structural requirements for larger allowables bearing values since specified minimum beam widths generally govern.

4.1.3 MAGNITUDE OF CENTER LIFT HEAVE POTENTIAL. - The magnitude of center lift heave potential (Y_{mCL}) given in the foundation design analysis should be the residual heave potential at the site. The value of Y_{mCL} should include effects due to subgrade removal and replacement criteria, any surcharge effects due to fill above original subgrade and the weight of the proposed structure. Maximum design value for center lift potential should not exceed 1.5 inches. Where attainable with reasonable removal/replacement depths (≤36 inches), it is desirable to limit Y_{mCL} to not more than 1.0 inch, which is well within the "tolerable" inservice deformation range of most structures. Minimum remove/replace depth should be taken to the bottom elevation of the ribbed mat slab beams.

function of anticipated loads

The heave potential is determined by three soil parameters: the coefficient of swell (C_s), depth of active zone (X_a) and expansion pressure (P_{exp}).

Caution should be used in selecting coefficient of swell (C_s) values for heave analyses since swell pressure test results significantly underestimate C_s values compared to controlled expansion-consolidation-rebound tests. Additionally, both test methods tend to give low C_s values since most rebound time curves are terminated well before primary swell is completed.

★ An appropriate design value of the depth of the active zone (X_a) typically lies between the present depth to the stable relative moisture content (estimated by observing the relationship of moisture content to the plastic limit) and the maximum depth observed, such as the maximum depth of weathering. Typical X_a values for the central and north Texas regions and central Oklahoma region appear to vary from about 10 to 15 feet. These values have been estimated for (1) regression heave analyses for distressed structures and (2) depth of moisture variation versus approximate return/duration interval studies. Values smaller than 14 feet may be applicable in specific cases such as where the active zone is the distance between the structural foundation element or slab on grade and a perched water table; a condition common in these regions. *

Center lift heave analyses should consider "saturated" conditions to a depth of X_a. If a nominal remove/replace depth and saturated subgrade assumptions indicate unreasonable residual heave potential, consider increasing the depth of remove/replace and/or recommending a more defensive design to prevent saturation of the subgrade.

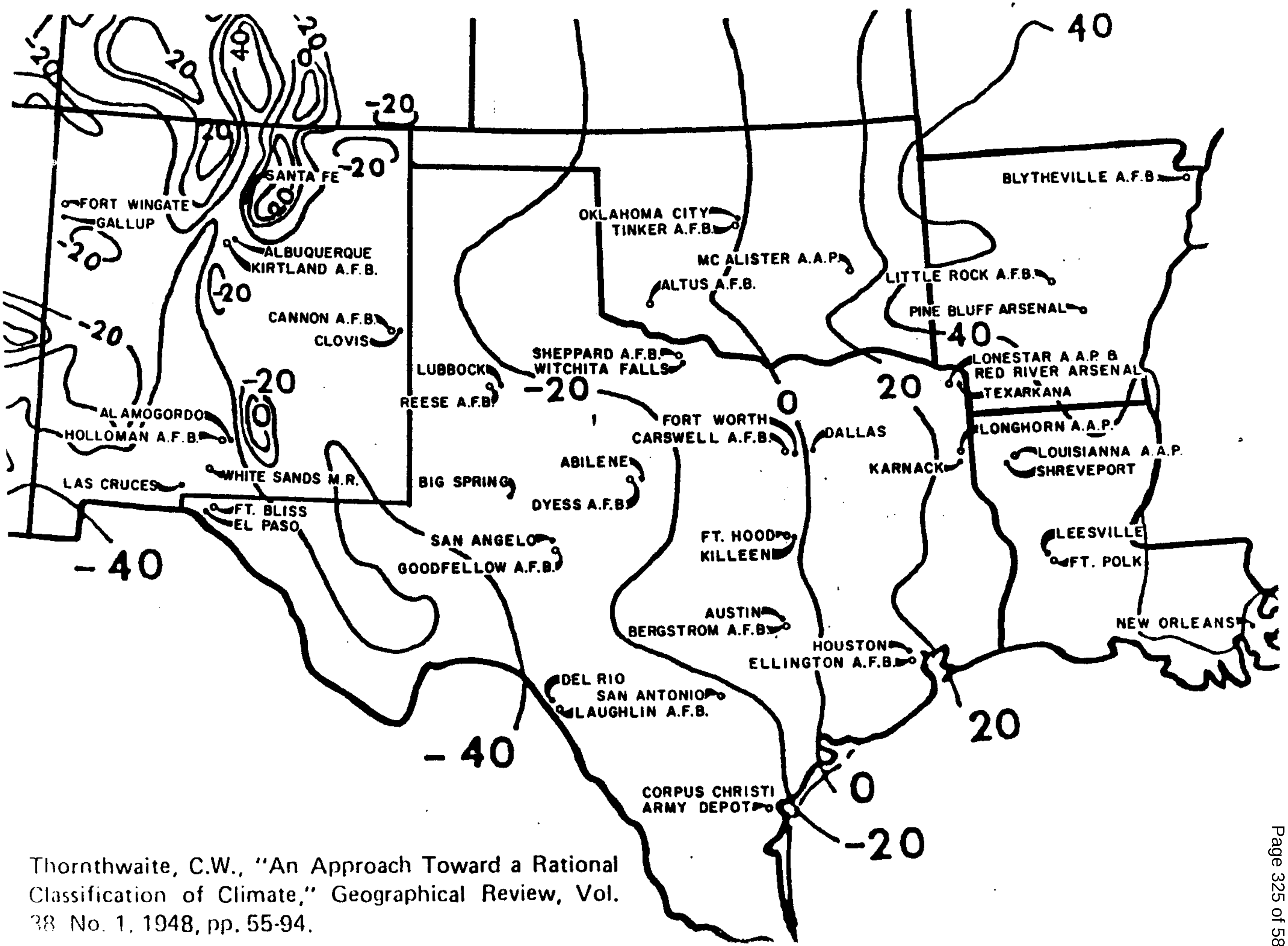
Expansion pressures should be developed versus depth using small depth intervals. These should be developed from laboratory data for the site. Additionally, these may be supplemented using proper correlations with nearby, preferably adjacent sites.

4.1.4 EDGE MOISTURE VARIATION DISTANCE. The edge moisture variation distance (L_{MCL}) may control the design of interior stiffener beams which are adjacent to the perimeter. The maximum moments and shear are induced in the transverse beams when these elements cantilever free of foundation support from the interior supported region to the outside of the perimeter beam. The length of cantilver is largely controlled by the value of L_{MCL}. SWD adopted this concept from Post-Tensioning Institute (PTI) guidelines, originally developed for lightly loaded flexible mats in the late 1970's and early 1980's. Standard practice in the

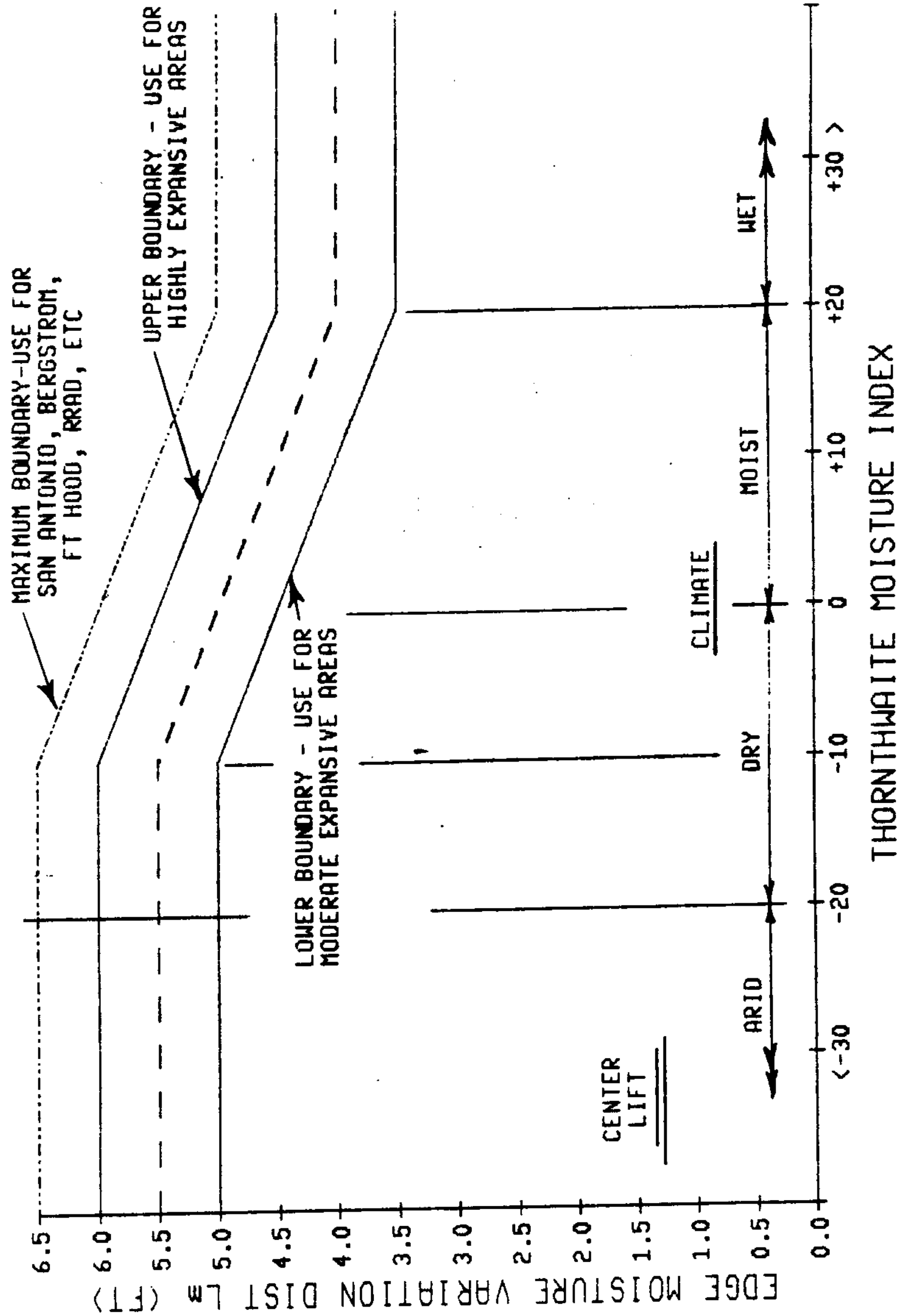
San Antonio area has been to assign upper or near upper bound values from TMI for design L_{MCL} values. At least two aspects of designs probably tend to moderate the actual edge moisture variation distance experienced; these being (1) relatively deep perimeter beams which act as a physical barrier and (2) the non-expansive fill blanket which tends to make changes in moisture content (and therefore any resultant heave or shrinkage) more uniform and provide a surcharge effect as well. Other factors, however, tend to offset these moderating effects. These include very short return interval of edge moisture variation events presented in TMI (reported by some sources to range from 1 to 2 years). Typical project design life of projects exceeds 20 or 30 years and, since we're still using many World War II facilities, it may well exceed 50 years. Estimated edge moisture variation values considering a 100 percent probability of experiencing a 20 to 30-year return interval event may well be twice typical TMI values.

Based on a subjective combination of all factors, it is suggested that L_{MCL} be taken as the edge moisture variation distance determined using figures 3 and 4. These values should be modified, either up or down, based on site secific soils investigations and engineering judgement.

4.2 EDGE LIFT - Edge lift parameters to be provided in the foundation design analysis include (1) modulus of subgrade reaction (K_1), (2) magnitude of edge lift heave (Y_{MEL}), (3) limiting soil-beam interface pressure (P_{SW}) for that portion of the beam being acted on by the heaving subgrade and (4) a value for edge moisture variation distance (L_{MEL}).



Thornthwaite, C.W., "An Approach Toward a Rational Classification of Climate," Geographical Review, Vol. 38 No. 1, 1948, pp. 55-94.



APPROXIMATE RELATIONSHIP BETWEEN THORNWAITE INDEX AND MOISTURE VARIATION DISTANCE

FIGURE 4

4.2.1 MODULUS OF SUBGRADE REACTION. - Values given for center lift are considered appropriate for edge lift also. $K_1 = 200$ pci

4.2.2 SOIL-BEAM INTERFACE PRESSURE. Discussion of both limiting soil-beam interface pressure and magnitude of edge lift heave parameters (P_{sw} and Y_{mEL}) are best handled concurrently since both are intimately related and the analysis necessary for solution determines both simultaneously.

The area of soil-beam contact in the swelling perimeter region involves a somewhat complex soil-structure interaction situation. As edge lift develops and loss of support occurs between the perimeter and interior regions, the heaving soil may well exert a pressure on the stiffener beams well in excess of typical design interface pressures (q_{all}). As the soil column swells and lifts the overlying beam, the soil-beam contact area increases toward the interior region to accommodate the greater structural reaction.

The soil-structure interaction in the edge lift region can be visualized as a three-component system; (1) a structural element (a beam or mat strip), (2) an element of nonexpansive fill beneath the structural element plus that piece of the expansive subgrade restrained against heave by the weight of the overlying fill and the stresses induced beneath the structural element, and (3) the heaving column of soil to a depth of X_a beneath the bottom of the nonexpansive fill blanket (figure 5).

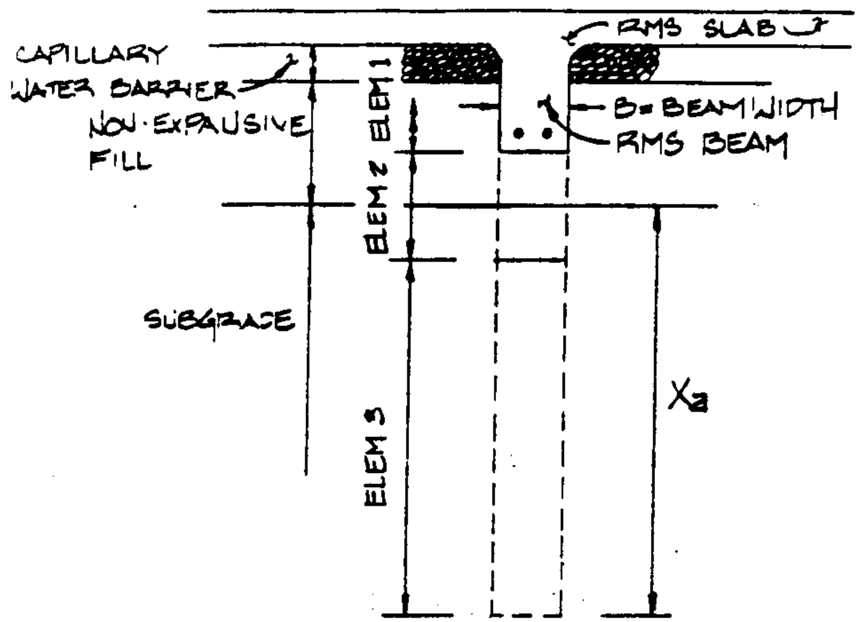


FIGURE 5

The load-deformation relationship of element 1 interacting with element 2 can be represented by a P-Y curve shown in figure 6.

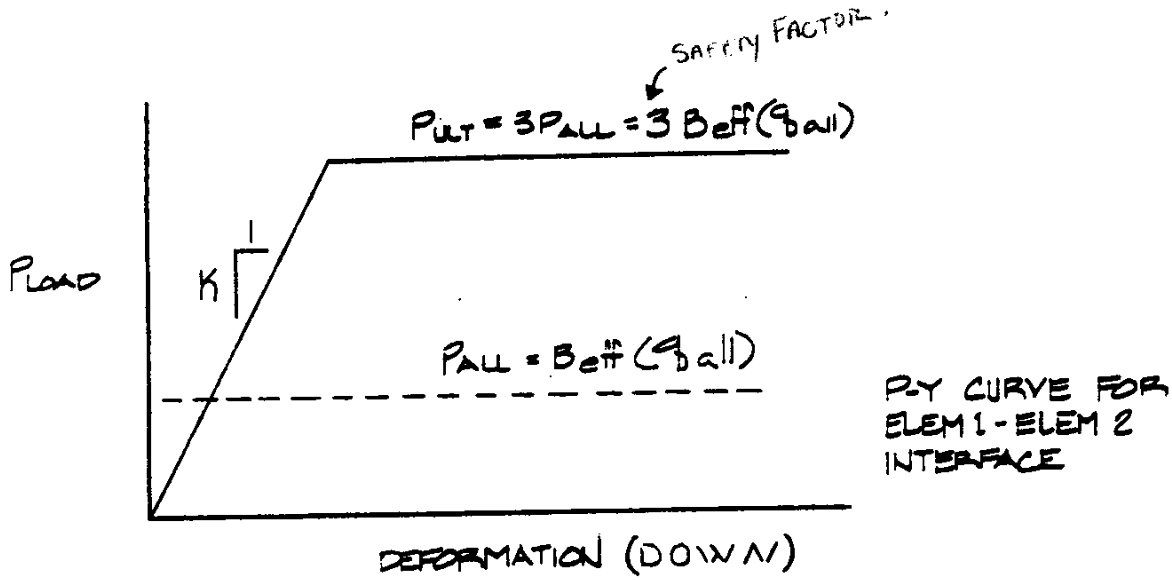


FIGURE 6

The load-deformation relationship of element 3 interacting with elements 1 and 2 in the column immediately below the beam as shown on figure 7. The plot consists of the net heave potential of the swelling soil column versus those forces resisting the tendency to swell, taken at the base of the structural beam.

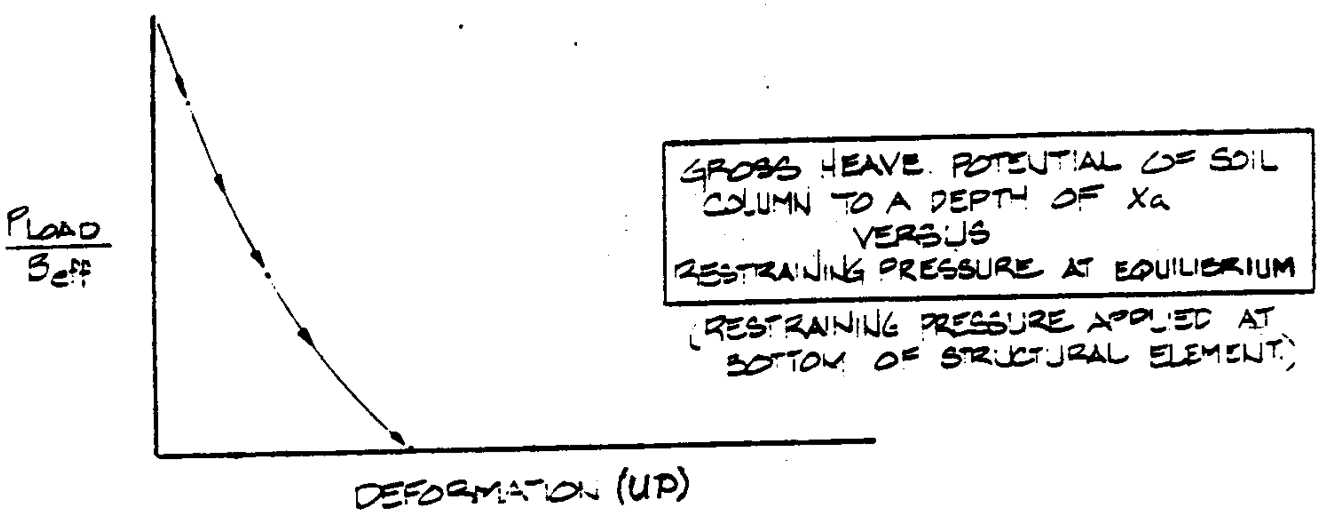


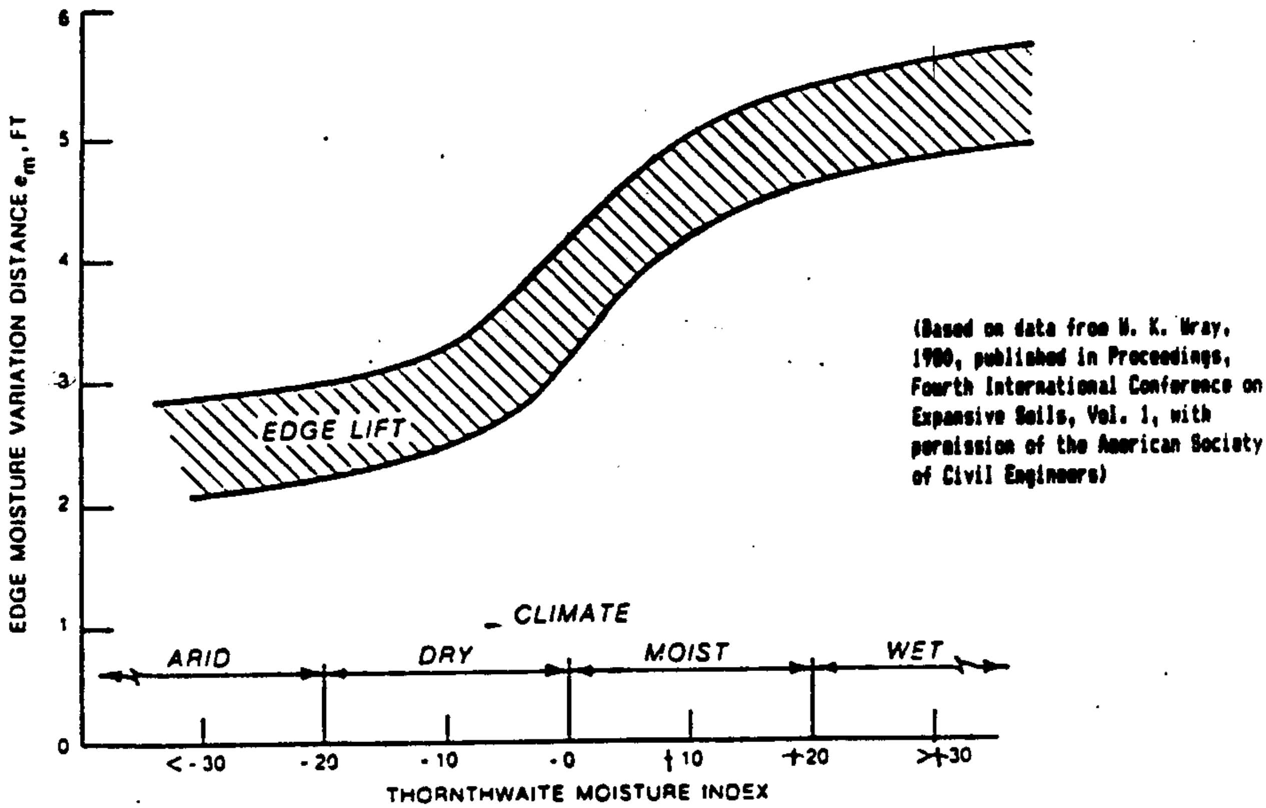
FIGURE 7

These relationships can be added algebracially to produce a composite p-y curve which can be easily utilized by available soil-structure interaction programs for structural analysis. Since such analysis is within the purview of the structural engineer, the geotechnical engineer need only furnish the pressure heave relationship in useable form in the Foundation Design Analysis. It is suggested that this information be provided in a tabulated format giving coordinates for at least three points. These minimum three points should be the Fsw and

Pult = F.S. x Pallow

YmBL coordinates for (1) pressure equal to Pult, (2) pressure equal to Pall and (3) pressure equal to zero.

4.2.3 <u>EDGE MOISTURE VARIATION DISTANCE</u>. Edge moisture variation distance (L_{mEL}) appropriate for edge lift analysis may be taken from the TMI chart given in figure 8.



Approximate relationship between the Thornthwaite Moisture Index and the edge lift-off distance.

FIGURE 8

The TMI values represent approximate environmentally induced events. As a result, upper bound values should be selected for design. It is recommended, however, that average values be used for all SWD projects. Additionally, recommendations should be made in the foundation design analysis to limit the potential for developing "hot spots" due to long term sources of free water around the building perimeter.

function of the type of bldg, ie, Brick Stucco or Not

4.3 Certain structure-site situations may well warrant deleting edge lift analyses as follows:

4.3.1 Where the proposed structure is a pre-engineered metal building <u>without</u> interior masonry walls or heavy interior dead or permanent live loads.

4.3.2 Where defensive design efforts have been incorporated and reasonable confidence exists that these will be constructed and maintained as intended.

4.3.3 Where minor architectural distress (such as cracking of masonry walls, plaster walls, tiled surfaces) is not likely to cause undue user concern or raise inservice maintenance requirements significantly.

5. <u>APPENDIX A</u>

5.1 <u>EXAMPLE PROBLEM</u>. An example problem is provided in Appendix A.

APPENDIX A

EXAMPLE PROBLEM

1. Required. - Develop geotechnical parameters for the structural design of a ribbed mat slab given the following:

a. Proposed Structure. - Office/Administration type structure located in San Antonio, Texas, 60X150 feet in plan. The structure is to consist of double wythe masonry (face brick over CMU) load bearing exterior walls and isolated interior colums at 20 ft. centers.

b. Proposed Site. - One acre, minimal topographic relief, site covered with mesquite trees.

c. Subsurface Conditions. - Drilling program (5 borings) indicates the foundation materials consist of (1) a surface stratum of high plasticity clay grading into medium plasticity clay with depth to a total thickness of 14 feet, (2) a water bearing sand and gravel stratum from 1 to 7 feet thick overlying, (3) an expansive clay shale formation.

d. Summary Laboratory Test Data. -

Stratum	Depth (ft)	USCS	$\bar{W}_o$ (%)	d (pcf)	LL	PI	P_{exp} (tsf) (net)	C_s	C_c	C_u (ts
1	0-4	CH	25	105	65	45	0.8 -1.0	0.06	0.02	0.
2	4-14	CL	14	108	44	30	0.6	0.06	0.18	0.
3	14-20	GC	6	-	25	12	0	-	-	5C B/
4	20 plus	Wea. Clay Shale	22	110	70	52	2.0	0.09	0.22	1.

2. Determine Parameters Required for Center Lift Analysis:

a. Modulus of Subgrade Reaction (K_1). - Mat slab will be founded on nonexpansive fill, therefore it is reasonable to assign a valve of K_1 = 200 PCI. The structural engineer should factor this value based on effective beam width such that $K_{design} = K_1$ (1ft/Beff, ft).

b. Design Bearing Allowable (q_{all}). - Since beams will be supported on nonexpansive fill and the building loads will range from light to moderate, it appears that a design bearing allowable of q_{all} = 2.0 KSF is appropriate.

c. Magnitude of Center Lift Heave Potential (Y_{mcl}). -

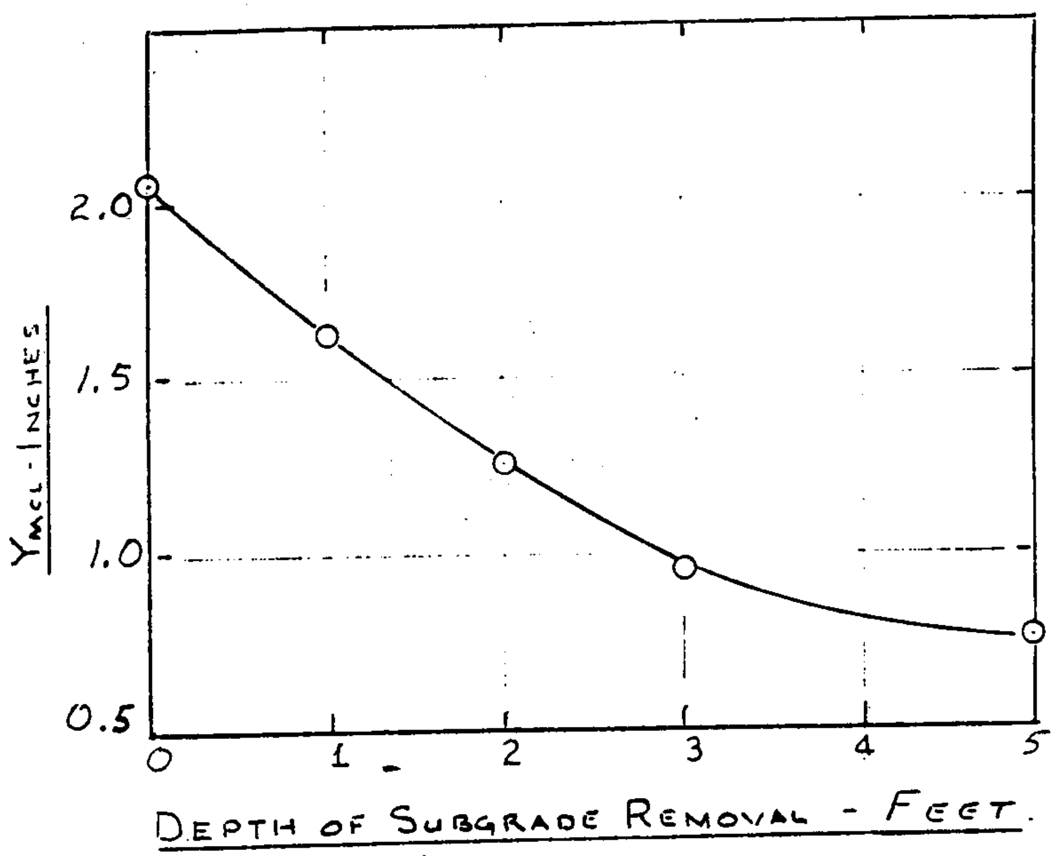
(a) Calculate site heave potential

Given: C_s = 0.06, e_o = 0.60, P_o = effective overburden pressure, P_{exp} = gross swell pressure, P_f = effective pressure resisting heave beneath mat including P_o, (surcharge due to fill and structural dead load, h_i = heave for soil layer h inches thick, and an X_a = 10 feet.

$C_s = .06$
$e_0 = .60$

z (ft)	$\bar{z}$ (ft)	P_o (tsf)	P_{exp} (tsf)	P_f (tsf)	h (in)	$h_i = \frac{C_s h}{1+e_o} \log_{10} \frac{P_{exp}}{P_f}$ (inches)	h_i (bottom to top) (inches)
0-1	0.5	0.03	1.0	.07+.03 0.1	12	0.45	2.07
1-2	1.5	0.1	1.0	.07+.1 0.17	12	0.35	1.62
2-3	2.5	0.17	1.1	.07+.17 0.24	12	0.30	1.27
3-4	3.5	0.23	0.8	0.3	12	0.19	0.97
4-6	5	0.33	0.9	0.4	24	0.31	0.78
6-8	7	0.46	1.0	0.53	24	0.25	0.47
8-10	9	0.6	1.2	0.67	24	0.22	0.22
10-12	11	0.73	1.35	0.8	24	0.2	N/A
12-14	13	0.86	0.9	0.93	24	N/A	N/A

Determine required depth of subgrade replacement and residual heave potential after replacement with nonexpansive fill. A plot of replacement depth versus residual heave taken from the above table follows:



Removal and replacement to 3.0 feet will reduce the heave potential to approximately 1.0 inch, thus Y_{mcl} = 1.0 inch. Note that significant additional removal would be required to reduce the residual heave potential any sigificant additional amount.

d. Edge Moisture Variation Distance (L_{mc1}) - taken from figures 3 and 4 as L_{mc1} = 6.5 feet.

3. Determine parameters required for Edge Lift analyses:

a. Modulus of Subgrade Reaction (K_1). - Same as for Center Lift.

b. Design Allowable Bearing (q_{all}). - Same as for Center Lift.

c. Soil - Beam Interface Pressure (P_{sw}) and Magnitude of Edge Lift Heave Potential (Y_{mel}). -

Determine the residual heave potential for the soil column beneath a typical beam for a range of assumed interface pressures.

A summary of calulations and results is presented in tabulated form on page 6. A plot of soil-beam interface pressure versus heave potential is shown on page 7. A reasonable bilinear representation of the results, for use by the structural engineer, can be developed assuming a linear relationship between the following points:

P_{sw}, TSF	Y_{mel}, Inches
0.0	Y_{mel} = 1.25
q_{all} = 1.00	Y_{mel} = 1.0
q_{ult} = 3(q_{all}) = 3.00	Y_{mel} = 0.6

d. Edge Moisture Variation Distance. (L_{mel}). The edge moisture variation distance is taken from figure 8 as L_{mel} = 3.0 feet.

Given: D_f = 2.0ft B = 1.0ft

C_s = 0.06 e_o = 0.60

γ_m = 125pcf

								q_{app}											
								0.5tsf			1.0tsf			2.0tsf			4.0tsf		
Z ft	$\bar{Z}$ ft	h in	$\frac{\bar{Z}-D_f}{B}$	I_s	P_o tsf	P_o+P_s tsf	P_{exp} tsf	ΔP tsf	P_f tsf	Δh_i in	ΔP tsf	P_f tsf	Δh_i in	ΔP tsf	P_f tsf	Δh_i in	ΔP tsf	P_f tsf	Δh_i in
0-3	<------------------COMPACTED NONEXPANSIVE FILL TO A DEPTH OF 3.0 FT.------------------>																		
3-4	3.5	12	1.5B	0.28	0.23	0.30	0.8	0.14	0.37	0.15	0.28	0.51	0.08	0.56	0.79	0	1.12	1.35	0
4-6	5.0	24	3.0B	0.15	0.33	0.40	0.9	0.07	0.40	0.32	0.15	0.48	0.25	0.30	0.63	0.14	0.60	0.93	0
6-8	7.0	24	5.0B	0.09	0.46	0.53	1.0	0.05	0.53	0.25	0.09	0.55	0.23	0.18	0.64	0.17	0.36	0.82	0.09
8-10	9.0	24	7.0B	0.07	0.60	0.67	1.2	0.04	0.67	0.23	0.07	0.67	0.23	0.14	0.74	0.19	0.28	0.88	0.12
10-12	11.0	24	9.0B	0.05	0.73	0.80	1.35	0.03	0.80	0.20	0.05	0.80	0.20	0.1	0.83	0.2	0.20	0.93	0.16
12-14	13.0	24	11.0B	0.04	0.83	0.90	0.9	0.02	0.90	0.0	0.04	0.90	0.0	0.08	0.91	0	0.16	0.99	0
								$\Sigma\Delta h_i$ = 1.15			$\Sigma\Delta h_i$ = 0.99			$\Sigma\Delta h_i$ = 0.7			$\Sigma\Delta h_i$ = 0.38		

Where:

Z = depth interval

$\bar{Z}$ = mean depth

B = beam width

D_f = beam depth

σ_z = stress with depth

P_o = overburden pressure

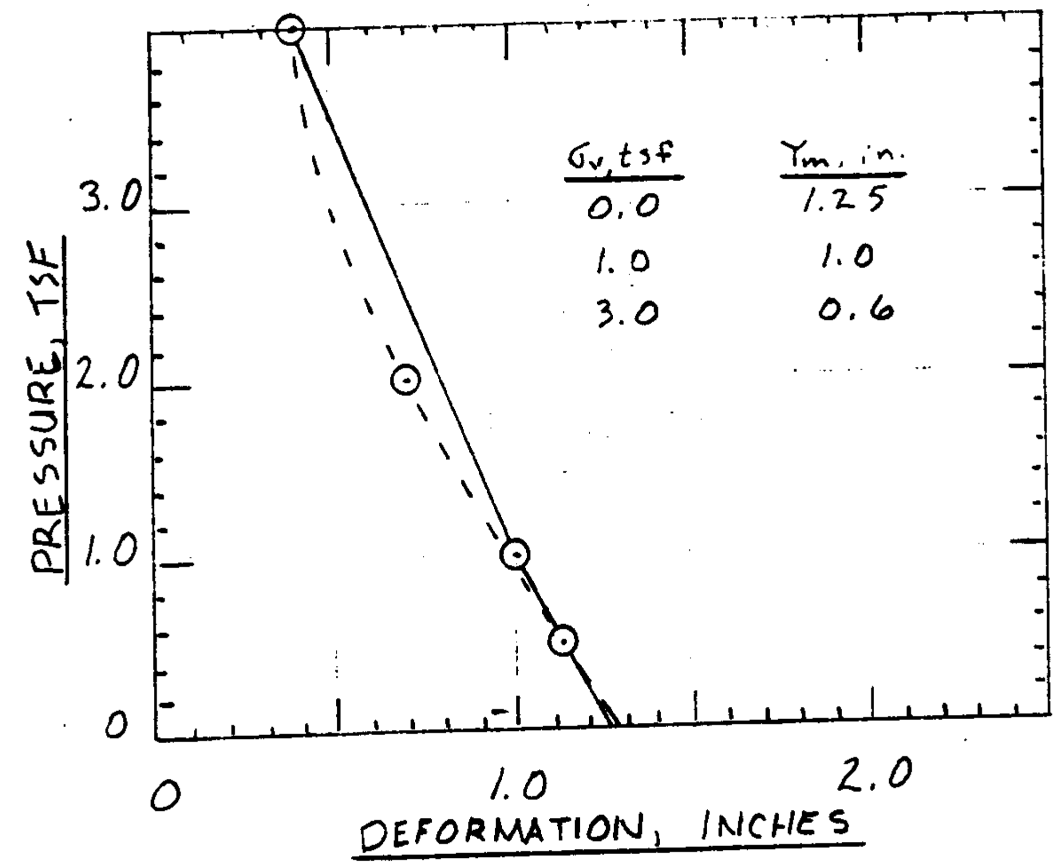
P_s = surcharge pressure next to beam

P_{exp} = expansion pressure

P_f = vertical pressure resisting heave below beam

P = stress @ depth due to to q_{app} $\Delta P = (I_s)(q_{app})$

$$P_f = \begin{cases} \Delta P + P_o \\ \text{or} \\ P_o + P_s \end{cases} \text{whichever is greater}$$



EDGE LIFT PARAMETER

EXAMPLE PROBLEM

APPENDIX B
List of Drawings

Not Used

APPENDIX C
Utility Connections

Not Used

Appendix D

Fire Flow Tests

REED FIRE PROTECTION ENGINEERING
THE EXPERTS IN FIRE/LIFE SAFETY SOLUTIONS

September 10, 2008

Mr. Richard Jamieson P E
R S & H
13750 San Pedro
Suite 600
San Antonio, Texas 78232

RE: Water Flow Test Data
AIT Barracks Replacement
Ft Sam Houston, Texas

RFPE #20-28425

Dear Richard:

On Tuesday, September 10, 2008, we visited the site to perform water flow tests to determine the available water supply for fire protection systems in the residential buildings. We utilized hydrant #1316, located at the corner of Williams and Koehler, to record static and residual pressures for both tests. The hydrant located ½ block west of the intersection and directly in front of the Mini Mall (#1315) was used to record flow for the first test at 12:15 pm. Hydrant #1317, located west of the corner of Williams and Hardee and directly behind the Mini Mall, was use to record the flow during test two at 12:30 pm.

Hydrant #1316 is connected to the water line which runs on the west side of Williams, hydrant #1315 is connected to the water line that runs on the north side of Kohler, and hydrant #1317 is connected to the water line that runs on the south side of Hardee. The data is as follows:

Test No. 1	
Static Pressure:	**84 PSI**
Residual Pressure:	**77 PSI**
Pitot reading:	68 PSI
Flow:	1,536 GPM
Hydrant Coefficient:	0.9
Adjusted Flow:	**1,382 GPM**

Test No. 2	
Static Pressure:	**84 PSI**
Residual Pressure:	**77 PSI**
Pitot reading:	70 PSI
Flow:	1,558 GPM
Hydrant Coefficient:	0.9
Adjusted Flow:	**1,402 GPM**

We noted that almost immediately after the flowing hydrants reached full flow and the residual pressure dropped to 77 psi, it appears the booster pump(s) initiated and increased the pressure back to the original static pressure. Please review the information and call if you need additional information

Sincerely,

Albert W Reed P E
Reed Fire Protection Engineering
Texas License #45400.

APPENDIX E
Environmental Information

Not Used

Appendix F

Conceptual Aesthetic Considerations

5

IF SHEET IS LESS THAN 24"x36" IT IS A REDUCED PRINT, SCALED REDUCED ACCORDINGLY

GTF AIT BARRACKS COMPLEX RENDERING

22 JUNE 2009

A10

Hensel Phelps Construction Co.
Hensel Phelps Construction Co.
8322 Cross Park Drive
Austin, Texas 78754

JACOBS
Jacobs Engineering Group, Inc.
Texas Registered Engineering Firm F-2966
777 Main Street
Fort Worth, TX 76102

TASK ORDER 0003 - GTF AIT 1200 PN BARRACKS AND CENTRAL ENERGY PLANT, PN 64202
FORT SAM HOUSTON, TEXAS

US Army Corps of Engineers
Fort Worth District

APPENDIX G
GIS Data

Not Used

Appendix H

Exterior Signage

Update
7/30/2006

11.4.2 Sign System Characteristics. There are several basic design characteristics that, by serving to convey necessary information clearly and attractively, are an integral part of any successful signage system.

11.4.2.1 **Simplicity**. An effective strategy provides only needed information, avoids redundancy, and eliminates over-signing with resultant clutter and visual confusion. Sign messages must be clear, simple, and easy for motorists to process quickly.

11.4.2.2 **Continuity**. It is essential that the system be applied uniformly and consistently throughout the entire installation. The importance of consistent implementation extends from the larger issues of sign type and size down to accurate color continuity and matching typestyles.

11.4.2.3 **Visibility**. Sign location is a very important ingredient within the system. Signs must be located at significant decision points and oriented to provide clear sight lines for the intended user. Close coordination of locations with respect to landscaping, utilities, adjacent signage, and various other street design elements is important to ensure long-term maximum visibility.

11.4.2.4 **Legibility**. Sign typestyle, line spacing, color, and size all combine to create the crucial design characteristics of legibility. This aspect of sign design should take into consideration users such as motorist, pedestrians, or bicyclists, and the relative travel speed at which each type of user will be traveling when viewing the signs.

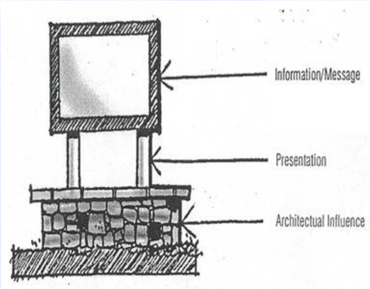


Fig. 11.12 - Signing Language Helps Establish A Signing System

11.4.3 Vocabulary-Communications.

11.4.3.1 A common language has been created for establishing a signing system. The different components that create the sign package have been named and referred to within the total signing system.

11.4.3.2 The creation of a "signing language" helps generate a unified bond within sign types that make up a signing family.

- Reference
  - Information/Message
  - Presentation
  - Architectural Influence
  - Graphic Architecture

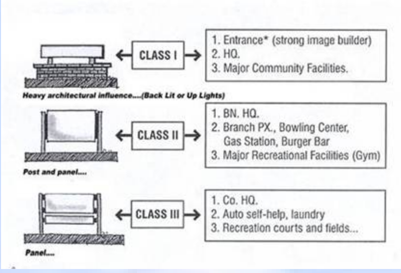


Fig. 11.13 - Signs Can Be Organized Into Classes Within The Visual Hierarchy

11.4.4 Visual Hierarchy.

Update
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11.4.4.1 The entire signing system must communicate, through a range of sign and typestyle sizes, the relative importance of the individual activity that the sign identifies. The system should follow a logical progression from a point of origin to the desired destination.

11.4.4.2 A stated ranking method supports the visual standard of hierarchy within the signing system. Signs can be organized within assigned classes with emphasis on the function and image of the installation.

11.4.4.3 Within each class, the level of architectural influence evokes the importance of the sign to the installation. This is also critical to the idea of progression. The importance of a sign must be presented in its size and level of detail.

11.4.4.4 As individuals move closer to their destination on the installation, the scale of the sign becomes progressively smaller and the level of the message more detailed.

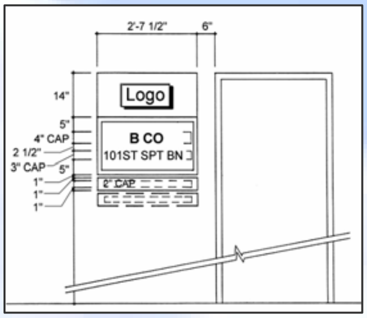

Fig. 11.14 – Building Mounted Information Sign

11.4.5 Types of Signs.

11.4.5.1 Information / Identification Signs.

These are signs that identify entrances to the installation, areas within the installation, major tenants, buildings, and organizational or functional components (Fig. 11.14). They identify a location, and greet the visitor to that location. They should be compatible in scale and character with the architecture and also blend with the natural surroundings (Fig. 11.15). These signs are designed to include the following:

Fig. 11.15 – Use of Street Addresses On All Building Identification Sign

11.4.5.1.1 **Typeface**: Lettering is self-adhesive backing material.

- Building Title: Helvetica Medium, Upper and lower case
- Building Numbers: Helvetica regular
- Building Addresses: Helvetica Medium, Upper and lower case

11.4.5.1.2 **Color**:

- Panel: Dark Brown
- Lettering: White
- Post: Dark Brown
- Exposed panel backs and edges: Dark Brown

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7/30/2006

- All paint: Semi gloss

11.4.5.1.3 **Materials:**

- Panel: Double-face 1/8" thick aluminum
- Post: Steel Pipe
- Foundation: Concrete pier or direct burial

11.4.5.1.4 Building Identification.

11.4.5.1.4.1 Street Addresses. The addressing procedures prescribed in DoD 4525.8-M, DoD Official Mail Manual are mandatory for use by all DoD components. DoD 4525.8-M, Chapter 3 prescribes the following:

All DoD address shall be assigned so they are compatible with the United States Postal Services automated delivery point sequencing (C3.3).

The DoD installation is responsible for assigning city-style, street address on the installation (C3.3.2.2).

Street addresses shall be assigned and used even though a DoD activity may deliver the mail to the addressee (C3.3.2.2.1).

Only geographically locatable civilian-style street address (such as 4102 Cindy Avenue, Fig. 11.X) shall be used (C3.3.2.2.4).

Installations shall not use one street address for the entire installation and then use secondary unit designators such as "Building 123" to designate the delivery addresses on the installation (C3.3.2.2.5).

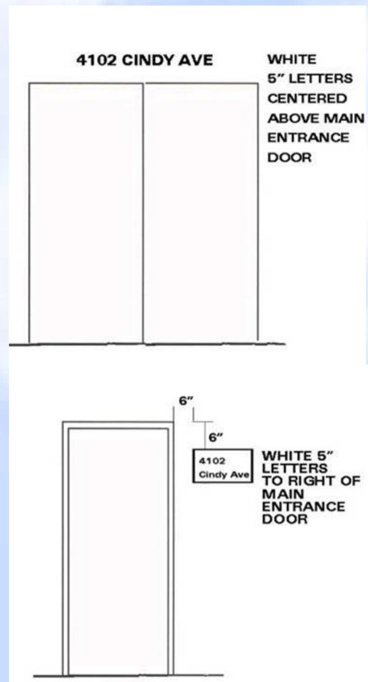

Fig. 11.16 - Street Address Location at Entrance Doors

Addresses such as "Building 123 Roberts Street" are not a valid address format and shall not be used (C3.3.2.2.6).

11.4.5.1.4.2 Address Placement.

Place addresses by the front entrance of the building so they can be seen (C3.3.2.3.1).

Place both the street name and address number on the building if both the building number and street address are visible from the street.

Building identification signs will use street addresses (Fig. 11.16).

Buildings without identification signs shall have the address number and street name centered above the main entrance or located to the right side (Fig. 11.16).

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7/30/2006

11.4.5.1.5 Housing Areas.

11.4.5.1.5.1 The sign should be complimentary to the architectural setting of the housing area and approved by the installation Real Property Planning Board.

11.4.5.1.5.2 Housing numbers should be placed on the curb in front of the respective house and on the house where lighting will effectively light the numbering.

11.4.5.1.6 Installation Identification Signs.

11.4.5.1.6.1 Installation identification signs name the installation and display the official US Army plaque (Fig. 11.17). The designation "United States Army" must appear at the top of the sign in accordance with AR 420-70, para 2-7h. Every installation entrance shall have an installation identification sign displaying only the US Army plaque, with the words "United States Army, Fort (Name of Fort), and gate name as indicated in "Figure 11.17 - Installation Entrance Signs". The placement of Senior Mission Commander logo, unit crest, and other installation identification signs, monuments, or displays shall be located inside the installation beyond the cleared area of the Access Control Point (ACP) of entry. When used service-wide, these signs convey a uniform image of strength and stability to the public. Emblems, branch colors, unit mottos, names, and titles of individuals are not to be displayed.

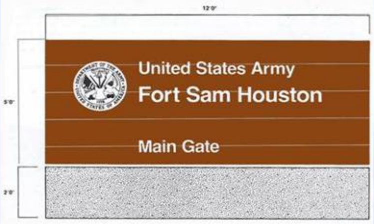

Fig. 11.17 - Installation Entrance Signs

11.4.5.1.6.2 Installation identification signs consist of three types:

- Sign type A1, main 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 access entry gate signs, identifies entry points with limited public access.

11.4.5.1.6.3 See Technical Manual (TM) 5-807-10, Signage, paragraph 3-3, for sign specifications and paragraph 3-11 for sign placement guidelines.

11.4.5.1.6 Street Signs.

Street name identification signs should be designed with the same lettering, color, and materials as other information signs (Fig. 11.18).

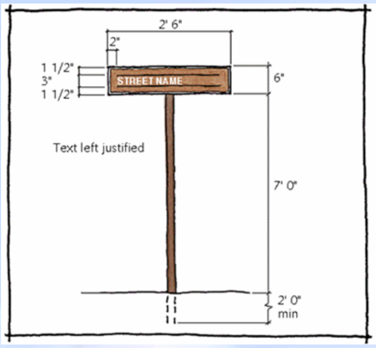

Fig. 11.18 - Typical Street Signs

11.4.5.1.7 Wheeled Electrical Signs.

Wheeled electrical signs will have an attractive presentation. Temporary landscape elements should be used whenever possible. The siting of this type of sign will be approved by the

RPPB. No sign of this type will be left in place for longer than six (6) months. After which time, the sign will be removed or turned into a permanent sign.

11.4.5.2 Directional Signs.

These signs guide the motorist or pedestrian in, around, and out of the installation (Fig. 11.19). The legibility and placement of these signs, as well as the ordering of information, is critical to their effectiveness. These signs should be placed in central locations and at major decision points along circulation routes. These signs are designed to include the following:

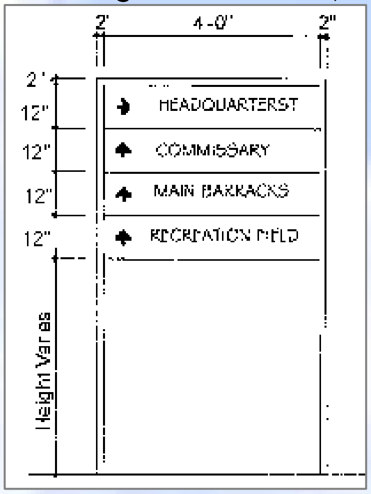

Fig. 11.19 – Direction Sign

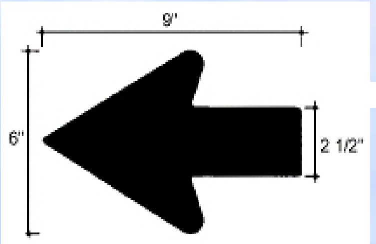

Fig. 11.20 - Typical Arrow For Use On All Destination Signs

11.4.5.2.1 **Typeface**: Lettering is self-adhesive backing material.

- Helvetica Medium upper and lower case

11.4.5.2.2 **Arrow**:

- Place at end indicating direction.
- Stoke width: Helvetica Medium cap

11.4.5.2.3 **Color**:

- Panel: Dark Brown
- Lettering: White
- Post: Dark Brown
- Exposed panel backs and edges: Dark Brown
- All paint: Semi gloss

11.4.5.2.4 **Materials**:

- Panel: Double-face 1/8" thick aluminum
- Post: Steel Pipe
- Foundation: Concrete pier or direct burial

11.4.5.3 Regulatory Signs.

These signs provide the rules for travel and parking on the installation. They include speed signs, turning and lane use signs, warning signs, parking control signs, etc. (Fig. 11.21). Related to these signs are pavement markings and traffic signals. These signs are designed to include the following:

Update
7/30/2006

11.4.5.3.1 **Typeface**: Lettering is self-adhesive backing material.

- Helvetica Medium upper and lower case

11.4.5.3.2 **Color**:

- Panel: Dark Brown
- Lettering: White
- Post: Dark Brown
- Exposed panel backs and edges: Dark Brown
- All paint: Semi gloss

11.4.5.3.3 **Materials**:

- Panel: Double-face 1/8" thick aluminum
- Post: Steel Pipe
- Foundation: Concrete pier or direct burial

11.4.5.3.4 Traffic Control Signs.

11.4.5.3.4.1 CONUS Installations. National highway standards will be used for signs to regulate vehicular traffic on CONUS installation (AR 420-72, Transportation Infrastructure and Dams, Para 2-15f). These standards are described in the Manual of Uniform Traffic Control Devices (MUTCD). Also see MTMC Pamphlet 55-14, Traffic Engineering for Better Signs and Markings. This pamphlet clarifies existing standards and provides definite guidelines for installation officials to conform to the MUTCD. These standards shall be used installation wide to include installation Access Control Points.

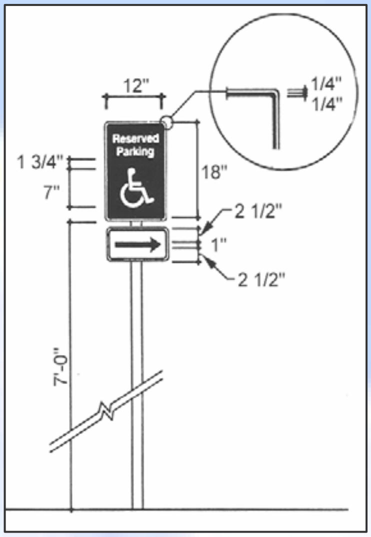

Fig. 11.21 – Regulatory Sign

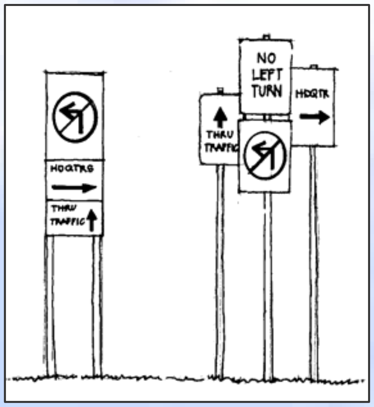

Fig. 11.22 – Sign should be Simple, Legible, and Combined

11.4.5.2.4.2 OCONUS Installations. OCONUS installation streets and roads are to be considered extensions of the road system of the host nation and shall use traffic control device standards and criteria of the host nation (AR 420-72, Transportation Infrastructure and Dams, Para 2-15e).

11.4.5.3.5 Prohibitory (Warning) Signs. This category of signage is intended to maintain security and safety on the installation perimeter and at other specific secure areas. These signs notify visitors of restrictions, as well as other security procedures. The guidelines for design, fabrication, and placement of warning signs are found in Technical Manual (TM) 5-807-10, Signage, para 3-9.

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7/30/2006

11.4.6 Electronic Exterior Signs

All exterior flashing signs, traveling lights, or signs animated by lights of changing degrees of intensity or color are prohibited.

11.4.7 Sign Placement

Placement of signs differs according to the type of sign and the specific site constraints. The following guidelines apply to placement of the majority of signs.

Do not place more than one sign at any location. Traffic rules are the exception to this rule (Fig. 11.X).

Place signs in areas free of visual clutter and landscape materials.

Place signs in locations that allow enough time for the user to read and react to the message.

Signs should not be placed to block sight lines at intersections.

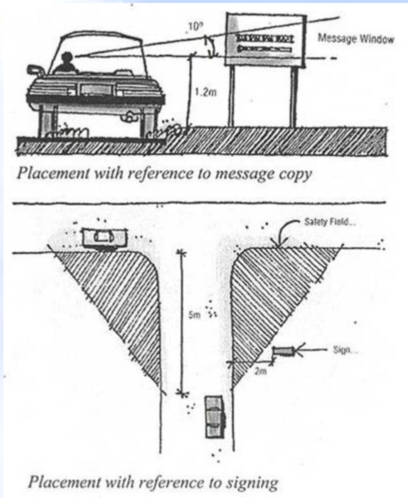

Fig. 11.23 - Placement Is Critical To Ensure Easy Readability

Place signs approximately 1.2 meters (4 feet) above ground level to be within 10 degrees the driver's line of vision (Fig 11.23). Provide proper placement to avoid a hazard to children.

11.4.8 Sign System Typography.

11.4.8.1 Military Emblems. The Army has a rich tradition of military heraldry. Military emblems are an important part of the soldiers' identity and the emblems have been carefully crafted over the years to express unit pride and unique history and function of the unit. The care and use of organizational emblems in a signage system can add visual interest as well as build pride and a sense of history. However, the overuse of miscellaneous emblems can lead to clutter and a dilution of their importance. Colors for military emblems must be in accordance with the Institute of Heraldry.

11.4.8.2 Department of the Army Plaque. The plaque should be displayed on installation identification signage to emphasize the heritage and professionalism of the United States Army. The design of the plaque must be in accordance with Army Regulation (AR) 840-1, Department of the Army Seal, and Department of the Army Emblem and Branch of Service Plaques, and must be reproduced in full color.

11.4.8.3 Insignias. The use of branch insignia, shoulder sleeve insignia, coat of arms and/or distinctive insignia on headquarters signs is permitted. All military emblems must appear in full color. Motivational symbols or motifs will not be used.

11.4.9 Reduce Visual Clutter.

11.4.9.1 Over-signing detracts form a uniform sign system and if left uncontrolled will eventually destroy the integrity of the system.

11.4.9.2 Clutter creates confusion and ineffectiveness. Often motorist and pedestrians are confused by the bombardment of messages that have no relationship to each other, or the communication is on such a minimal level that the sign serves no purpose.

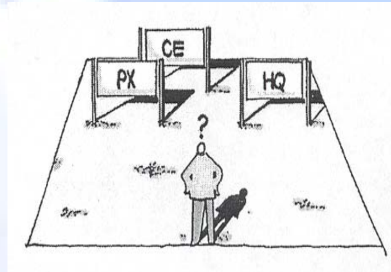

Fig. 11.24 - Visual Clutter

11.4.10 Location Maps.

11.4.10.1 The location map is an integral element of an installation entrance. The location map display provides information and sense of place to the viewer. The design and construction should be of compatible architectural materials found throughout the installation.

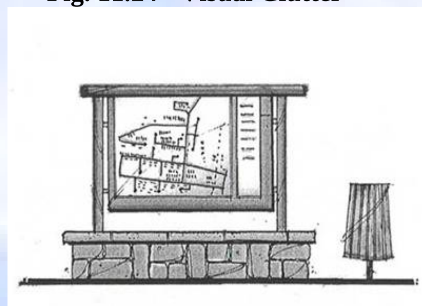

Fig. 11.25 - Location Maps Provide a Sense of Place

11.4.10.2 The location map should contain the following characteristics within the design.

- Plexiglas covered map for protection
- Architectural compatible materials used for the base
- Paved walk-up area
- Litter receptacle
- Provide parking adjacent
- Provide current takeaway maps

11.5 LIGHTING

11.5.1 Lighting is a functional requirement of installations that also impacts the visual environment. The installation lighting system conveys a sense of order and organization. There are five primary types of lighting on military installations. They are:

- Roadway Lighting
- Pedestrian Lighting
- Parking Lot Lighting
- Outdoor Architectural Lighting
- Security Lighting

Appendix I

Acceptable Plant List

Update
7/30/2006

SECTION 10 LANDSCAPE DESIGN STANDARDS

10.1 INTRODUCTION

10.1.1 The Landscape Design Standards includes the selection, placement, and maintenance of plant material on the installation. Landscape plantings provide a simple and cost effective enhancement to the general appearance of the installation. **(Fort Sam Houston developed and published a Landscape Master Plan in 1997 and a Historic District Landscape Master Plan in 1999, both of which provide very specific guidance concerning landscaping for different parts of the installation. The general guidance included in the remainder of this section of the IDG will be followed only if a design consideration is not addressed in the existing Landscape Master Plan or the Historic Landscape Master Plan).**

10.1.3 The visual image conveyed by a military installation is defined not just by architectural character and site organization, but also by an attractive, organized landscape design. The presence of plant material on the installation greatly enhances the visual character and environmental quality of the installation.

10.1.2 Plantings add an element of human scale to open spaces and can be used functionally to screen undesirable views, buffer winds, reinforce the hierarchy of the circulation system, or provide a visual transition between dissimilar land uses.

10.2 LANDSCAPE OBJECTIVES

10.2.1 The overall objective of the use of plant material within the installation is to improve the physical and psychological well being of the people who live and work on the installation. This is achieved through the following objectives:

10.2.1.1 Preserve and enhance urban trees, forest lands, and detailed planting features such as shrubs and groundcovers.

10.2.1.2 Improve the overall visual quality of the installation through the use of native plant material to (Fig. 10.1):

Figure 10. 1 - Use native Plants to Improve Visual Quality

10.2.1.2.1 Blend the built environment with the natural environment.

10.2.1.2.2 Provide scale and comfort to pedestrian environments (Fig. 10.2).

10.2.1.2.3 Reinforce the hierarchy of the traffic circulation system (Fig. 10.3).

10.2.1.2.4 Screen unsightly views or elements.

10.2.1.2.5 Buffer incompatible land uses.

10.2.1.2.6 Minimize maintenance through the use of native plant materials that require less maintenance to survive.

10.2.1.2.7 Enhance Antiterrorism capabilities.

Figure 10.2 - Provide Comfort to Pedestrian Environment

Figure 10.3 - Landscaping Reinforces Circulation Hierarchy

10.3 PRINCIPLES OF LANDSCAPE DEVELOPMENT

10.3.1 Landscape design is based on the following principles.

10.3.1.1 **Unity**. The selection and placement of plant material can be used to blend, screen, and soften incompatible architectural or other unattractive visual impacts. Plant material as a unifying element can be placed in front of a building or view to frame and enhance the visual impact.

10.3.1.2 **Balance**. Plant material can be selected and placed to provide visual equilibrium or balance through the use of either a symmetrical or asymmetrical planting scheme. Symmetrical plantings are generally more formal while asymmetrical plantings are informal.

10.3.1.3 **Contrast**. Plant material can be selected and placed to provide differences in size and shape that add interest to the environment. Plants can be located to provide a backdrop for other plants such as a hedge behind a bed of annuals or perennials.

10.3.1.4 **Rhythm**. Repetition of a single plant or a mass of plants provides visual interest and formality to the landscape. Rhythm produces emphasis and unity and is especially effective in articulating main circulation routes.

10.3.1.5 **Color and Texture**. Plants can be selected and placed to provide visual interest according to their color and texture. Colors are classified as either warm (red, orange, yellow) or cool

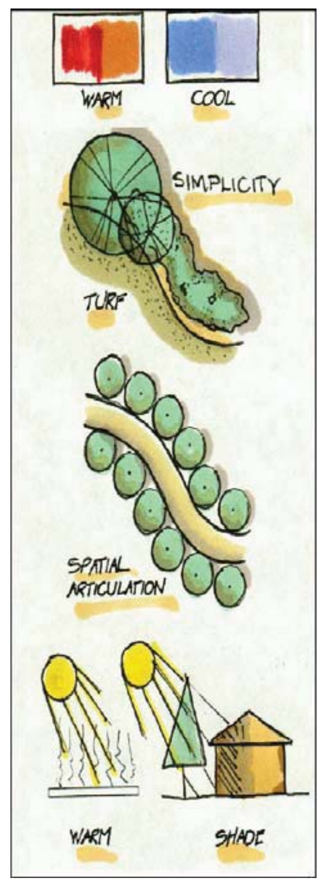

Figure 10. 4 - Principles of Design

(violet, blue, green). Texture is classified as either coarse or fine.

10.3.1.6 **Simplicity**. Landscape plans should be broad and simple in form to limit excessive maintenance. Plant material should be grouped in beds with simple edges that are easy to mow. Small turf areas should be avoided because of the difficulty of mowing. The use of annuals should be minimal because of the high maintenance involved.

10.3.1.7 **Ultimate Effect**. The landscape plan should be prepared with consideration for the mature size of all plants. The spacing of all material should utilize nursery industrial standards for mature material to account for spread as well as height. The ultimate height of the material should also be considered in relation to windows and other visual concerns.

10.3.1.8 **Spatial Articulation**. Plants can be selected and placed to create enclosed spaces or to separate spaces from one another. They can also be used to direct people by visually defining and reinforcing patterns of movement. The degree of enclosure, separation, or movement is dependent upon the density, form, and type of plants used.

10.4 SUSTAINABLE LANDSCAPE DEVELOPMENT

10.4.1 The use of plant material on the installation promotes the sustainability of the development. Trees, shrubs, groundcover, and vines provide aesthetic appeal as well as preservation of fauna and flora, energy conservation, climate modification, erosion control, air purification, and noise abatement (10.5).

10.5 LANDSCAPE DESIGN GUIDELINES

10.5.1 Proposed plantings must be reviewed to ensure that site conditions (soil, topography, adjacent uses, and architecture) and climatic criteria (sun, shade, and moisture requirements) are considered in the desired plant design and selection (i.e., form, texture, color, size). The uses and users of the site must also be considered. Landscape planting plans should be approved by qualified personnel to provide quality assurance and promote design consistency within each visual zone.

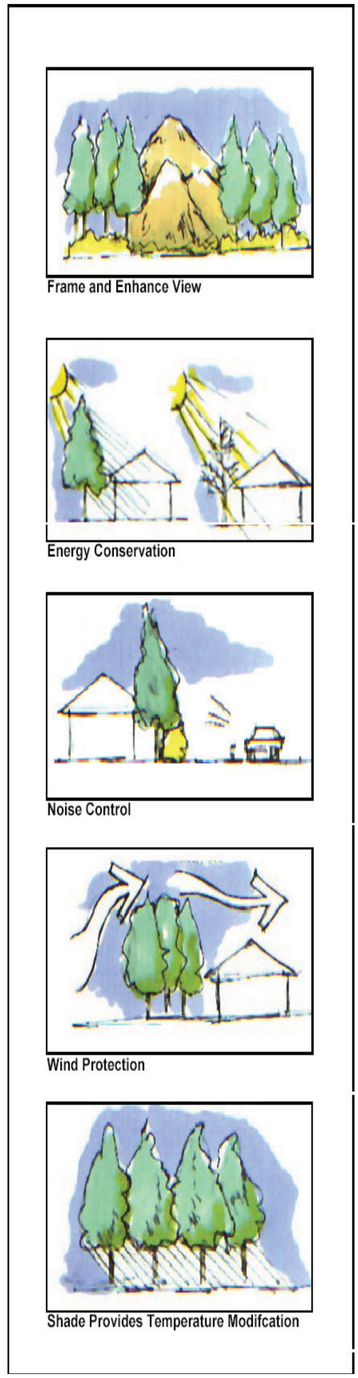

Figure 10.5 Plant Material Promotes Sustainability

10.5.2 The following paragraphs present landscaping guidelines for the various locations of plant material use.

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10.5.2.1 **Foundation Planting**. Foundation planting provides a green background for additional plantings, adds scale and character to the building, helps to integrate the building with its surroundings, screens HVAC and other utilities and helps create a sense of arrival (Fig.10.6). When developing foundation planting plans consideration should be given Antiterrorism measures (See paragraph 10.11).

Figure 10.6 - Foundation Plantings Help Screen Utilities

10.5.2.1.1 Focal and seasonal plantings should be located at building entries for pedestrian interest.

10.5.2.1.2 Use the architecture of the building to evaluate the planting design and selection of plants.

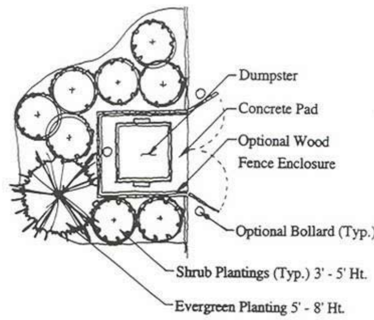

Figure 10.7 - Screen Dumpsters

10.5.2.1.3 Plant materials should not block windows and views from interior spaces.

10.5.2.1.4 Trees shall be setback from the building walls to provide space for mature growth and to prevent root systems from damaging the foundation.

10.5.2.1.5 A symmetrical foundation planting design should be used for a symmetrical building.

10.5.2.1.6 Due to the possibility of insect problems (bee stings, etc.) do not plant flowering plants near entrances.

10.5.2.2 **Screening**.

10.5.2.2.1 **Windscreens**. Use a combination of evergreen and deciduous trees to provide windbreak protection from prevailing winds. Windbreak plantings should be irregular in form, rather than straight and evenly spaced, in order to provide more effective wind control and to visually blend with the natural character of the installation.

Figure 10.8 - Enhance Open Spaces with Plantings

10.5.2.2.2 **Screening of Dumpsters**. Landscape planting should be used to supplement wood fence and masonry wall dumpster enclosures (Fig. 10.7).

10.5.2.3 **Buffer Planting**. Use a mixture of evergreen and deciduous trees and shrubs to visually separate land uses and to help separate visual zones.

10.5.2.4 **Open Space Planting**. Enhance open space areas with planting. Use a mix of evergreen, deciduous, and flowering trees. Plant the same kind of trees in massive groupings to impact the vast open areas (Fig. 10.8).

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10.5.2.5 **Street Trees**. Street tree plantings should be used to reinforce vehicular hierarchy, orient and direct traffic, upgrade views, and to visually de-emphasize on-street parking (Fig. 10.9). Also, in the design of a street tree planting, separate plant species may be used to identify distinctive details or areas of the installation, for example, a particular land use relationship, historical district, community area, or other similar entity.

10.5.2.5.1 Use formal street trees in single rows to visually reinforce primary and secondary roads. Use regularly spaced and uniformly shaped deciduous trees to provide a regimented appearance.

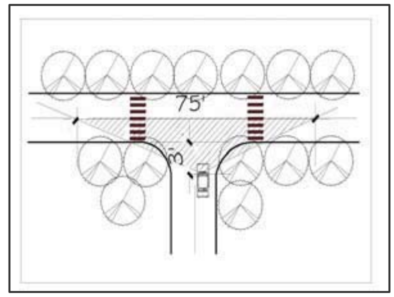

Figure 10.9 – Use Street Trees to Visually Reinforce Roadway Hierarchy

10.5.2.5.2 Use informal groupings of street trees along tertiary routes. Utilize medium size deciduous trees to screen on-street parking along roadways. Set trees 1 to 2 meters (3 to 6 feet) from the back of curbs. Spacing should be uniform, except where curb cuts interrupt regular spacing.

10.5.2.5.3 As a general rule, street trees should be deciduous species, resistant to salt and root pressure, and should have a 10' to 12' high clearance between the street pavement and branch height to allow adequate clearance for pedestrian and vehicle traffic to pass unimpeded by lower branches.

10.5.2.5.4 The street tree layout should be coordinated with the layout of proposed street lighting.

10.5.2.5.5 Appropriate plant heights should be used within sight triangles to ensure safe views from intersections.

10.5.2.5.6 Weeping trees should not be used in locations where they may hang over the roadway or block views.

10.5.2.6 **Parking Lot Planting**. Parking lots are often the least attractive elements on a military installation. The use of landscape plant material and earth berms can greatly improve the appearance of these areas as well as help define circulation and reduce heat gain during summer months (Fig. 10.10).

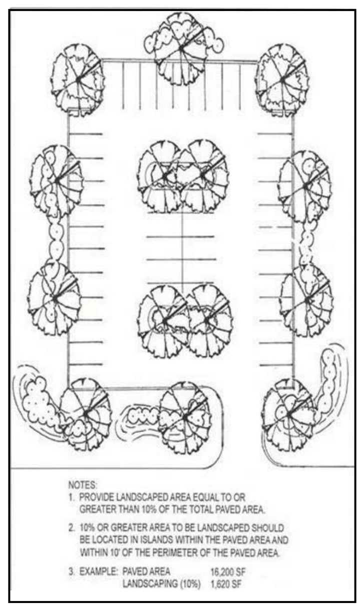

Figure 10.10 - Provide Parking Lot Planting to Reduce Heat Gain

10.5.2.6.1 Use shade tree plantings at parking lots to reduce glare and moderate ambient air temperatures on the lot. Optimum spacing of parking lot shade trees is 10 to 12 meters (35 to 40 feet) on center.

10.5.2.6.2 Choose trees and shrubs that require minimum maintenance and will not litter the parking area with leaves, fruit, or nuts.

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10.5.2.6.3 Consider sight distances near entrances and exits when selecting and placing plant material.

10.5.2.6.4 Select trees, shrubs, and ground covers that can withstand harsher conditions, such as sun, glare, heat, and reduced water supply.

10.5.5.6.5 Use a mix of evergreen and deciduous plant material to screen parking areas from adjacent uses.

10.5.2.7 Environmental Control Planting. When properly placed, plants can provide environmental benefits, as well as address visual concerns.

10.5.2.7.1 Use deciduous trees and shrubs at courtyards, buildings and along streets to provide shade, moderate temperatures and reduce glare during the summer months while allowing solar exposure in the winter.

10.5.2.7.2 Locate deciduous plantings on the southeast and southwest corner of buildings or courtyards to mitigate solar radiation and glare due to heat build-up and lower sun angles in the mid-morning and late afternoon hours.

10.5.2.7.3 Use mixed massing of deciduous shrubs and evergreen trees and shrubs to provide sound control along primary and secondary roads.

10.5.2.8 Image Planting. The image of the installation is formed by the visual impressions that exist within the installation. The primary locations of highly visible images are the main gate, along primary circulation systems, and at areas of high concentrations of people. Features such as signs, statues, static displays, and other primary visual images can be improved by the use of trees, shrubs, and ground cover.

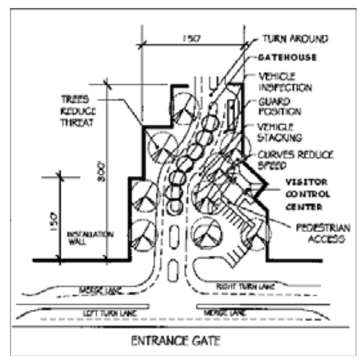

Figure 10.11 - Landscaping at Entrance Gates will Meet AT/FP Requirements

10.5.2.9 Entrances to the Installation. The entrances and streetscapes into the installation are areas to place landscaping that will develop a strong visual image and provide visual interest during all four seasons. The entrance to the installation creates the first visual impression for the visitor (Fig. 10.11).

10.5.2.9.1 The landscape materials and planting areas should be proportional in scale to the hierarchy of the street on which they are located.

10.5.2.9.2 Landscaping must be integrated with the Force Protection requirements of Section 12. Low shrubs, groundcover, annual/perennial plants and canopy trees provide seasonal interest as well as maintain views required to ensure force protection measures. Large evergreen trees are discouraged in these locations because they may obstruct sightlines and impact the need for force protection. Adequate lines of sight must be maintained fro guard personnel to observe vehicular and pedestrian traffic approaching the gate.

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10.5.2.10 Zeroscaping. Where appropriate, to conserve water and lower maintenance consider zeroscaping.

10.5.2.11 Xeriscape. Xeriscape is the conservation of water and energy through creative and adaptive landscape design. Xeriscape landscapes provide attractive solutions that save money, water, and maintenance. The following website provides guidance on specific design principles of the xeriscape design process and xeriscape design application:

- USAF Landscape Design Guide, Xeriscape.

10.6 PLANT MATERIAL SELECTION

10.6.1 Trees, shrubs, ground cover and turf are the major elements of a planting composition. Basic plant selection criteria should consider creating a unified composition utilizing native materials for low maintenance and sustainability, avoiding incompatible colors, textures and forms, and matching the appropriate plant to the land use, situation, and environmental condition.

10.6.2 The ability of plant material to provide lasting benefit is dependent upon the plant's hardiness and its appropriateness to the site use. Major factors affecting plant hardiness are soil type and organic content, temperature, moisture and light. These climatic conditions can be modified to an extent by specific site conditions, such as wind protection, solar orientation, and planting design, to create microclimates.

10.6.3 Selecting appropriate plants for a given condition is only one aspect of planting design. Compositional arrangement to provide texture variety and to accent site and building features is another. The selection and composition of a planting design requires an understanding of each plant's characteristics, form, and environmental needs as well as how each plant can relate to and complement other plants in the design. Plants are used in the four basic design categories (Fig 10.12):

- Canopy
- Barrier
- Screen (or Baffle)
- Groundcover

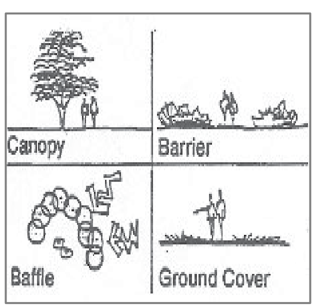

Figure 10.12 Basic Design Categories

Plant Categories

Cultural Characteristics

Growth Rate-Rapid

Growth Rate-Medium

Growth Rate-Slow

Disease/Pest Resistance

Environmental Characteristics

Acidic Soil Tolerant

Alkaline Soil Tolerant

Dry Soil Tolerant

Moist Soil Tolerant

Poor/Rocky Soil Tolerant

Salt Tolerant

Shade Tolerant

Summer Wind Tolerant

Urban Condition Tolerant

Ornamental Characteristics

Blue Flowers

Figure 10.13 - Plant Categories

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10.7 PLANT PALETTE AND PLANT CATEGORIES

10.7.1 The plant palette and categories are designed to help the designer choose the best plant for each particular set of design requirements. The plants that appear on the palette and in the categories were selected for their hardiness and their ability to survive in this geographical area. To use them effectively, the design requirements must be well defined for the specific site.

10.7.2 The Plant Palette.

10.7.2.1 A select group of plant materials has been divided into the following six categories:

- deciduous trees
- coniferous trees
- deciduous shrubs
- coniferous shrubs
- broadleaf evergreen shrubs
- groundcover and vines

10.7.2.2 On the palette, the plants appear in alphabetical order by their botanical name, followed by their common name, design characteristics, cultural information, recommended use, and miscellaneous notes. The plant palette is presented in a matrix format in Appendix O.

10.7.3 The Plant Categories.

10.7.3.1 Plants from the plant palette with similar characteristics have been cataloged in the Plant Categories (Fig. 10.13). These characteristics could be cultural (e.g., upright, narrow form), environmental (e.g., shade tolerant), ornamental (e.g., red fall color), or functional (e.g., screening plant). Characteristics include: Cultural Conditions (mature height and spread, form and growth rate, disease and pest resistance), Environmental Conditions (sun/shade, pH range, soil moisture required, and wind/sun), and Ornamental Characteristics (flower color, autumn color, fruit color, and/or summer leaf color).

Plant Categories Cont.

Ornamental Characteristics

Pink/Purple Flowers

Red/Crimson Flowers

White/Cream Flowers

Yellow/Orange Flowers

Yellow/Orange/Red Fall Color

Functional Characteristics

Erosion Control/Bank Stabilizer

Foundation Plants

Large Hedges (+25')

Medium Hedges (10-20')

Low Hedges (4-10')

Naturalizing/Conservation

Park Trees

Figure 10.14 - Plant Categories Continued

10.7.3.2 Each category describes a list of plants that share a similar quality. For example, materials that are shade tolerant would be placed in the Shade Tolerant group under the "Environmental Conditions" heading. To further explain the Categories, under the

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"Environmental Conditions" heading, in the Shade Tolerant group, all shade tolerant deciduous trees would be listed under “Deciduous Trees"; all shade tolerant Coniferous trees would be listed under "Coniferous Trees"; and so on.

10.8 PLANT MATERIAL INSTALLATION

10.8.1 A key step in assuring successful planting is to select plants of the highest quality. Plant material should be of the size, genus, species, and variety to comply with the recommendations and requirements of the "American Standard for Nursery Stock" ANSI Z60.1.

10.8.2 As part of the design process and prior to plant installation, review the installation's Master Plans, Basic Information Maps, or As Built Drawings for utility locations and verify with the Directorate of Public Works or equivalent.

10.8.3 The planting and establishment of trees, shrubs, ground covers, and vines is detailed in TM 5-803-13, Chapter 3.

10.8.4 General Guidelines for Plant Installation.

10.8.4.1 At planting time, thin plants by removing one-third of the vegetative material.

10.8.4.2 Spray all evergreens with an antidesiccant within 24 hours of planting.

10.8.4.3 Water all plants thoroughly during the first 24-hour period after planting.

10.8.4.4 Site all plants and stakes plumb.

10.8.4.5 Space plants according to their mature size (Fig. 10.15).

10.8.4.6 Install plant materials in groups for greater impact (Fig. 10.16).

10.8.4.7 Installation of Lawn Areas.

10.8.4.8 Installation techniques for turf are detailed in Unified Facilities Criteria (UFC) *3-210-05FA*, Design: Landscape Design and Planting Criteria, Chapter 4. The details include site evaluation, site preparation, selection of turf, and maintenance requirements.

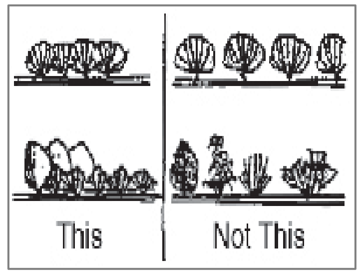

Figure 10.15 - Space Plants According to their Mature Size

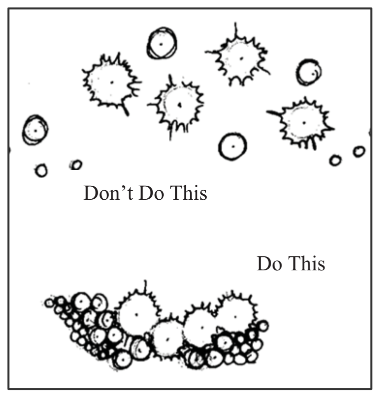

Figure 10.16 - Grouped Plants Have Greater Impact

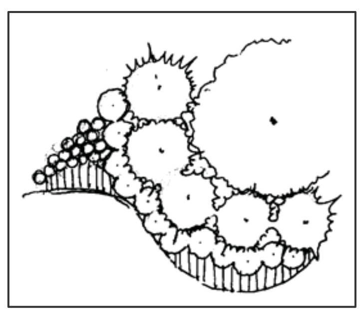

Figure 10.17 - Group Plants in Mulched Beds to Reduce Maintenance

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10.9 MAINTENANCE OF PLANT MATERIAL

10.9.1 The ease of maintenance should be one of the primary goals when considering the success of any planting design (Fig. 10.17).

10.9.2 Pruning. In general plant material should be allowed to conform to its natural shape. This practice allows the plant to mature in a health manner, and saves the time and energy required for trimming. The pruning of trees and shrubs is done to maintain overall plant health, direct plant growth, maintain a desired shape, and increase flower or fruit development.

10.9.2.1 Pruning Shrubs.

- Do not prune shrubs flat across the top.
- Prune branches yearly on thick-branched shrubs and at the base of the shrub.
- When pruning deciduous shrubs prune shrub stems as close to the ground as possible and shrub branches as close to the stem as possible.
- When "thinning out" deciduous shrubs prune about one-third of all branches where they meet their main stem.

10.9.2.2 Pruning Trees.

- Remove a large limb by making three cuts as follows:
- Make the first cut at the bottom of the branch 12-24" from the branch attachment (Cut A, Fig 10.18).
- Make the second cut on the top of the branch within 1" of the undercut (Cut B, Fig 10.18).
- Make the final cut just beyond the outer portion of the branch collar (Cut C, Fig 10.18). The first two cuts were necessary to remove the weight of the branch to allow cut #3 to be clean without ripping the bark.
- Never cut the central leader of the tree.
- Coniferous evergreens trees should be pruned, during the spring, by snipping off new growth. Avoid geometrically shaping plant material while pruning.

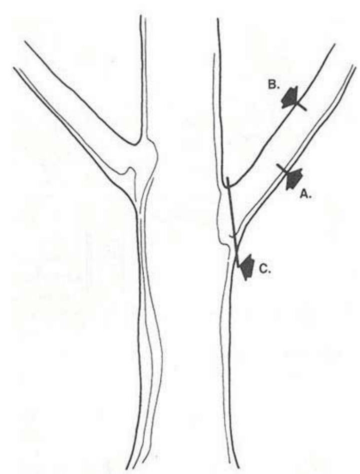

Figure 10.18 - Proper Tree Pruning Procedures

10.9.3 Mulching.

- Use mulch around the base of plant material to provide for greater moisture and help inhibit the growth of weeds and grasses. Mulch should be maintained at a depth of two (2) to four (4) inches.

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- The best time to mulch for water conservation is in the late spring. Apply mulch immediately to new fall plantings.

10.9.4 Ground Cover Maintenance. Although ground covers do not require pruning, they may be periodically dug up in the spring or fall for propagation and to prevent overcrowding in their beds.

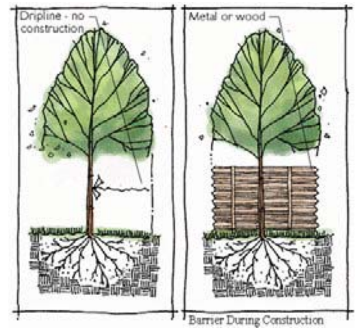

Figure 10.19 - Construct a Barrier at Drip Line During Construction to Maintain Grade

10.9.5 Landscape Maintenance Schedule. The general objective of a landscape maintenance schedule is to ensure an orderly and efficient care of the grounds. The landscape maintenance schedule included in the Army Installation Design Guide (See Appendix F) identifies times throughout the year when specified maintenance should be undertaken. Use of the landscape maintenance schedule will improve all aspects of landscape on the installation. Materials and supplies can be ordered in a timely fashion, manpower needs can be calculated and anticipated, and a correlation between the level of maintenance and appropriate cost can be derived.

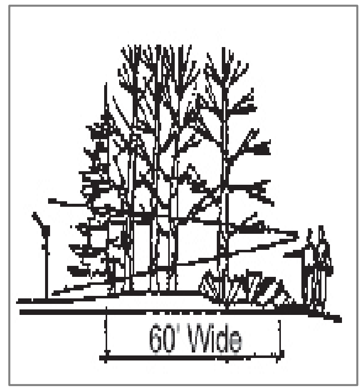

Figure 10.20 – Establish a Visual Barrier in Perimeter Setback

10.10 TREE PROTECTION AND PRESERVATION

10.10.1 Existing urban trees and forest should be preserved if they are in good health. Construction should be planned to provide for the preservation of significant trees.

10.10.2 During the clearing and construction process, trees should be protected from damage. Construction barricades should be erected to protect the existing trees to be preserved. The barricades should be no closer to the trunk of the tree than one-half the distance form the trunk to the drip line. Existing trees that cannot be preserved should be considered for transplanting to a different location on site or to a different site.

10.10.3 Changes in the grade of the soil around trees can cause extensive root damage and eventually death of the tree. To prevent damage to the tree, it is important to maintain the existing grade for least the size of the threes canopy (the drip line) (Fig. 10.19).

10.11 ANTI-TERRORISM/FORCE PROTECTION CONSIDERATIONS

10.11.1 The presence of vegetation on an installation can have both beneficial and detrimental impacts on security. The selection and placement of landscape plant material on Army installations is an integral element in the provision of protective measures to reduce the threat of terrorism.

10.11.2 Proper selection and placement of trees and shrubs can be utilized to provide visual screening without creating concealment for covert activity. The landscape architect responsible for tree placement should work closely with installation force protection experts to design a landscape plan that provides visual screening without compromising Antiterrorism measures (Fig. 10.20).

10.11.3 The plant material must allow building occupants to see out, but must not allow outside forces to monitor interior activity. The landscape architect should incorporate the following aspects into the design:

- Avoid conditions within 10 meters (33 feet) of inhabited structures that permit concealment of aggressors or obscure the view of objects or packages 150-millimeters (6 inches) in height from the view of security personnel. This results in the placement of shrubs and trees that are loose rather than dense in growth habit and possess multiple small stems rather than a single trunk that will obscure a 150 mm (6 inch) package.

- Vegetation groupings provide reduction of blast effect.

- Plant material selection and placement shall minimize potential hiding places for bombs and aggressors.

- Provide vegetation screens for play areas and outdoor recreation areas to obscure from off-installation view.

- Use trees to obscure sight lines of on-installation buildings from off-installation buildings (Fig. 10.21).

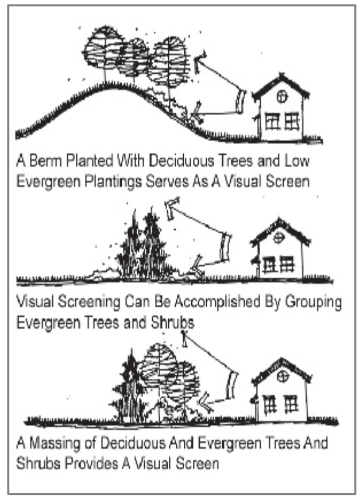

Figure 10.21 - Use Trees to Obscure Sight Lines

10.12 ARMY STANDARDS

10.12.1 The cited Army Standards shall be met.

- Army Regulation (AR) 420-70, *Buildings and Structures*

- Unified Facilities Criteria (UFC) *3-210-05FA*, Design: Landscape Design and Planting Criteria

- Technical Manual (TM) 5-630, *Natural Resources Land Management*

- American Standard for Nursery Stock, ANSI Z60.1

- Overseas (Host Nation Standards)

10.13 REFERENCES

10.13.1 The following references are provided for guidance.

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- Unified Facilities Criteria (UFC) 2-600-01, *Installation Design*, Chap 10
- USAF Landscape Design Guide
- C. Brickell and D. Joyce. Pruning and Training, 1996.

Links

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Appendix J

Project Specific Specifications and Site and BTN HQ Drawings

PROJECT SPECIFIC REQUIREMENTS

6.0 PROJECT SPECIFIC REQUIREMENTS

6.1 GENERAL

The requirements of this paragraph in this chapter augment the requirements indicated in Paragraphs 3 through 5.

6.2 APPROVED DEVIATIONS

The following are approved deviations from the requirements stated in Section 01 10 00, Paragraphs 6.3, 6.4 and 6.6.

6.3 SITE PLANNING AND DESIGN

The following supersedes Chapter 6.3 in 01 10 00.

6.3.1. General: See Appendix J, DRAWINGS for the project location and the location of haul routes and Contractor's staging area. Construction limits shall be confined to the construction site boundaries as shown on the Site Development Plan (SDP) within the Appendices. HQ Contractor shall coordinate with site contractor to determine construction bubble. Reference Specification 01 35 12 for special project conditions for Fort Sam Houston.

6.3.1.1. Existing Conditions: The site is located approximately seven-hundred feet (700') west of Williams Road at Koehler Road. It is an approximate seventeen thousand square foot (+/- 17,000 sq ft) parcel of the AIT Barracks Site. Existing utilities have been run to the area by the site contractor. They have been located, within the area, of the Headquarters, as shown on the Site Utility Plan.

6.3.1.2. Site Development Plan (SDP). The SDP, has been developed with information provided by the Site Contractor and provided, to the HQ Contractor, by the government and is included within the Appendices. It shall be the responsibility of the HQ Contractor to field verify the veracity of the information found on the SDP. Any discrepancies which are found in the furnished plans shall be the responsibility of the HQ Contractor. Borings, a boring location map, data on the subsurface conditions, and the geotechnical report are furnished as part of the RFP, see Appendix A (report) and Appendix J (drawings).

a. The Contractor shall accept the site, as is, and be solely responsible for any geotechnical investigations required to accommodate the Contractor's proposed foundation and other site features (as required by the Contractor's final geotechnical report). The Contractor's pad preparation operations shall be confined to the work area defined by the SDP. However, the HQ Contractor shall provide, as a minimum, soil preparations, as defined in the Governments Geotechnical Report, to the 5' line. Excess soil may not be wasted within the SDP work area without the written approval of the Contracting Officer's Representative (COR). When construction has been completed, the HQ Contractor shall leave the site, free of any debris and with Phase II Erosion Control Measures in-place.

b. The Contractor will be allotted an area as shown on the SDP for the placement of a construction trailer complex and storage for the Contractor and respective Subcontractors. Permanent Trailers will not be permitted within the building envelope work areas. Trailers within the work area may be required to be relocated at no additional cost to the Government to accommodate site activities. The Contractor shall be responsible for the site preparation, fencing, access drives, and maintenance of the compound at all times. Upon completion of the project and after removal of trailers, materials, and equipment from within the fenced area, the fence shall be removed and will become the property of the Contractor. Areas used by the Contractor for the storage of equipment or material, or other use, shall be restored to the original or better condition. Gravel used to traverse grassed areas shall be removed and the area restored to its original condition, including top soil and seeding as necessary.

c. For proposal purposes, the Contractor should assume he will be responsible for providing temporary utilities (water, sewer, and electricity, etc.) during construction at the project site. A water fill point will be provided as indicated on the

SDP. It may be necessary, initially, for the Contractor to truck water to the project site until new utilities are constructed. Installation and maintenance of the haul road from the water fill point to the entrance of the construction site will be the responsibility of the Contractor. The Contractor shall supplement the temporary water connection point with a PRV backflow preventer and the connection, must be metered. Routing of haul roads shall be coordinated with the COR.

d. The Contractor is responsible for connection of all utilities from the building to the service lines. These service lines may not fall in the five foot (5') line, but lie within the construction limits. The Contractor's utility plan shall show the points of connection. The Contractor shall be responsible for coordinating his connection points and any utility outages with the installation and service providers. The Contractor shall adhere to the requirements of SECTION 01 35 13.00 44 SPECIAL PROJECT PROCEDURES FOR FORT SAM HOUSTON paragraph 3.3.

e. Any deviations from the SDP become the responsibility of the Headquarters Contractor.

6.3.1.3. Grading Requirements:

a. Finished Floor Elevations: The Grading Plan has been completed by the Site Contractor, Finished floor elevation has been determined and is shown on the SDP. The finished grade shall meet the requirements of the Site Grading Plan. The Headquarters Contractor shall confine all building pad and subgrade preparation to the five-foot (5') line. All, site preparation, outside the five-foot (5') line shall be the responsibility of the Site Contractor. However, the HQ Contractor shall provide positive drainage away from the HQ Facility.

b. Unpaved Areas Adjacent to Buildings: Outside finished grade shall slope away from the building at a 3% minimum grade for the first 10 feet. This grade should be extended to 20 to 30 feet in areas with expansive soils. When site conditions require the use of slopes greater than 10% near buildings, a 5% grade will be provided for the first ten feet immediately adjacent to the building. These requirements shall be indicated on the grading plan with critical spot elevations.

c. Lawns and Landscaped Areas: Landscape areas, within the five-foot (5') are the responsibility of the site contractor. The Headquarters contractor shall bring the site to Final Grade, with proper materials and provide erosion control measures until such a time that the Site Contractor provide the landscaping.

d. Ditches and Channels: Not Applicable

e. Roads, Streets, and Access Drives: Gradients for roads, streets and access drives shall be as outlined in AASHTO, *A Policy of Geometric Design of Highways and Streets*. Grade changes in excess of 1% shall be accomplished by means of vertical curves. The length of vertical curves will be determined in accordance with the aforementioned AASHTO criteria. Profiles are mandatory for vertical control of centerline gradients. Roads, streets and highways should be shown using half-plan/half-profile type drawings.

f. Parking Areas: Not Applicable

g. Culverts: Not Applicalble

h. Finish Grade Contours and Spot Elevations: Provide finish grade contours at 1-foot intervals and spot elevations to construct all site development features. Spot elevations on the drawings should be sufficient so that interpolation between contours is not required for structures, grading or paved areas. Spot elevations shall be provided at a minimum at all grade changes, points of curvature/tangency for curbs and swales, corners of parking lots and sidewalks, building corners, thresholds, and ramps.

6.3.1.4. Demolition: The Contractor shall conduct a site visit, and coordinate with Site Contractor, prior to bids. The contractor shall remove any utility lines that have been abandoned in place.

6.3.1.5. Design Submittal: The Contractor's site design shall include separate drawings to include, but not limited to Demolition, Site Layout, Grading, including storm drainage structures, Site Utilities, Erosion and Sediment Control, and Turfing and Landscaping. Complete design calculations shall be included in a design analysis for site development items such as storm drainage, storm drainage structures, and all outside utilities. Horizontal and vertical control shall be provided for all new facilities. Innovative site design is encouraged within the site boundaries. The Contractor shall provide electronic design files (CADD/GIS) for the site as part of their design and construction responsibilities. The electronic files shall follow the coordinate system utilized in the SDP, and must be included as an as-built condition.

6.3.2 Site Structures and Amenities:

a. Building Setback and Force Protection: The site shall be laid out based on the facility threat security level to protect against exterior attack by providing standoff distance between an aggressor or bomb, barriers, and to facilitate visual monitoring of the site. Reference is made to the force protection requirements in UFC 4-010-01.

b. Building Spacing: Fire clearance separations shall be in accordance with UFC 3-600-01 and the International Building Code. Verify that fire clearances and access for equipment is acceptable to the installation’s Fire Chief. Separation for buildings shall conform to force protection requirements per UFC 4-010-01.

c. Service Drives: Widths of drives to unloading ramps or docks for usual types of trucks or tractor trailers are: Trucks, Single-Unit - 12 feet, Semi-trailers - 16 feet>

d. Walks: Walks/stoops, within the five-foot (5’) line shall be provided by the Headquarters Contractor. The walks/stoops shall be constructed of reinforced concrete. The loading dock pad, the stairway to the loading dock, driveway, gate and removable bollards shall be furnished by the site contractor.

e. Dumpsters: Dumpster pads and enclosures shall be provided by the site contractor.

6.3.3. Site Functional Requirements:

6.3.3.1. Stormwater Management (SMM) Systems:

a. Because the construction bubble, for the HQ Facility is +/- 1.9 acres, the Contractor shall comply with the requirements of general permit number TXR150000. The latest specs, for Stormwater Management shall be obtained, with the assistance of the COR, and completed, prior to construction.

6.3.3.1.1. Storm Drainage Systems: The storm drain system, for the entire site, including loading dock area, However, the HQ Contractor shall accommodate the roof drains, below grade, to the stormwater collection system, provided by site contractor, located in front of the headquarters building.

6.3.3.2 Erosion and Sediment Control:

During the construction of the facilities, the Contractor shall be responsible for the Storm Water Pollution Prevention Plans (SWPPP) for the limits of the entire HQ construction site. The use of silt fences, mulch straw/hay bales around inlets, and sediment traps to control erosion during construction shall be included in the design.

6.3.3.3. Vehicular Circulation:

a. Geometric Features: Geometric design of all roads, streets, access drives, and parking areas shall conform to the requirements presented in AASHTO, *A Policy of Geometric Design of Highways and Streets*. Verify with the local installation that access for fire equipment is adequate. Radii, to back of curb, for intersections are standardized as follows:

Primary and Secondary Intersection - 30 feet

Tertiary intersections - 20 feet

Access drives at end parking space - 5 feet

6.4 SITE ENGINEERING

The following supersedes Chapter 6.4 in 01 10 00.

6.4.1. Existing Topographic Conditions:

All necessary Topographical Information, Horizontal and Vertical, shall be the responsibility of the HQ Contractor.

6.4.2. Existing Geotechnical Conditions: A Government Geotechnical Report has been prepared and is in Appendix A. The Government Geotechnical Report provides a general overview of the areal geologic conditions with detailed descriptions of the subsurface strata encountered during the Government geotechnical field investigation. Based on the results of the field investigation, laboratory testing program, and engineering analyses, the Government Geotechnical Report further provides parameters and minimum foundation design requirements which the Contractor shall utilize and comply with for designing the foundation. However, as stated in the Government Geotechnical Report, the Contractor (successful bidder) is responsible for drilling additional borings at the site, and performing additional laboratory testing (specified in the Government Geotechnical Report). The additional geotechnical field investigations conducted by the Contractor shall be ONLY for the purpose of supplementing the data regarding subsurface conditions provided by the Government geotechnical field investigation, as presented in the Government Geotechnical Report. The Contractor's team shall include a licensed geotechnical engineer to interpret the Government Geotechnical Report. The Contractor's geotechnical firm shall have demonstrated successful performance in design of at least five (5) projects of similar type and scope in expansive soil environments in the state of Texas. The Contractor's licensed geotechnical engineer, in accordance with the requirements of the Government Geotechnical Report, shall develop and oversee the additional geotechnical field investigations and laboratory testing, and analyze and use this data to prepare a report that will verify the sufficiency of the minimum foundation and pavement design requirements provided in the Government Geotechnical Report.

6.4.2.1 A final geotechnical evaluation report shall be prepared by the Contractor's licensed geotechnical engineer and submitted along with the first foundation design submittal. This report shall summarize the subsurface conditions encountered during supplemental geotechnical borings and lab testing and provide recommendations for the design of appropriate foundations, floor slabs, retaining walls, embankments, and pavements **in full compliance** with the minimum foundation, floor slab system, earthwork, and pavement design requirements established in the Government Geotechnical Report. Specifically, THE BATTALION HEADQUARTERS SHALL BE FOUNDED ON EITHER A REINFORCED CONCRETE RIBBED MAT SLAB OR A REINFORCED CONCRETE FLAT MAT SLAB, DESIGNED IN ACCORDANCE WITH THE CRITERIA AND REQUIREMENTS PRESENTED IN THE GOVERNMENT GEOTECHNICAL REPORT. NO OTHER FOUNDATION SYSTEMS SHALL BE ALLOWED. THE FOLLOWING FOUNDATION SYSTEMS ARE SPECIFICALLY PROHIBITED: SPOT AND/OR CONTINUOUS SPREAD FOOTINGS, STRAIGHT-SHAFT DRILLED PIERS, DRIVEN OR CAST-IN-PLACE PILES, AND AUGER CAST PILES. The Contractor's geotechnical report shall discuss the types of foundation systems to be used, lateral load resistance capacities for foundation systems, and allowable bearing capacity and elevations for the foundation elements. An assessment of post-construction settlement potential including total and differential shall be provided. Recommendations regarding lateral earth pressures to be used in the design of retaining walls shall be provided and shall be in compliance with the parameters provided in the Government Geotechnical Report. 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, heave, and pavement sections. Supporting documentation shall be included for all recommended design parameters such as site class, shear strength, earth pressure coefficients, friction factors, sub grade modulus, California Bearing Ratio (CBR), etc. in addition, the report shall provide earthwork recommendations and address variations between the recommendations provided by the government and the contractor's geotechnical consultant; expected frost penetration; expected groundwater levels; recommendations for dewatering and groundwater control; and 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. All of these parameters shall meet or exceed the minimum requirements established in the Government Geotechnical Report.

6.4.2.2 The Design-Build contractor and the professional geotechnical engineer consultant shall certify in writing that the foundation, floor slab, earthwork, and pavement designs for the project have been developed **in full compliance** with the requirements established in the Government 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.>

6.4.2.3 PAVEMENT: Pavement designs shall meet the minimum required pavement sections provided in the Government Geotechnical Report, and shall be designed in accordance with the design guidance referenced cited in the Government Geotechnical Report and using Pavement-Transportation Computer Assisted Structural Engineering (PCASE) pavement design software (which is available as a free download – refer to Section 6.b. of the Government Geotechnical Report). The Contractor’s geotechnical report shall contain flexible and rigid pavement design(s) including design CBR and modulus of subgrade reaction and the required compaction effort for subgrades. Information shall be offered on the types of base course materials available in the area and design strengths. Pavement markings and traffic signage shall comply with the Installation requirements and with the Manual on Uniform Traffic Control Devices.

6.4.3. Fire Flow Test: Although a fire flow test has been provided in Appendix D, The HQ Contractor shall perform a fire flow test to support previous data. This shall be coordinated through the COR.

6.4.4. Pavement Engineering and Traffic Estimates:

6.4.4.1. Pavements: Geometric design of roads and streets shall following the guidance provided in AASHTO - *A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS and GUIDELINES FOR GEOMETRIC DESIGN OF VERY LOW-VOLUME LOCAL ROADS (ADT≤400)*. Pavement structures shall be designed in accordance with criteria contained in AASHTO - *GUIDE FOR DESIGN OF PAVEMENT STRUCTURES*. Vehicle types expected to occupy the pavements and their frequency of use are as follows: Delivery Trucks

a. Pavement markings and striping shall be in accordance with state DOT standards and the Manual of Uniform Traffic Control Devices (MUTCD). Channelization and pavement markings shall be as required by the FHWA MUTCD and FHWA Standard Highway Signs.

6.4.4.2. Delivery Vehicle Access: Access drive, shall be provided by the site contractor.

6.4.4.3. Concrete Hardstands: A joint pattern plan shall be developed showing locations of each type of joint to be used. Spot elevations are required at the intersection of each joint to facilitate placement of forms during construction.

6.4.5. Traffic Signage:

Permanent and construction roadway signs shall be as required by the FHWA MUTCD and FHWA Standard Highway Signs.

6.4.6. Base Utility Information:

a. Underground utility lines such as sanitary sewer, water, and gas shall not be placed under existing or proposed pavements, but the utility shall be placed between the back slope of a road ditch and building, or back of curb. Deviations to the aforementioned requirements shall be coordinated with the COR. Do not locate above ground utility features in front of, or in such a manner as to detract from the facility, make landscaping more difficult, or restrict or negate close-in recreational areas. High pressure gas lines shall not be closer than 100 feet from an occupied building without special protective provisions and COR approval.

b. Utility information shall be coordinated and planned with the Installation’s DPW through the COR. The SUP provides existing utility routing and general orientation for points of connection. Specific connection locations shown are noted hereinafter.

c. Included in Appendix J is the Site Utility Plan (SUP), which includes the following information: Location of Sanitary Sewer Service, Storm Drainage, Water Service, and Natural Gas Service.

6.4.6.1. Site Electrical:

a. Only the first two sentences of paragraph 6.9.1 are relevant to this RFP.

b. Only paragraphs 3.10.1p, 3.10.1q, 3.10.2.1b, 3.10.2.1c and 3.10.2.1d in Appendix CC apply to the exterior electrical requirements of this RFP.

6.4.6.2. Water Distribution System: The water distribution system is shown on the SUP. The Contractor shall coordinate points of connection through the COR with the installation DPW. Although the water lines are not within the five-foot (5') line, the HQ Contractor is responsible , for connection, to these lines as shown on the SUP, this includes the fire water connection. Design and construction of potable water service between the main line and the facility shall be the responsibility of the Contractor. Design and construction of the water distribution system for domestic water shall be in accordance with applicable AWWA Standards. A meter will be provided by the Contractor, and the Contractor will be responsible for connection to the meter and all service piping beyond the meter outlet. Design and installation of the water system and meter shall be in accordance with the requirements of the Coordination with the installation DPW. The HQ Contractor shall verify the installation requirements for the backflow preventer and water meter , with DPW, prior to the bid process.

a. Potable Water Disinfection - Verification of water line disinfection shall be performed per AWWA C651-05. The samples shall be analyzed by an analytical lab that holds a current state license and certification. Repeating disinfection protocols per AWWA C651-05 is required until satisfactory results are obtained (two consecutive sets of acceptable samples taken 24 hours apart). Water samples shall be collected in proper sterilized containers, and a bacterial examination shall be performed in accordance with state approved methods. As a minimum, one water sample from each 1000 linear feet segment of disinfected water line shall be collected. The water supply system disinfection is not approved for usage until each test result is negative for bacteriological examination. The water sample analytical results shall be provided to the DPW's Environmental Office for record keeping. The commercial laboratory shall be certified by the state's approving authority for examination of potable water.

6.4.6.3. Sanitary Sewer System: The sanitary sewer system is shown on the SUP. The connection point does not lie within the five-foot (5') Line, however, the HQ Contractor is responsible for the tie in, no further than the location, as shown,on the SUP. The Contractor shall coordinate points of connection through the COR with the DPW. Design and construction of the sanitary sewer system shall be in accordance with American Society of Civil Engineers (ASCE) and the Water Environment Federation (WEF), *Gravity Sanitary Sewer Design and Construction*, Second Edition (ASCE Manuals and Reports on Engineering Practice No. 60 / WEF Manual of Practice No. FD-5). Sanitary Sewer service shall be provided to the building. The Contractor is responsible for the installation of two-way cleanouts and all structures required by criteria, as well as, all piping between the designated point of connection and the building. Minimize the use of lift stations. If a lift station is required, provide a packaged unit assembled of coated materials that do not easily corrode. Provide an audible and visible alarm. Ensure location of lift station is accessible by service vehicles. Manholes shall be provided at every change of direction and every 400 feet. Provide drop manholes if pipe elevations differ more than 18 inches. The minimum sewer main size shall be 8-inch. Provide 6-inch minimum sewer connections to buildings. Provide two-way cleanouts every 100 feet along a sewer branch connection from a building, and provide two-way cleanouts at the building connection. Manhole inlets shall be constructed of reinforced concrete or pre-cast reinforced concrete. Structures in pavement shall be designed to handle H-20 loading. Structures in turfed areas can be constructed for lighter weight loading. The Contractor has the option of using PVC pipe, High Density Polyethylene pipe, Reinforced Plastic Mortar pipe, or Reinforced Thermosetting Resin pipe for the sanitary sewer pipes. A video of the sanitary sewer line, from the building main to the tie-in manhole, shall be the responsibility of the HQ Contractor and shall be submitted to DPW prior to the final inspection.

6.4.6.4. Natural Gas Distribution: Natural Gas distribution lines are shown on the SUP. The Contractor shall coordinate points of connection to the facility with the CPS Energy through the COR. Natural gas service shall be brought to the face of the building by the CPS Energy. CPS Energy shall install the site gas distribution piping. CPS Energy shall provide and install the gas meter and connect the meter to the building stub out. The Contractor shall be required to stub the gas feed out of the building. The Contractor is not responsible for costs incurred for services provided by CPS Energy. Design and construction of the natural gas service lines shall be in accordance with ANSI B31.8, *Gas Transmission Distribution* *and Piping Systems*. Natural gas shall be provided to the building. A meter/regulator assembly shall be provided for the facility by the Contractor and shall have a valved bypass.>

6.4.7. Cut and Fill: The Contractor shall strive to achieve a balanced cut and fill for earthwork.

6.4.8. Borrow Material: Borrow areas are located on the installation. If required, The Contractor shall meet with DPW Environmental Office to determine stabilization requirements at borrow sources. Waste earth shall be disposed of in the DPW material compound.

6.4.9. Haul Routes: See Appendix J, DRAWINGS for the project location and the location of haul routes and Contractor’s staging area.

6.4.9.1 A water fill point, necessary for construction, shall be coordinated with the COR, prior to bid.

6.4.9.2 Laydown Area and construction trailer area, although shown on sheet G301, shall be coordinated with the Site Contractor, prior to bid.

6.4.10. Clearing and Grubbing:

Clearing and grubbing, if necessary, shall be the responsibility of the Site Contractor

6.4.11. Landscaping:.

a. Landscaping shall be the responsibility of the Site Contractor.

b. Landscape Irrigation. No permanent landscape irrigation is to be provided for the HQ Facility.

6.4.12 Turf: Turfing, or other approved erosion control measures, shall be required on all graded, unpaved and disturbed areas resulting from the Contractor’s operations. Sod shall be used in areas with steep slopes (≥ 3:1) or ditch linings to assist in establishing turf and to aid in erosion protection. Turf Reinforcement Matting (TRM) should be used in ditches that are subject to high velocity storm runoff. Erosion control matting shall also be utilized as necessary to control erosion on steeper slopes.

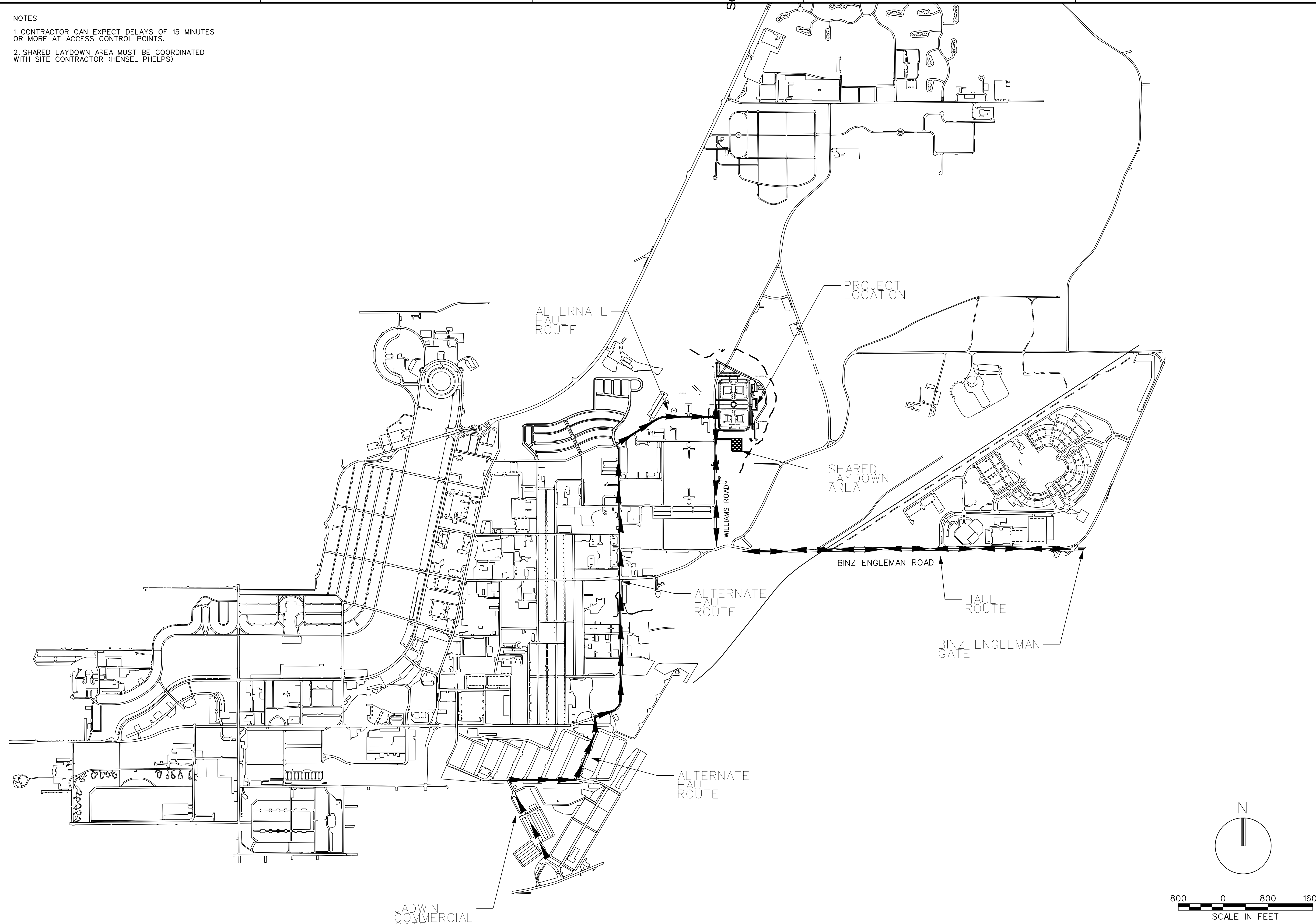
6.6.3 Foundation (This paragraph supersedes paragraph 6.6.3 in 01 10 00)

USE OF EITHER A REINFORCED CONCRETE RIBBED MAT SLAB OR REINFORCED CONCRETE FLAT MAT SLAB, DESIGNED IN ACCORDANCE WITH THE REQUIREMENTS AND CRITERIA PRESENTED IN THE GOVERNMENT GEOTECHNICAL REPORT, IS REQUIRED FOR THE BATTALION HEADQUARTERS. NO OTHER FOUNDATION SYSTEMS SHALL BE ALLOWED. THE FOLLOWING FOUNDATION SYSTEMS ARE SPECIFICALLY PROHIBITED: SPOT AND/OR CONTINUOUS SPREAD FOOTINGS, STRAIGHT-SHAFT DRILLED PIERS, DRIVEN OR CAST-IN-PLACE PILES, AND AUGER CAST PILES. Structural foundation elements shall have a minimum concrete strength of 3000 psi. Piers, carton forms, minimum reinforcing steel requirements, and all other aspects of the foundation design shall be in full compliance with (shall **meet or exceed**) the requirements presented in the Government Geotechnical Report attached as part of this document. Use a vapor barrier with a minimum 10-mil polyethylene membrane under all slabs on grade.

NOTES

1. CONTRACTOR CAN EXPECT DELAYS OF 15 MINUTES OR MORE AT ACCESS CONTROL POINTS.

2. SHARED LAYDOWN AREA MUST BE COORDINATED WITH SITE CONTRACTOR (HENSEL PHELPS)



US Army Corps of Engineers
Fort Worth District

Symbol	Description	Date	Action	Tracking No.

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION ENGINEERING BRANCH

Designed by: BOB LOPEZ
Dwn by: BOB LOPEZ
Reviewed by:
Submitted by: DAVID G. BROWN, P.E. CHIEF, CIVIL SECTION

Date: MAY 2010
Sol No.
Contr No.
Rev.

File name: G301.dgn
Plot date: 10/8/2010
Plot scale:

FORT SAM HOUSTON, TEXAS
ADVANCED INFANTRY TRAINING (AIT) HEADQUARTERS

ROJECT LOCATION AND HAUL ROUTE

SHEET SEQUENCE NUMBER

G301

Contr No.

10/8/2010 10:34:44 AM
M2ECDRJL
G301.dgn

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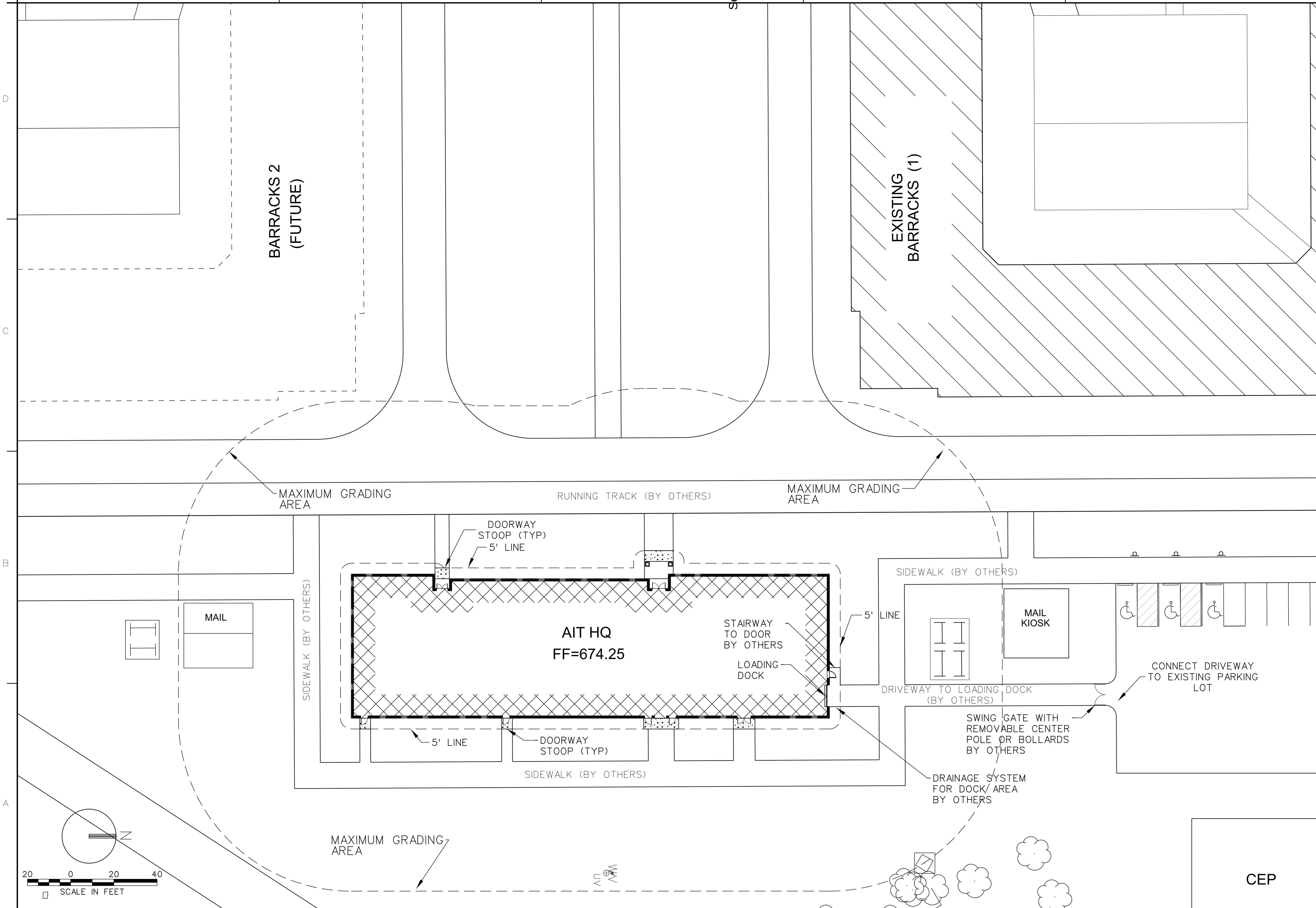

11/5/2010 7:36:48 AM
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C101.dgn

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: Bob Lopez
Dwn by: Bob Lopez
Reviewed by:
Submitted by: DAVID BROWN, P.E. CHIEF, CIVIL SECTION
Date: OCTOBER 2010
Rev.
Sol No.
Contr No.
File name: C101.dgn
Plot date: 11/5/2010
Plot scale:

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION ENGINEERING BRANCH

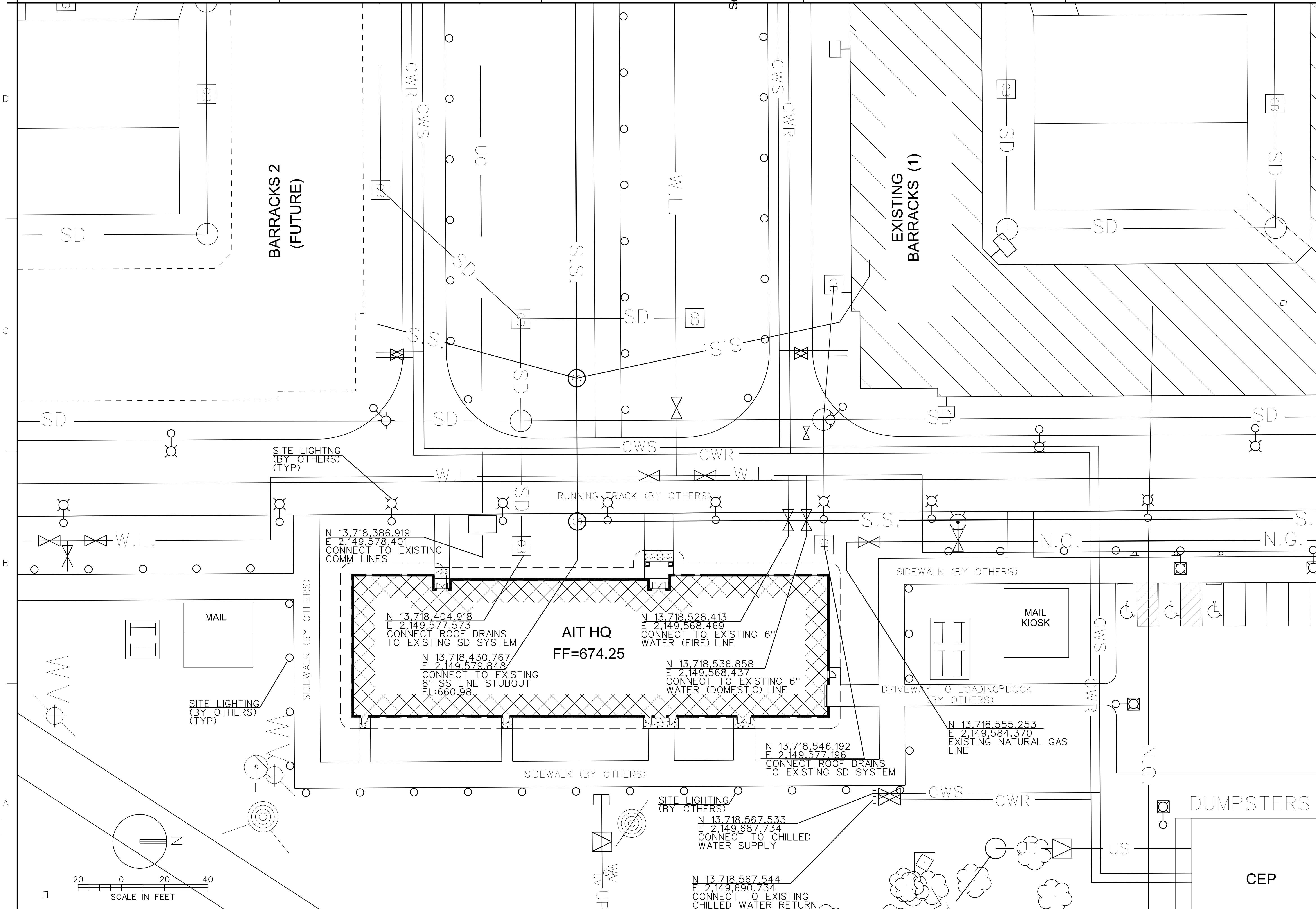
FORT SAM HOUSTON, TEXAS
ADVANCED INFANTRY TRAINING (AIT) HEADQUARTERS
PN# 64202

SITE DEVELOPMENT PLAN (SDP)

Sheet reference number:

C101

Contr No.



US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Rev.	
Date: OCTOBER 2010	
Designed by: Bob Lopez	Sol No.
Dwn by: Bob Lopez	Contr. No.
Reviewed by:	File name: C501.dgn Plot date: 11/5/2010 Plot scale:
Submitted by: DAVID BROWN, P.E. CHIEF, CIVIL SECTION	

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION ENGINEERING BRANCH

FORT SAM HOUSTON, TEXAS
ADVANCED INFANTRY TRAINING (AIT) HEADQUARTERS
PN# 64202

SITE UTILITY PLAN (SUP)

Sheet reference number:
C501

11/5/2010 7:36:50 AM
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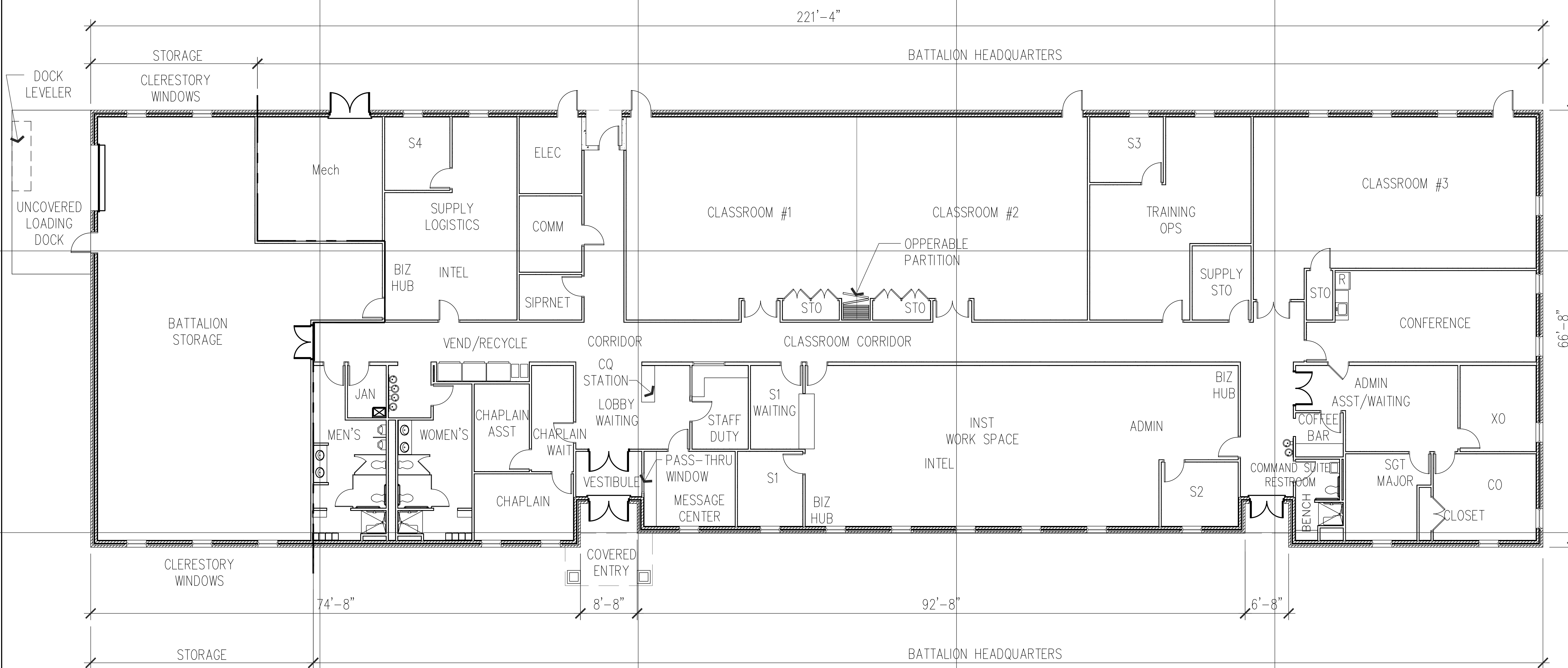
C501.dgn



1 AIT BATTALION HEADQUARTERS

SCALE: N.T.S.

0 4' 8' 16' 32'

GRAPHIC SCALE

AREA	GROSS SQUARE FOOTAGE
BATTALION HEADQUARTERS FACILITY (EXCLUDING COVERED PORCHES)	12,197
COVERED ENTRY (REAR) AT 1/2 SCOPE	15
COVERED ENTRY (MAIN) AT 1/2 SCOPE	20
CANOPY AT MAIN ENTRY AT 1/2 SCOPE	50
COVERED ENTRY (COMMAND SUITE) AT 1/2 SCOPE	15
TOTAL BTHQ BUILDING AREA	12,297
STORAGE BUILDING AREA	2,227
BUILDING TOTAL	14,524
AUTHORIZED GSF	14,560

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date
				06-10-2010

Designed by: JJG
Dwn by: JJG
Reviewed by: WW, BB
Submitted by: BILL BOYLE, A.I.A CHIEF, ARCHITECTURAL SECTION
Date: 10-04-2010
Sol No.
Revision No: 01
File name: $$cadd file name$$
Plot date:
Plot scale:

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION DESIGN BRANCH

FORT SAM HOUSTON
ADVANCED INDIVIDUAL TRAINING
BATTALION HEADQUARTERS

UNIQUE FACILITY FLOOR PLAN

Sheet reference number:
A-101

Appendix K

Fuel Cost Information

FUEL COST INFORMATION

The following utility rates for this installation are provided for the purpose of performing life-cycle cost calculations in response to this solicitation and for design development in accordance with Section 01012 Design After Award:

MONTHLY ELECTRIC BILL

Rate
$ 1,000.00 Service Availability Charge

Demand Charge
Summer Billing (June - September)
$ 8.25 Per KW for all KW of Billing Demand

Non-Summer Billing (October - May)
$ 6.90 Per KW for all KW of Billing Demand

The Monthly Demand will be the KW as determined from reading the demand meter for the 15 minute period of the greatest demand reading during the month.

Energy Charge
$ 0.0346 Per KWH for the first 250 KWH per KW of Billing Demand
$ 0.0310 Per KWH for all additional KWH

MONTHLY GAS BILL

Rate
$ 325.00 Service Availability Charge

Demand Charge
Winter Billing (December-March)
$ 0.92 Per CCF/Day of Billing Demand

Non-Winter Billing (April-November)
$ 0.74 Per CCF/Day of Billing Demand

Energy Charge
$ 0.280 Per CCF for all CCF .

1 CCF equals 100 cubic feet

MONTHLY WATER BILL

$1 .50/1000 Gallons

Appendix L

LEED Project Credit Guidance

Appendix L

LEED Project Credit Guidance (OCT 09)

This spreadsheet indicates Army required credits, Army preferred credits, project-specific ranking of individual point preferences, assumptions guidance for individual credits, and references to related language in the RFP for individual credits.

LEED Credit Paragraph	LEED Project Credit Guidance	**Army Guidance:** Required - Preferred - Avoid	**Project Preference Ranking**: (1=most preferred, blank=no preference, X=preference not applicable to this credit, Rqd=required)	
PAR	**FEATURE**			**REMARKS**
<u>SUSTAINABLE SITES</u>				
SSPR1	Construction Activity Pollution Prevention (PREREQUISITE)	Rqd	Rqd	All LEED prerequisites are required to be met.
SS1	Site Selection		X	See paragraph LEED CREDITS COORDINATION.

SS2	Development Density & Community Connectivity - OPTION 1 DENSITY		X	See paragraph LEED CREDITS COORDINATION.
	Development Density & Community Connectivity - OPTION 2 CONNECTIVITY		X	See paragraph LEED CREDITS COORDINATION.
SS3	Brownfield Redevelopment		X	See paragraph LEED CREDITS COORDINATION.
SS4.1	Alternative Transportation: Public Transportation Access		X	See paragraph LEED CREDITS COORDINATION.
SS4.2	Alternative Transportation: Bicycle Storage & Changing Rooms	Pref		Assume that non-transient building occupants are NOT housed on Post unless indicated otherwise.
SS4.3	Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 1			Requires provision of vehicles, which cannot be purchased with construction funds. Assume Government will not provide vehicles unless indicated otherwise. Assume that 50% of GOV fleet is NOT alternative fuel vehicles unless indicated otherwise.
SS4.3	Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 2	Pref		
SS4.3	Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 3			Requires provision of vehicle refueling stations. Installation must support type of fuel and commit to maintaining/supporting refueling stations.
SS4.4	Alternative Transportation: Parking Capacity	Pref		

SS5.1	Site Development: Protect or Restore Habitat			
SS5.2	Site Development: Maximize Open Space	Pref		Assume AGMBC option for aggregated open space at another location on the installation is not available to the project unless indicated otherwise.
SS6.1	Stormwater Design: Quantity Control	Pref		See paragraph STORMWATER MANAGEMENT.
SS6.2	Stormwater Design: Quality Control	Pref		See paragraph STORMWATER MANAGEMENT.
SS7.1	Heat Island Effect: Non-Roof			
SS7.2	Heat Island Effect: Roof	Pref		Coordinate with nearby airfield requirements, which may preclude this credit.
SS8	Light Pollution Reduction	Pref		
WATER EFFICIENCY				
WEPR1	Water Use Reduction (Version 3 only)	Rqd	Rqd	All LEED prerequisites are required to be met.
WE1.1	Water Efficient Landscaping: Reduce by 50%	Pref		See paragraph IRRIGATION. Project must include landscaping to be eligible for this credit.
WE1.2	Water Efficient Landscaping: No Potable Water Use or No Irrigation	Pref		Project must include landscaping to be eligible for this credit.
WE2	Innovative Wastewater Technologies - OPTION 1			
WE2	Innovative Wastewater Technologies - OPTION 2			
WE3	Water Use Reduction	Pref		See paragraph BUILDING WATER USE REDUCTION.

ENERGY AND ATMOSPHERE				
EAPR1	Fundamental Commissioning of the Building Energy Systems (PREREQUISITE)	Rqd	Rqd	All LEED prerequisites are required to be met.
EAPR2	Minimum Energy Performance (PREREQUISITE)	Rqd	Rqd	All LEED prerequisites are required to be met.
EAPR3	Fundamental Refrigerant Management (PREREQUISITE)	Rqd	Rqd	All LEED prerequisites are required to be met.
EA1	Optimize Energy Performance	Rqd	1	Earning of LEED EA1 points as indicated in paragraph ENERGY CONSERVATION, as a minimum, is required.
EA2.1	On-Site Renewable Energy	Pref		See paragraph ENERGY CONSERVATION.
EA3	Enhanced Commissioning			The Commissioning Authority may be provided through the Design-Build Contractor only if in accordance with USGBC Credit Interpretation Ruling (CIR) dated 9/15/06. Commissioning Authority activities begin during design phase and continue well beyond beneficial occupancy. Assume Government will not provide CxA post-occupancy activities unless indicated otherwise.
EA4	Enhanced Refrigerant Management			
EA5	Measurement & Verification			Assume Government will not provide post-occupancy activities unless indicated otherwise.
EA6	Green Power		X	See paragraph LEED CREDITS COORDINATION.
MATERIALS AND RESOURCES				

MRPR1	Storage & Collection of Recyclables (PREREQUISITE)	Rqd	Rqd	All LEED prerequisites are required to be met. Coordinate with Installation during design development on collection service and receptacles.
MR1	Building Reuse			
MR2.1	Construction Waste Management: Divert 50% From Disposal	Pref		See paragraph CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT.
MR2.2	Construction Waste Management: Divert 75% From Disposal	Pref		
MR3	Materials Reuse			
MR4.1	Recycled Content: 10% (post-consumer + 1/2 pre-consumer)	Pref		See paragraph RECYCLED CONTENT.
MR4.2	Recycled Content: 20% (post-consumer + 1/2 pre-consumer)	Pref		
MR5.1	Regional Materials:10% Extracted, Processed & Manufactured Regionally			
MR5.2	Regional Materials:20% Extracted, Processed & Manufactured Regionally			
MR6	Rapidly Renewable Materials	Pref		See paragraph BIOBASED AND ENVIRONMENTALLY PREFERABLE MATERIALS and

				paragraph FEDERAL BIOBASED PRODUCTS PREFERRED PROCUREMENT PROGRAM.
MR7	Certified Wood	Pref		See paragraph BIOBASED AND ENVIRONMENTALLY PREFERABLE MATERIALS.
INDOOR ENVIRONMENTAL QUALITY				
EQPR1	Minimum IAQ Performance (PREREQUISITE)	Rqd	Rqd	All LEED prerequisites are required to be met.
EQPR2	Environmental Tobacco Smoke (ETS) Control (PREREQUISITE)	Rqd	Rqd	All LEED prerequisites are required to be met. Assume all buildings are smoke free unless indicated otherwise (family housing, barracks and other lodging are facility types where smoking may be permitted in some cases).
EQ1	Outdoor Air Delivery Monitoring			
EQ2	Increased Ventilation			
EQ3.1	Construction IAQ Management Plan: During Construction	Pref		See paragraph CONSTRUCTION IAQ MANAGEMENT.
EQ3.2	Construction IAQ Management Plan: Before Occupancy	Pref		See paragraph CONSTRUCTION IAQ MANAGEMENT.
EQ4.1	Low Emitting Materials: Adhesives & Sealants	Pref		See paragraph LOW-EMITTING MATERIALS.
EQ4.2	Low Emitting Materials: Paints & Coatings	Pref		See paragraph LOW-EMITTING MATERIALS.
EQ4.3	Low Emitting Materials: Carpet/Flooring Systems	Pref		See paragraph LOW-EMITTING MATERIALS.
EQ4.4	Low Emitting Materials: Composite Wood & Agrifiber Products	Pref		See paragraph LOW-EMITTING MATERIALS.
EQ5	Indoor Chemical & Pollutant Source Control	Pref		System requiring weekly cleaning to earn this credit is not a permitted option unless indicated

				otherwise.
EQ6.1	Controllability of Systems: Lighting			
EQ6.2	Controllability of Systems: Thermal Comfort			
EQ7.1	Thermal Comfort: Design	Pref		See paragraph APPLICABLE CRITERIA
EQ7.2	Thermal Comfort: Verification			Project must earn credit EQ7.1 to be eligible for this credit. Assume Government will not provide post-occupancy activities unless indicated otherwise.
EQ8.1	Daylight & Views: Daylight 75% of Spaces	Pref		See paragraph DAYLIGHTING.
EQ8.2	Daylight & Views: Views for 90% of Spaces	Pref		
INNOVATION & DESIGN PROCESS				
IDc1.1	Innovation in Design			See paragraph INNOVATION AND DESIGN CREDITS. Assume Government will not provide any activities associated with ID credits.
IDc1.2	Innovation in Design			
IDc1.3	Innovation in Design			
IDc1.4	Innovation in Design			
IDc2	LEED Accredited Professional	Rqd	Rqd	LEED AP during design and construction is required.
REGIONAL PRIORITY CREDITS (Version 3 only)				See paragraph LEED CREDITS COORDINATION.

Appendix M

LEED Owner Project Rqmts

Owner's Project Requirements Document for LEED Fundamental Commissioning

Project: Advanced Individual Training Battalion Headquarters (AIT BNHQ)

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 Version 2.2 EA Prerequisite 1, 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.

Use of this template is not required, nor are there any restrictions on editing of it. It is provided simply as a tool to assist project teams in meeting the documentation requirements for LEED Fundamental Commissioning. The intent of the Owner's Project Requirements Document, per the LEED v2.2 Reference Guide, 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 v2.2 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*

What is the primary purpose, program and use of this project? (example: office building with data center)

The WT facilities will house soldiers temporarily while they recuperate from injuries sustained during their service in the United States and overseas fighting the Global War on Terror (GWoT). These facilities will provide the best accommodations the Army can build in gratitude for their service and sacrifice.

Describe pertinent project history. (example: standard design development)

Current standard was developed for an entire battalion complex including barracks, office, classroom, dining and outdoor training spaces in 2000 with mandatory floor plans and site plans. Minor changes were made in 2005 and in 2006 it was revised to delete many mandatory features to reduce project cost. Barracks floor plan remains mandatory. All complexes are sized for one battalion.

Broad Goals

What are the broad goals relative to program needs?

To provide economical, standardized facilities that meet the basic functional needs of units.

What are the broad goals relative to future expansion?

No provision for future expansion is needed.

What are the broad goals relative to flexibility?

Open, flexible design for admin offices. Ability to subdivide sleeping bays to accommodate gender ratio variations.

What are the broad goals relative to quality of materials?

Trainee spaces receive very heavy use. Company level interior spaces are not plush, receive a good deal of muddy boot travel, and need to be easy to keep clean. Maximum durability within budget.

What are the broad goals relative to construction costs?

Facility must meet budget.

What are the broad goals relative to operational costs?

Meet EPACT 05 (reduced water, energy consumption). Minimize operating costs as much as possible within first cost budget.

Other broad goals: *(Insert as applicable)*

To provide essentially the same functional facility at all locations (site-adapt) to the extent possible to facilitate unit mobility and to reduce repetitive design costs.

To reduce construction time to 18 months.

2. Environmental and Sustainability Goals

What are the project goals relative to sustainability and environmental issues? (example: LEED Silver rating)

LEED Silver rating

What are the project goals relative to energy efficiency? (example: Meet EPACT)

Meet EPACT 05

What are the project goals and requirements for building siting that will impact energy use?

Same facility must be site-adapted nationwide. Consistent building orientation cannot be expected.
Variations in availability of fuel sources.
Special local requirements are indicated in Paragraph 6 of Section 01 10 00.

What are the project goals and requirements for building facade that will impact energy use?

Same facility must be site-adapted nationwide. Exterior appearance will vary to be compatible with adjoining environment's architectural theme.
Special local requirements are indicated in Paragraph 6 of Section 01 10 00.

What are the project goals and requirements for building fenestration that will impact energy use?

Same facility must be site-adapted nationwide. Fenestration will vary to be compatible with adjoining environment's architectural theme. Consistent building orientation cannot be expected.
Antiterrorism/Force Protection criteria (UFC 4-010-01) requires laminated glass and heavy duty frame.

What are the project goals and requirements for building envelope that will impact energy use?

ASHRAE 90.1 and EPACT are required. Antiterrorism/Force Protection criteria (UFC 4-010-01) requires hardened structure at Covered Training.
Special local requirements are indicated in Paragraph 6 of Section 01 10 00.

What are the project goals and requirements for building roof that will impact energy use?

Special local requirements are indicated in Paragraph 6 of Section 01 10 00.

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.

Trainee daily schedule is as indicated in Section 01 10 00 Functional Requirements. Company office may have sporadic after-hours use.

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.

Supervised monitoring of building. IDS at arms vault. Lights manually controlled in barracks areas. Office areas have automatic lighting controls with manual override as necessary.

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: IESNA Lighting Handbook, IESNA RP-1-04, ASHRAE 90.1 (ASHRAE 90.1 does not apply to residential)
Temperature: See Table 5-1 in Section 01 10 00 of RFP

Humidity: 50%
Air Quality: ASHRAE 62.1

Ventilation: ASHRAE 62.1

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.

As indicated in Section 01 10 00 of RFP

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: On/off control in sleeping bays. Automatic controls elsewhere. Dimming as indicated in Section 01 10 00 of RFP

Temperature: No occupant adjustment
Humidity: No occupant adjustment
Air Quality: No occupant adjustment

Ventilation: No occupant adjustment

What, if any, specific types of lighting are desired? (example: fluorescent in 2x2 grid, accent lighting, particular lamps)

None

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: None Identified

Quality: ____

Preferred Manufacturer: N/A
Reliability: ____
Automation: Automatically controlled through Building Automation System (BAS)

Flexibility: Total building heating load split between two boilers if a central system is utilized__
Maintenance Requirements: ____
Efficiency Target: Comply with ASHRAE 90.1

Desired Technologies: ____

Indicate desired features for the following commissioned system: Ventilation

Desired Type: None identified

Quality: Comply with ASHRAE 62.1

Preferred Manufacturer: N/A
Reliability: ____
Automation: Automatically controlled through Building Automation System (BAS)

Flexibility:____
Maintenance Requirements: ____________________________________
Efficiency Target: ____

Desired Technologies: Energy Recovery

Indicate desired features for the following commissioned system: Air Conditioning

Desired Type: None identified

Quality: ____

Preferred Manufacturer: N/A
Reliability: ____
Automation: Automatically controlled through Building Automation System (BAS)

Flexibility: See Section 01 10 00 regarding split bays
Maintenance Requirements: ____________________________________
Efficiency Target: Comply with ASHRAE 90.1

Desired Technologies: Economizer cycle

Indicate desired features for the following commissioned system: Refrigeration

Desired Type: None identified

Quality: ____

Preferred Manufacturer: ____________________________________
Reliability: Total building cooling load split between two units if a central system is utilized
Automation: Automatically controlled through Building Automation System (BAS)

Flexibility:____
Maintenance Requirements: ____________________________________
Efficiency Target: Comply with ASHRAE 90.1

Desired Technologies:

Indicate desired features for the following commissioned system: HVAC Controls

Desired Type: LonWorks Technology

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: None identified

Quality: ____

Preferred Manufacturer: ____
Reliability: ____
Automation: Standard Manufacturer's Controls, Return Water Recirculation

Flexibility: ____
Maintenance Requirements: ____
Efficiency Target: Compliant with ASHRAE 90.1

Desired Technologies: ____

Indicate desired features for the following commissioned system: Lighting Controls

Desired Type: As indicated in Section 01 10 00

Quality: ____

Preferred Manufacturer: ____
Reliability: ____
Automation: ____

Flexibility: ____
Maintenance Requirements: ____
Desired Technologies: As indicated in Section 01 10 00

Indicate desired features for the following commissioned system: Daylighting Controls

Desired Type: Not required

Quality: ____

Preferred Manufacturer: ____
Reliability: ____
Automation: ____

Flexibility: ____
Maintenance Requirements: ____
Efficiency Target: ____

Desired Technologies: ____

Indicate desired features for the following commissioned system: Emergency Power

Desired Type: Not required

Quality: ____

Preferred Manufacturer: ____
Reliability: ____
Automation: ____

Flexibility:____
Maintenance Requirements: ____
Efficiency Target: ____

Desired Technologies: ____

Indicate desired features for the following commissioned system: Other - Plumbing

Desired Type: ____

Quality: ____

Preferred Manufacturer: ____
Reliability: ____
Automation: ____

Flexibility: Tempering valves to handle wide demand fluctuations.
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? By DPW contractor.

Will the facility be connected to an EMCS? If so, what are the interface requirements? (example: monitoring points, control points, scheduling) As indicated in Section 01 10 00

What is the desired level of training and orientation for building occupants to understand and use the building systems? Minimal for occupants

What is the desired level of training and orientation for O&M staff to understand and maintain the building systems? As indicated in Section 01 78 02.00 10.

Appendix N

LEED Rqmts for Multiple Contractor Combined Projects

LEED Requirements for Multiple Contractor Combined Projects (30 Oct 08)

When site work and building(s) for a project are accomplished by separate contractors, it is referred to as a Combined Project for purposes of LEED scoring and documentation and the following is required:

- LEED points relating to site work must be combined with the LEED points for each building to arrive at a single LEED Combined Project score.
- LEED points having both building requirements and site requirements (combined bldg/site points) must be coordinated between the contractors.
- LEED aggregate materials points must be coordinated between the contractors and a division of responsibilities for each contractor's required contribution to the point must be developed.
- LEED Project documentation from separate contractors must be combined.

Multiple Contractor Combined Project Definition. See paragraph MULTIPLE CONTRACTOR COMBINED PROJECT in paragraph PROJECT SPECIFIC REQUIREMENTS of the Statement of Work to see if this project is part of a Multiple Contractor Combined Project. A summary of the separate projects that constitute the Combined Project may be provided at paragraph SUSTAINABLE DESIGN – ADDITIONAL INFORMATION or may be obtained from the Contracting Officer's Representative. Typical Multiple Contractor Combined Projects are comprised of the site work contract and all the building-only contracts for buildings that the site work is provided for in the separate site work contract.

LEED Points Coordination. See Appendix LEED Strategy Table(s) for the total number of points each contractor is responsible for obtaining, for special requirements relating to combined building/site points and for each contractor's requirement relating to aggregate materials points each portion of this Multiple Contractor Combined Project. Each contractor providing a building is referred to as Building CTR and Site CTR refers to the contractor providing the site development. For each building included in the site work contract, the site work contractor is both Building CTR and Site CTR for that building. Aggregate materials percentages indicated in the table(s) are percentage of that contractor's materials total.

Point Substitutions. During preparation of the Proposal, each contractor is free to substitute other LEED points for those indicated in the LEED Strategy Table(s), except points marked "NO" in the "Building CTR Substitutions Permitted" column may not be deleted or added by substitution by building contractor and points marked "NO" in the "Site CTR Substitutions Permitted" column may not be deleted or added by substitution by site contractor. Credit substitutions after award are not permitted except with the advance approval of the Contracting Officer.

LEED Documentation. Each contractor is responsible for developing all project LEED documentation demonstrating compliance for their portion of the work and must utilize the LEED Letter Templates. Each contractor is responsible for updating construction phase LEED documentation at least monthly until construction closeout. No CTR will duplicate the data of another CTR within their own documentation. Each contractor will include the contractor name, project name and number and individual building description as applicable on each Letter Template. The LEED Letter Templates are copyright protected and shall be used only for this specific contract and this registered project.

Compiling LEED Documentation from Multiple Contractors. At completion and acceptance of final design submittals the completed design phase letter templates and their attachments from all CTRs in the Multiple Contractor Combined Project will be compiled at the registered site project. All CTRs will furnish electronic copies of their completed letter templates and their attachments for this purpose. Monthly during construction and at construction closeout all CTRs current construction phase letter templates and their attachments will be compiled at the registered site project. Summary letter templates for all aggregate credits (see AGMBC for which credits are aggregate credits) will be created and maintained monthly with summary data from all from all CTRs in the Multiple Contractor Combined Project at the registered site project. All CTRs will furnish electronic copies of the current updated templates and their attachments for this purpose monthly and at closeout.

Site Work Portion of Multiple Contractor Combined Project, Administration by the Government. If paragraph 16.4.2 CREDIT VALIDATION indicates this is the site work or site work and building(s) portion of a Multiple Contractor Combined Project and that administration of the online project is by the Government, the Government will provide access to blank Letter Templates for site CTRs use and the Government will perform the compiling indicated in paragraph Compiling LEED Documentation from Multiple Contractors above.

Site Work Portion of Multiple Contractor Combined Project, Shared Administration. If paragraph 16.4.2 CREDIT VALIDATION indicates this is the site work or site work and building(s) portion of a Multiple Contractor Combined Project and that administration of the online project is shared between Contractor and Government, the Contractor will administer the registered site project until final design acceptance, at which point administration will be transferred to the Government. The Government will administer the project during construction and the Government will perform the compiling indicated in paragraph Compiling LEED Documentation from Multiple Contractors above.

Site Work Portion of Multiple Contractor Combined Project, Administration by the Contractor. If paragraph 16.4.2 CREDIT VALIDATION indicates this is the site work or site work and building(s) portion of a Multiple Contractor Combined Project and that administration of the online project is by the Contractor, the Contractor will administer the project and **the Contractor will perform the compiling indicated in paragraph Compiling LEED Documentation from Multiple Contractors above**.

Standard Design Building(s) portion of Multiple Contractor Combined Project, Administration by the Government. If paragraph 16.4.2 CREDIT VALIDATION indicates this is a standard design building(s) portion of a Multiple Contractor Combined Project and that administration of the online project is by the Government, the Government will provide access to blank Letter Templates for standard design building CTRs use.

Instructions for Obtaining LEED Letter Templates for Registered Army Standard Designs

General. Contractors providing Army standard design buildings only (site work by another contractor) in a Multiple Contractor Combined project obtain their LEED Letter Templates for the project from the Center of Standardization (COS) for that standard design.

Information You Need to Provide. After award, contact the COS POC indicated below requesting LEED Letter Templates for your project. In your request, indicate the following:
Project name, location, Contractor name, PN number and contract number
Description of building(s) you are responsible for (example: S/M/L/L COF w/detached admin)
LEED Documentation Responsible Party name, phone number, email contact info
Responsible party certification of understanding that Letter Templates furnished by the Government for this project are copyright protected and will not be used for any purposes other than for this project documentation.
Attach the LEED Registered Project Checklist from conformed proposal which indicates the points the project will earn/contribute to.
It is recommended that you copy the sample below and revise for your project information.
****

SAMPLE EMAIL REQUEST:

To: (COS POC below)
CC: (Contracting Officer’s Representative (COR) for your contract)
Subject: COS LEED Letter Templates Request

We have an awarded contract and request COS LEED Letter Templates for:

Project: 4th BCT Complex
Location: Fort Bragg, NC

Contractor: Great Design Builder Inc.
Project Number/Contract Number: PN 65555, W912HN-08-C-0001
Standard Design Building Type(s): Brigade HQ, Battalion HQ

Our **Responsible Party** for LEED Documentation for this project is (name, phone number, email).

Certification: I, (sender name), certify that the LEED Letter Templates furnished by the Government for this project are copyright protected and I will ensure that they are not used for any purpose other than project documentation for this project only.

Attached Checklist: Please see attached LEED Project Checklist, which indicates the points this project will earn.

Salutation,
Name
****

COS Points of Contact for Obtaining Letter Templates. Email your request to the applicable POC indicated below. If there is no POC indicated for the standard design you are providing, contact your project COR for direction.

Army Standard Design	Point of Contact
Army Family Housing	Lisa.A.Bobotas@usace.army.mil
Battalion Headquarters	judith.f.milton@usace.army.mil
Brigade Headquarters	judith.f.milton@usace.army.mil
Company Operations Facilities (COF)	judith.f.milton@usace.army.mil
Criminal Investigation Facilities	Matthew.C.Scanlon@usace.army.mil
Enlisted Personnel Dining Facilities	David.A.Gary@usace.army.mil
General Instruction Buildings/Classroom XXI	Huong.M.Huynh@usace.army.mil
Military Entrance Processing Stations	Lisa.A.Bobotas@usace.army.mil
Tactical Equipment Maintenance Facilities (TEMF)	judith.f.milton@usace.army.mil
Transient Officer's Quarters (part of ORTC)	paul.m.kai@usace.army.mil

Furnishing Completed Documentation to COS Letter Template Library. Certain completed design phase letter templates with attachments may be requested by the COS for future use as part of the standard design. If requested, provide an electronic copy to the COS Point of Contact indicated above. The Center of Standardization (COS) for individual Army standard designs may maintain a library of completed LEED documentation for that standard design. The Government will make the completed templates available to subsequent standard design projects in order to reduce duplication of documentation effort to the extent possible. To inquire about reviewing or obtaining completed LEED documentation that may be applicable to a particular project, contact the Center of Standardization POC

Appendix O

LEED Strategy Tables

LEED Credit Paragraph	LEED 2.2 Strategy Table	Building CTR Substitution Permitted	Site CTR Substitution Permitted	**Required Points Strategy**	YELLOW ITEMS: GD please fill in indicating whether site will earn these credits and return to COS. GREEN ITEMS: GD please review and confirm feasibility/revise as needed and return to COS. BLUE ITEMS: GD please highlight any added building and shared points proposed.
AIT BNHQ					
PAR	**FEATURE**				**REMARKS**
CATEGORY 1 – SUSTAINABLE SITES					
SSPR1	Construction Activity Pollution Prevention (PREREQUISITE)	NIC	NO	R	Site CTR is primary permittee. Building CTR is secondary permittee to primary permittee.
SS1	Site Selection	NIC	NO		Site CTR responsible.
SS2	Development Density & Community Connectivity	NIC	NO		Site CTR responsible.
SS3	Brownfield Redevelopment	NIC	NO		Site CTR responsible.
SS4.1	Alternative Transportation: Public Transportation Access	NIC	NO		Site CTR responsible.
SS4.2	Alternative Transportation: Bicycle Storage & Changing Rooms	NO	NO	1	Combined Bldg/Site credit. Site CTR responsible for bicycle storage. Building CTR responsible for shower/changing rooms.
SS4.3	Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 1	NIC	YES		Site CTR responsible.
	Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 2	NIC	YES	1	Site CTR responsible.
	Alternative Transportation: Low Emitting & Fuel Efficient Vehicles - OPTION 3	NO	NO		Combined Bldg/Site credit.
SS4.4	Alternative Transportation: Parking Capacity	NIC	YES	1	Site CTR responsible.
SS5.1	Site Development: Protect or Restore Habitat	NIC	YES		Site CTR responsible.
SS5.2	Site Development: Maximize Open Space	NIC	YES	1	Site CTR responsible.
SS6.1	Stormwater Design: Quantity Control	NIC	YES		Site CTR responsible.
SS6.2	Stormwater Design: Quality Control	NIC	YES		Site CTR responsible.
SS7.1	Heat Island Effect: Non-Roof	NIC	YES		Site CTR responsible.
SS7.2	Heat Island Effect: Roof	YES	NIC		Building CTR responsible.
SS8	Light Pollution Reduction	NO	NO	1	Combined Bldg/Site credit. Building CTR responsible for building lighting rqmts. Site CTR responsible for site lighting rqmts.
CATEGORY 2 – WATER EFFICIENCY					
WE1.1	Water Efficient Landscaping: Reduce by 50%	NIC	YES	1	Site CTR responsible.
WE1.2	Water Efficient Landscaping: No Potable Water Use or No Irrigation	NIC	YES	1	Site CTR responsible.

LEED Credit Paragraph	LEED 2.2 Strategy Table	Building CTR Substitution Permitted	Site CTR Substitution Permitted	**Required Points Strategy**	YELLOW ITEMS: GD please fill in indicating whether site will earn these credits and return to COS. GREEN ITEMS: GD please review and confirm feasibility/revise as needed and return to COS. BLUE ITEMS: GD please highlight any added building and shared points proposed.
AIT BNHQ					
PAR	**FEATURE**				**REMARKS**
WE2	Innovative Wastewater Technologies - OPTION 1	NO	NO		Combined Bldg/Site credit.
WE2	Innovative Wastewater Technologies - OPTION 2	NIC	YES		Site CTR responsible.
WE3.1	Water Use Reduction: 20% Reduction	YES	NIC	1	Building CTR responsible.
WE3.2	Water Use Reduction: 30% Reduction	YES	NIC		Building CTR responsible.
CATEGORY 3 – ENERGY AND ATMOSPHERE					
EAPR1	Fundamental Commissioning of the Building Energy Systems (PREREQUISITE)	NO	NO	R	Building CTR responsible for commissioning of building systems. Site CTR responsible for commissioning of site systems.
EAPR2	Minimum Energy Performance (PREREQUISITE)	NO	NIC	R	Building CTR responsible.
EAPR3	Fundamental Refrigerant Management (PREREQUISITE)	NO	NIC	R	Building CTR responsible.
EA1	Optimize Energy Performance	YES	NIC	6	Building CTR responsible. Must comply with EPACT
EA2	On-Site Renewable Energy	YES	NO		Proposed credit must fall within CTR scope or be coordinated with other CTR.
EA3	Enhanced Commissioning	NO	NO		
EA4	Enhanced Refrigerant Management	YES	NIC	1	Building CTR responsible.
EA5	Measurement & Verification	YES	NIC		Building CTR responsible.
EA6	Green Power	NO	NIC		Building CTR responsible.
CATEGORY 4 – MATERIALS AND RESOURCES					
MRPR1	Storage & Collection of Recyclables (PREREQUISITE)	NO	NIC	R	Building CTR responsible.
MR1.1	Building Reuse: Maintain 75% of Existing Walls, Floors & Roof	N/A	N/A		
MR1.2	Building Reuse: Maintain 95% of Existing Walls, Floors & Roof	N/A	N/A		

LEED Credit Paragraph	LEED 2.2 Strategy Table	Building CTR Substitution Permitted	Site CTR Substitution Permitted	**Required Points Strategy**	YELLOW ITEMS: GD please fill in indicating whether site will earn these credits and return to COS. GREEN ITEMS: GD please review and confirm feasibility/revise as needed and return to COS. BLUE ITEMS: GD please highlight any added building and shared points proposed.
AIT BNHQ					
PAR	**FEATURE**				**REMARKS**
MR1.3	Building Reuse: Maintain 50% of Interior Non-Structural Elements	N/A	N/A		
MR2.1	Construction Waste Management: Divert 50% From Disposal	NO	NO	1	Combined Aggregate credit. Building CTR responsible for diversion of minimum 50% of waste generated. Site CTR responsible for diversion of minimum 50% of waste generated.
MR2.2	Construction Waste Management: Divert 75% From Disposal	NO	NO		Combined Aggregate credit. Building CTR responsible for diversion of minimum 75% of waste generated. Site CTR responsible for diversion of minimum 75% of waste generated.
MR3.1	Materials Reuse: 5%	NO	NO		Combined Cumulative credit. Building CTR responsible for 5% materials reuse. Site CTR responsible for 5% materials reuse.
MR3.2	Materials Reuse: 10%	NO	NO		Combined Cumulative credit. Building CTR responsible for 10% materials reuse. Site CTR responsible for 10% materials reuse.
MR4.1	Recycled Content: 10% (post-consumer + 1/2 pre-consumer)	NO	NO	1	Combined Cumulative credit. Building CTR responsible for minimum 15% recycled materials. Site CTR responsible for minimum 1% recycled materials.
MR4.2	Recycled Content: 20% (post-consumer + 1/2 pre-consumer)	NO	NO		Combined Cumulative credit. Building CTR responsible for minimum 30% recycled materials. Site CTR responsible for minimum 1% recycled materials.
MR5.1	Regional Materials:10% Extracted, Processed & Manufactured Regionally	NO	NO	1	Combined Cumulative credit. Building CTR responsible for minimum 3% regional materials. Site CTR responsible for minimum 30% regional materials.
MR5.2	Regional Materials:20% Extracted, Processed & Manufactured Regionally	NO	NO		Combined Cumulative credit. Building CTR responsible for minimum 6% regional materials. Site CTR responsible for minimum 60% regional materials.
MR6	Rapidly Renewable Materials	YES	NIC		Building CTR responsible.
MR7	Certified Wood	YES	NIC		Building CTR responsible.
CATEGORY 5 – INDOOR ENVIRONMENTAL QUALITY					
EQPR1	Minimum IAQ Performance (PREREQUISITE)	NO	NIC	R	Building CTR responsible.
EQPR2	Environmental Tobacco Smoke (ETS) Control (PREREQUISITE)	NO	NO	R	Smoking is prohibited in non-residential federal facilities. Building CTR responsible for building ETS control features. Site CTR responsible for site ETS features.
EQ1	Outdoor Air Delivery Monitoring	YES	NIC		Building CTR responsible.
EQ2	Increased Ventilation	YES	NIC		Building CTR responsible.
EQ3.1	Construction IAQ Management Plan: During Construction	YES	NIC	1	Building CTR responsible.
EQ3.2	Construction IAQ Management Plan: Before Occupancy	YES	NIC	1	Building CTR responsible.
EQ4.1	Low Emitting Materials: Adhesives & Sealants	YES	NIC	1	Building CTR responsible.
EQ4.2	Low Emitting Materials: Paints & Coatings	YES	NIC	1	Building CTR responsible.
EQ4.3	Low Emitting Materials: Carpet Systems	YES	NIC		Building CTR responsible.

LEED Credit Paragraph	LEED 2.2 Strategy Table	Building CTR Substitution Permitted	Site CTR Substitution Permitted	**Required Points Strategy**	YELLOW ITEMS: GD please fill in indicating whether site will earn these credits and return to COS. GREEN ITEMS: GD please review and confirm feasibility/revise as needed and return to COS. BLUE ITEMS: GD please highlight any added building and shared points proposed.
AIT BNHQ					
PAR	**FEATURE**				**REMARKS**
EQ4.4	Low Emitting Materials: Composite Wood & Agrifiber Products	YES	NIC	1	Building CTR responsible.
EQ5	Indoor Chemical & Pollutant Source Control	YES	NIC	1	Building CTR responsible.
EQ6.1	Controllability of Systems: Lighting	YES	NIC	1	Building CTR responsible.
EQ6.2	Controllability of Systems: Thermal Comfort	YES	NIC	1	Building CTR responsible.
EQ7.1	Thermal Comfort: Design	YES	NIC		Building CTR responsible.
EQ7.2	Thermal Comfort: Verification	YES	NIC		Building CTR responsible.
EQ8.1	Daylight & Views: Daylight 75% of Spaces	YES	NIC	1	Building CTR responsible.
EQ8.2	Daylight & Views: Views for 90% of Spaces	YES	NIC	1	Building CTR responsible.
CATEGORY 6 – FACILITY DELIVERY PROCESS					
IDc1.1	Innovation in Design	YES	YES		Proposed credit must fall within CTR scope or be coordinated with other CTRs.
IDc1.2	Innovation in Design	YES	YES		Proposed credit must fall within CTR scope or be coordinated with other CTRs.
IDc1.3	Innovation in Design	YES	YES		Proposed credit must fall within CTR scope or be coordinated with other CTRs.
IDc1.4	Innovation in Design	YES	YES		Proposed credit must fall within CTR scope or be coordinated with other CTRs.
IDc2	LEED Accredited Professional	NO	NO	1	
	TOTAL			29	

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

NOTE TO SPECIFIER:

1. Appendix R" will be a Adobe Acrobat pdf version of the Specifier completed "Sample Preliminary Submittal Register." The Sample Register is Excel Spreadsheet format of the RMS Input Form 4288A, which serves two purposes.

2. First, The Register allows the both Government and the Proposers to see and estimate the cost of the Division 00 and Division 01 submittals required by the contract in addition to the Contractor generated submittal register items developed during Design After Award.

3. Secondly, after award, the Government will provide the Contractor the actual Excel Spreadsheet for the Contractor to input the data into RMS to create the Submittal Register used during contract performance. See Section 01 33 00 (Submittal Procedures), paragraph 1.8 (Submittal Register) for the contract requirements.

4. For the contract or task order Solicitation, the Specifier must complete APPENDIX R, found at the following link: http://rfpwizard.cecer.army.mil/HTML/Docs/Refs/Sample%20Preliminary%20Submittal%20Register.xls , save it as a PDF file and then upload it into the Wizard as Appendix R.

5. The RMS Input Form initially includes submittals required by the standardized Model RFP Division 00 and Division 01 Sections, except Section 01 10 00, paragraph 3. Examine the Special Contract Requirements, paragraphs 3 and 6 and any other locally developed portions of the RFP for required submittals and add them to the Input Form. Do not duplicate submittals already listed in the standardized RMS Input Form, because the Contractor needs to submit this information only once.

6. After award, the Government provides the Excel spreadsheet to the selected contractor to develop and input the RMS Input form for the submittal register required by paragraph 1.8 of Section 01 33 00, Submittals.

Appendix AA

Section 438 EISA

Technical Guidance on Implementing
Section 438 of the Energy Independence and Security Act

INTRODUCTION

In December 2007, Congress enacted Energy Independence and Security Act. Section 438 of that legislation establishes strict stormwater runoff requirements for Federal development and redevelopment projects. The provision reads as follows:

> "**Storm water runoff requirements for federal development projects.** The sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."

The intent of Section 438 of the Energy Independence and Security Act (EISA) is to require federal agencies to develop and redevelop applicable facilities in a manner that reduces stormwater runoff and associated pollutant loadings in order to protect or restore the waters of the U.S. Until recently, stormwater programs established under the Clean Water Act Amendments of 1987 have been administered to control traditional pollutants that are commonly associated with municipal and industrial discharges, e.g., nutrients, sediment, and metals. Increases in runoff volume and peak discharge rates have been regulated through State and local flood control programs. Although these programs have merit, knowledge accumulated during the past 20 years has led stormwater experts to the conclusion that conventional approaches to control runoff have not resulted in adequate protection of the nations water resources (National Research Council, 2008).

Stormwater management practices, e.g., extended detention ponds, that have been designed to reduce peak flows and trap pollutants entrained in the runoff have been proven to inadequately protect receiving waters both in terms of maintaining stream channel stability and the biotic integrity of the waterbody. What research has shown is that the use of conventional stormwater management practices fails to achieve the desired management goals and as a result there is an increased incidence of runoff events that have flow volumes and runoff rates that are erosive and detrimental to the stability of the stream. In addition, the higher volumes and velocities also cause and carry increased pollutant loadings (Shaver, et al., 2007; Holz testimony, 2008; Horner testimony, 2008). A 2008 National Research Council report on urban stormwater confirmed the shortcomings of current stormwater control efforts. Three of the report's findings on stormwater management approaches are particularly relevant (National Research Council, 2008).

1. Individual controls on stormwater discharges are inadequate as the sole solution to stormwater in urban watersheds;
2. Stormwater control measures such as product substitution, better site design, downspout disconnection, conservation of natural areas, and watershed and land-use

planning can dramatically reduce the volume of runoff and pollutant load from new development; and

3. Stormwater control measures that harvest, infiltrate, and evapotranspire stormwater are critical to reducing the volume and pollutant loading of small storms.

Purpose and Organization of this Guidance

The purpose of this document is to provide guidance and background information on Section 438. The document contains guidance on how compliance with Section 438 can be achieved, measured, evaluated, and reported. In addition, information detailing the rationale for the stormwater management approach contained herein has been included.

The following information is presented within this document:

Part I: Implementation Framework

A. Background
B. Benefits and outcomes of the new stormwater performance requirements
C. How to meet the requirements of Section 438
D. Applicability and definitions
E. Complying with the performance requirement
F. Calculating the 95th percentile rainfall event

Part II: Case Studies on Capturing the 95th Percentile Storm Using Onsite Management Practices

Case studies representing typical Federal installations have been included. The case studies were selected to demonstrate the feasibility of providing adequate stormwater control for a range of site conditions and building designs. Each case study includes a description of a method that can be used to determine the design objectives of the project based on controlling the 95th percentile storm. Examples of on-site technologies and practices have also been provided. The case studies are intended to provide examples of modeling procedures that can be used to quantify treatment system performance and processes for assessing sites and determining appropriate control techniques.

Part I: Implementation Framework

A. Background

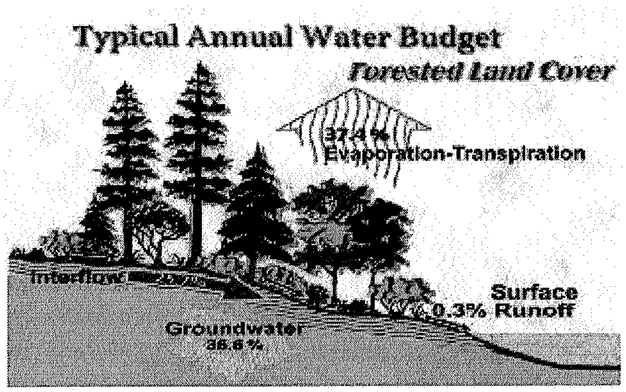
This section contains background on the causes and consequences of stormwater discharges, solutions that can be used to address the causes and consequences of stormwater discharges and how to implement those solutions to comply with Section 438 of EISA.

Alterations to Natural Hydrology and the Impact on Stormwater Runoff
In the natural, undisturbed environment rain that falls is quickly absorbed by trees, other vegetation, and the ground. Rainfall that is not intercepted by leaves infiltrates into the ground or is returned to the atmosphere by the process of evapotranspiration. Very little rainfall becomes stormwater runoff, and runoff generally only occurs with larger precipitation events. Traditional development practices cover large areas of the ground with impervious surfaces such as roads, driveways, sidewalks, and buildings. Once such development occurs, rainwater cannot infiltrate into the ground and as a result, runs off the site at rates and volumes that are much higher than would naturally occur. Under developed conditions runoff occurs even during small precipitation events that would normally be absorbed by the soil and vegetation. The collective force of the increased runoff scours streambeds, erodes stream banks, and causes large quantities of sediment and other entrained pollutants to enter the water body each time it rains (Shaver, et al., 2007; Booth testimony, 2008).

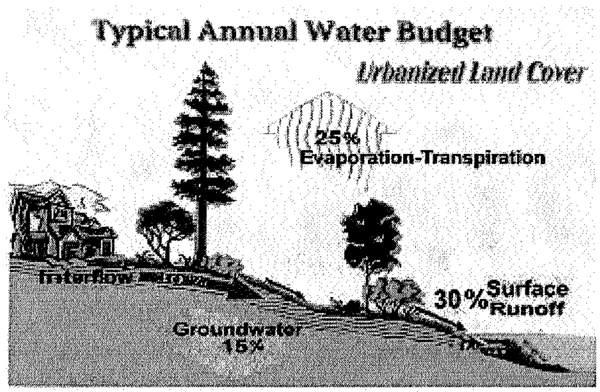
As watersheds are developed and impervious surfaces increase in area, the hydrology of the watersheds fundamentally changes over time which results in degraded aquatic ecosystems. In recognition of these problems, stormwater managers employed extended detention approaches to mitigate the impacts of increased runoff peak runoff rates. However, wet ponds and similar practices inadequately protect downstream hydrology because of the following inherent limitations of these conventional practices (National Research Council, 2008; Shaver, et al., 2007):

- Poor peak control for small, frequently-occurring storms;
- Negligible volume reduction; and
- Increased duration of peak flow.

Detention storage targets relatively large, infrequent storms, such as the two and 10-year/24-hour storms for peak flow rate control. As a result of this design limitation, flow rates from smaller, frequently-occurring storms typically exceed pre-development levels and result in flows erosive to stream channel stability (Shaver, et al., 2007). Section 438 is intended to address the inadequacies of the historical detention approach to managing stormwater and promote more sustainable practices that have been selected to maintain or restore predevelopment site hydrology.



Pre-development Hydrology. *Courtesy of C. May, University of Washington.*



Post-Development Hydrology. *Courtesy of C. May, University of Washington.*

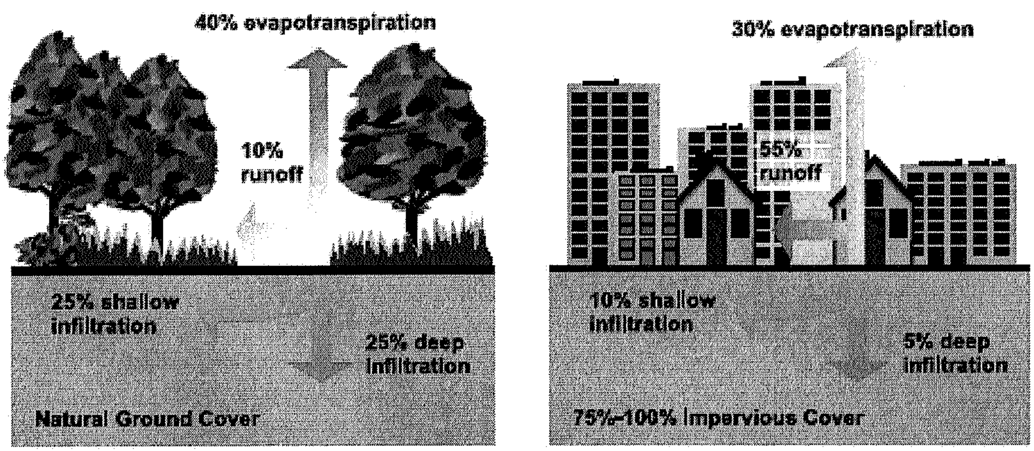


Figure 1. Pre-Development and Post-Development Hydrology. (USDA).

Land cover changes including increased imperviousness, soil compaction, loss of vegetation, and loss of natural drainage patterns result in increased runoff volumes and peak runoff rates. The cumulative impacts of the land cover changes result in alterations of the natural hydrology of a site, which disrupts the natural water balance and changes water flow paths. The consequences of these impacts include:

1. *Increased volume of runoff.* With decreased area for infiltration and evapotranspiration due to development, a greater amount of rainfall is converted to overland runoff which results in larger stormwater discharges.
2. *Increased peak flow of runoff.* Increased impervious surface area and higher connectivity of impervious surfaces and stormwater conveyance systems increase the flow rate of stormwater discharges and increase the energy and velocity of discharges into the stream channel.
3. *Increased duration of discharge.* Detention systems generate greater flow volumes for extended periods. These prolonged higher discharge rates can undermine the stability of the stream channel and induce erosion, channel incision and bank cutting.

4. *Increased pollutant loadings*. Impervious areas are a collection site for pollutants. When rainfall occurs these pollutants are mobilized and transported directly to stormwater conveyances and receiving streams via these impervious surfaces.
5. *Increased temperature of runoff*. Impervious surfaces absorb and store heat and transfer it to stormwater runoff. Higher runoff temperatures may have deleterious effects on receiving streams. Detention basins magnify this problem by trapping and discharging runoff that is heated by solar radiation (Galli, 1991; Schueler and Helfrich, 1988).

The resulting increases in volume, peak flow, and duration are illustrated on a hydrograph, which is a representation of a site's stormwater discharge with respect to time. The hydrograph below reflects the impacts of development on runoff volume and timing of the runoff. Individual points on the curve represent the rate of stormwater discharge at a given time. The graph shows that development and corresponding changes in land cover result in greater discharge rates, greater volumes, and shorter discharge periods. In a natural or pre-development condition, runoff rates are slower and occur over a longer time period. The predevelopment peak discharge rate is also much lower than the post-development peak discharge rate due to attenuation and absorption by soils and vegetation. In the post-development condition there is generally a much shorter time before runoff begins because of increased impervious surface area, a higher degree of connectivity of these areas and the lost of soils and vegetative cover that slow or reduce runoff.

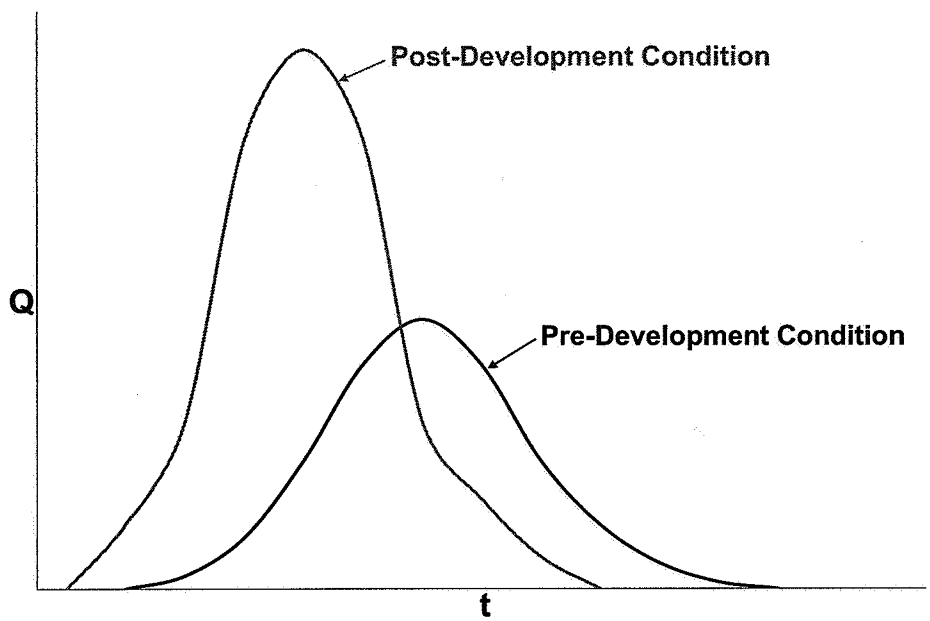


Figure 2. Post-Development Hydrograph.
(Q = volumetric flow rate; t = time)

In addition to the problems caused by stormwater and nonpoint source runoff, many older cities (including many of the largest cities in the United States), have combined sewage and stormwater pipes that frequently overflow due to precipitation events. By the late 20th century, most cities that attempted to reduce sewer overflows did so by separating combined sewers, expanding treatment capacity or storage within the sewer system, or by replacing broken or decaying pipes. However, these practices can be enormously expensive and take decades to implement. Moreover, piped stormwater and combined sewer overflows (CSOs) may also, in some cases, have the adverse effect of upsetting the hydrological balance by moving water out of the watershed, thus bypassing local streams and ground water.

Figure 3. Stream Displaying the Effects of Stormwater Runoff and Channel Downcutting.

The Solution: Preserving and Restoring Hydrology

A new approach has evolved in recent years to eliminate or reduce the amount of water and pollutants that run off a site and ultimate are discharged into adjacent waterbodies.

The fundamental principle is to employ systems and practices that use or mimic natural processes to 1) infiltrate and recharge, 2) evapotranspire, and/or 3) harvest and reuse precipitation near to where it falls to earth.

Green infrastructure practices include a wide variety of practices that utilize these mechanisms. They can be used at the site, neighborhood and watershed/regional scales. In this document the focus is on site-level practices, which is most consistent with the terms used in Section 438: "project", "facility", and "property."

The purpose of the new approach is to replicate pre-development hydrology to protect and preserve both the water resources onsite and those downstream. For example, if prior to development, five (5) percent of the annual rainfall runs directly into the stream and the remainder infiltrates into the ground or is evapotranspired into the air, then the post-development goal should be to limit runoff to five (5) percent while maintaining the correct aquifer recharge rate. This has the benefit, in most cases, of delivering water to the stream at approximately the same rate, volume, duration and temperature as the stream had evolved to handle most effectively and safely. The result will be to eliminate or minimize the erosion of streambeds and streambanks, significantly reduce the delivery of many pollutants to water bodies, and retain historical instream temperatures.

Restoring or maintaining pre-development hydrology has emerged as a control approach for several reasons. Most importantly, this approach is intended to directly address the root cause of impairment. Current control approaches have been selected in an attempt to control the symptoms (peak flow, and excess pollutants), but this strategy is largely ineffectual because of the scale of the problem, the cumulative impacts of multiple developments and the need to manage both site and watershed level impacts. With current approaches, it is also difficult to adequately protect and improve water quality because the measures employed are not addressing the main problem which is a hydrologic imbalance.

Designing facilities based on the goal of maintaining or restoring predevelopment hydrology provides a site specific basis and objective method with which to determine appropriate practices to protect the receiving environment.

Using pre-development hydrology as the guiding control principal also allows the designer to consider climatic and geologic variability and tailor the solutions to the site and geographic location. Thus the need for a one size fits all approach is rendered unnecessary since the design objective is dictated by the pre-development site conditions and not a solution based on ease of administration. Instead of prescribed approaches dictating discharge volumes or flow rates, site assessments of historical infiltration and runoff rates will inform the designer and provide the basis for a suitable design. The use of this approach will minimize compliance complications that may arise from prescriptive designs approaches which do not account for the variability of precipitation frequencies, rainfall intensities and land cover and soil conditions that influence infiltration and runoff.

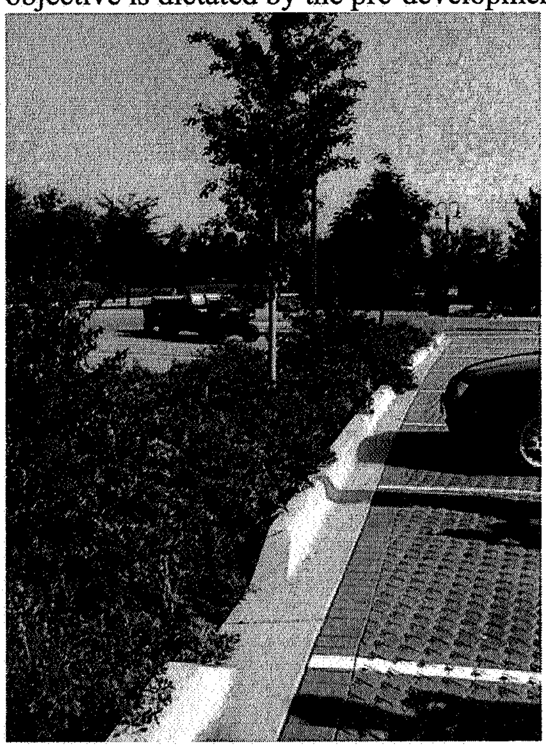


Figure 4. Parking lot bioswale and permeable pavers in Chicago.

This approach also helps to prevent and reduce pollutant loadings to both groundwater and surface waters. Traditional stormwater controls typically are designed to reduce the concentration of pollutants in runoff without addressing the increased volume of stormwater discharged from developed areas. Although removal of pollutants is an important aspect of stormwater management, the larger problem resulting from increased flow volumes and rates often overshadows the gains achieved by a pollutant focused approach. Even with stormwater controls and high rates of pollutant removal, absent volume reductions, urban areas will contribute more pollution than pre-development conditions making it difficult to achieve water quality standards. Table 1 below highlights this condition with the familiar example of the runoff from a one-acre meadow and one-acre parking lot after one-inch of rain.

Table 1. Runoff Volume and Pollutant Load from One-Acre Parking Lot with Treatment and Meadow for a One-Inch Rain Event (Schueler and Holland, 2000)(Wisconsin DNR, 2008).

Land Use	Pollutant	Concentration (mg/L)	% Removal	Effluent Concentration (mg/L)	Runoff Volume (gal)	Pollutant Load (lbs)
Paved Parking Lot with Treatment	TSS	130	80	26	25,800	5.6
Meadow		25	0	25	1,600	0.34

The data in the table show that even when treatment measures were used to reduce discharge (effluent) pollutant concentrations to levels similar to pre-development conditions, the large increase in runoff volume due to the parking lot caused a pronounced increase in total pollutant loadings. To maintain predevelopment pollutant loadings, the designer has two main choices, i.e., reduce pollutant loadings by designing the site and treatment systems to mimic the pre-development hydrology of the site or significantly raise the pollutant removal rates (% removal) to almost irreducible levels using very effective and probably expensive practices.

B. BENEFITS AND OUTCOMES OF THE NEW STORMWATER PERFORMANCE REQUIREMENTS

Implementation of these new stormwater performance requirements provides numerous environmental and economic benefits in addition to reducing the volume of sewer overflows and runoff:

Benefits to Water Resources:

- *Cleaner Water.* The use of plants, soils and water reuse practices can reduce stormwater runoff volumes and pollutant loadings and the frequency and magnitude of combined sewer overflows (volume and pollutant loading reductions). These practices are part of a larger set of practices called Green Infrastructure.
- *Clean and Adequate Water Supplies.* Green infrastructure approaches using soil based vegetated infiltration systems can be used to recharge groundwaters and maintain stream base flow. By recharging groundwater aquifers, aquatic ecosystem health is maintained and base flows are increased which helps ensure more constant flows for drinking water withdrawals. Harvesting and reusing rainwater also reduces the need to use potable water for all uses and can reduce both the infrastructure and energy needed to treat and transport both drinking water and stormwater.
- *Source Water Protection.* Green infrastructure practices provide pollutant removal benefits, thereby providing some protection for both ground water and surface water sources of drinking water. In addition, green infrastructure provides groundwater recharge benefits.

Green infrastructure for managing wet weather is a set of management approaches and technologies that utilize and/or mimic the natural hydrologic cycle processes of infiltration, evapotranspiration and reuse. Green infrastructure practices include green roofs, trees and tree boxes, rain gardens, vegetated swales, pocket wetlands, infiltration planters, porous and permeable pavements, vegetated median strips, reforestation and revegetation and protection of riparian buffers and floodplains. Green infrastructure can be used almost anywhere soil and vegetation can be worked into the urban or suburban landscape. Green infrastructure includes decentralized harvesting approaches such as rain barrels and cisterns that can be used to capture and re-use rainfall for watering plants or flushing toilets.

Other Social and Environmental Benefits:

- *Cleaner Air.* Trees and vegetation improve air quality by filtering many airborne pollutants and can help reduce the amount of respiratory illness (Vingarzan and Taylor, 2003).
- *Reduced Urban Temperatures.* Summer city temperatures can average 10°F higher than nearby suburban temperatures (Casey Trees, 2007). High temperatures are also linked to higher ground level ozone concentrations. Vegetation creates shade, reduces the amount of heat absorbing materials and emits water vapor – all of which cool hot air (Grant, et al., 2003). Reductions in impervious surface and the use of light colored pervious surfaces (e.g., permeable concrete) also can mitigate urban temperatures.
- *Moderate the Impacts of Climate Change.* Climate change impacts and effects vary regionally, but green infrastructure techniques can provide adaptation benefits for a wide array of circumstances. They can be used to conserve, harvest and reuse water, to recharge groundwaters and to reduce surface water discharges that could contribute to flooding. In addition, there are mitigation benefits such as reduced energy demand and carbon sequestration by vegetation.
- *Increased Energy Efficiency.* Green space helps lower ambient temperatures and, when incorporated on and around buildings, helps shade and insulate buildings from wide temperature swings, decreasing the energy needed for heating and cooling. Diverting stormwater from wastewater collection, conveyance and treatment systems can reduce the amount of energy needed to pump and treat the water. Energy efficiency not only reduces costs, but also reduces generation of greenhouse gases.
- *Community Benefits.* Trees and plants improve urban aesthetics and community livability by providing recreational and wildlife areas. Studies show that property values are higher when trees and other vegetation are present. Increased green space also has public health benefits and has been shown to reduce crime and associated the associated stresses of urban living.

Figure 5. Rainwater cistern.

C. HOW TO MEET THE REQUIREMENTS OF SECTION 438

"**Section 438. Storm water runoff requirements for federal development projects.** The sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."

Compliance with Section 438 of the EISA can be achieved through either of the two performance requirements described below. The intention of the statute is to preserve or restore site hydrology during the development or redevelopment process. To be more specific, this requirement is intended to maintain stream flows that are protective of aquatic biota, stream channel stability, and historical aquifer recharge rates such that receiving waters are not negatively impacted by changes in runoff temperature, volumes, durations and rates. It should also be noted that a performance based approach was selected in lieu of a prescriptive requirement in order to provide site designers maximum flexibility in selecting control practices appropriate for the site. Described below are the two options site designs can use to comply with Section 438.

Option 1: Control of the 95^{th} Percentile Rainfall Event
Design, construct, and maintain stormwater management practices that manage rainfall on-site, and prevent the off-site discharge of the precipitation from all rainfall events less than or equal to the 95^{th} percentile rainfall event. This objective shall be accomplished by the use of practices that infiltrate, evapotranspire and/or harvest and reuse rainwater. The 95^{th} percentile rainfall event is the event whose precipitation total is greater than or equal to 95 percent of all storm events over a given period of record. For example, to determine what the 95^{th} percentile storm event is in a specific location, all 24 hour storms that have recorded values over a 20 or 30 year period would be tabulated and a 95^{th} percentile storm would be determined from this record, i.e., 5% of the storms would be greater than the number determined to be the 95^{th} percentile storm. Thus the 95^{th} percentile storm would be represented by a number such as 1.5", and this would be the design storm. The designer would then select a system of practices that infiltrate, evapotranspire or harvest and reuse this volume. Methods and data used to estimate the 95^{th} percentile event are discussed in Part II of this document.

This approach has been selected because it directly addresses the statutory requirements to restore and maintain predevelopment hydrology for duration, rate and volume of stormwater flows. The 95^{th} percentile storm event was selected because this storm size approximates the predevelopment hydrologic conditions, i.e., only large storms typically generate runoff. In addition, this approach was selected because it employs natural treatment and flow attenuation methods that are presumed to have existed on the site prior to human disturbance. Because this approach necessitates the use of practices that generally preclude extended detention, it will also typically address the issue of maintaining predevelopment temperatures. However, in cases where there are discharges to cool water streams or other sensitive receiving waters, additional care should be taken to ensure that stormwater discharges do not result in thermal impacts (Schueler and Helfrich, 1988).

One hundred percent (100%) of the volume of water from storms less than or equal to the 95^{th} percentile event shall not be discharged to surface waters except in cases where the discharge of harvested and reused runoff is authorized or allowed to be discharged into sanitary treatment systems such as those owned and operated by a publicly owned treatment works (POTW). For example if runoff is captured for nonpotable uses such as toilet flushing or other uses that are not irrigation related, these waters potentially could be discharged into the sanitary sewer system. Preferred mechanisms for controlling discharges from storms greater than the 95^{th} percentile event shall be through overflow or diversion for the volume that exceeds the 95^{th} percentile amount. Because standard underdrains typically discharge from smaller storms as well, underdrain designs, if employed, should ensure adequate retention capacity for the 95th percentile event volume. For structures such as roofs and paved surfaces that can increase the temperature of stormwater runoff, materials that minimize temperature increases (e.g., concrete vs. asphalt; vegetated roofs) should be considered and used as appropriate.

Table 2. Example 95th Percentile Storm Events for Select U.S. Cities (adapted from Hirschman and Kosco, 2008).

City	95th Percentile Event Rainfall Total (in)	City	95th Percentile Event Rainfall Total (in)
Atlanta, GA	1.8	Kansas City, MO	1.7
Baltimore, MD	1.6	Knoxville, TN	1.5
Boston, MA	1.5	Louisville, KY	1.5
Buffalo, NY	1.1	Minneapolis, MN	1.4
Burlington, VT	1.1	New York, NY	1.7
Charleston, WV	1.2	Salt Lake City, UT	0.8
Coeur D'Alene, ID	0.7	Phoenix, AZ	1.0
Cincinnati, OH	1.5	Portland, OR	1.0
Columbus, OH	1.3	Seattle, WA	1.6
Concord, NH	1.3	Washington, DC	1.7
Denver, CO	1.1		

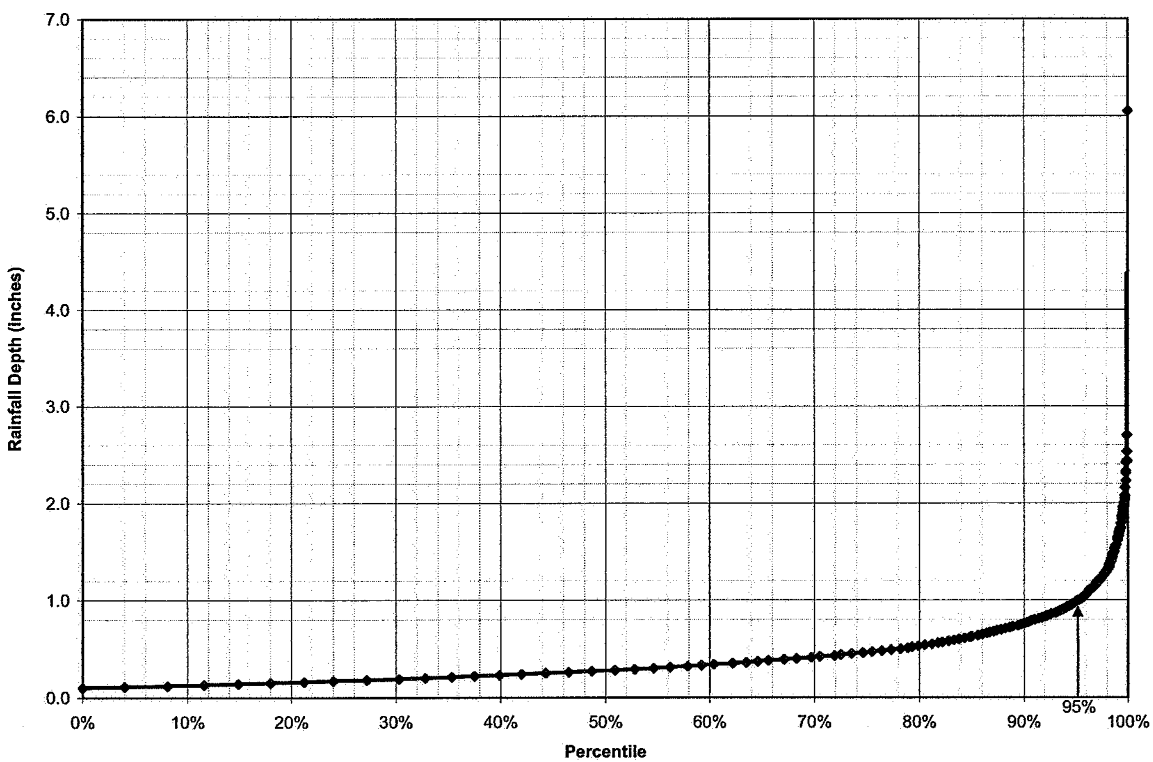


Figure 6. Rainfall Frequency Spectrum showing the 95th percentile rainfall event for Portland, OR (~1.0 inches)

Calculating the 95th Percentile Rainfall Event
Section F of this guidance contains information on how to calculate the 95th percentile rainfall event for a specific area. A long-term record of daily rainfall amounts (ideally, at least 30 years) is needed to calculate the 95th percentile rainfall.

Option 2: Hydrologic Analysis
Design, construct/implement, and maintain stormwater management practices that preserve the pre-development runoff conditions following construction. The post-construction rate, volume, duration and temperature of runoff shall not exceed the pre-development rates and the predevelopment hydrograph for 1, 2, 10, 25, 50 and 100 year storms should be replicated through site design and other appropriate practices. These goals shall be accomplished through the use of the infiltration, evapotranspiration, and/or rainwater harvesting and reuse. Defensible and consistent hydrological assessments and modeling methods should be used and documented. Additional discussions of appropriate methodologies to use in assessing and modeling site hydrology have been included in the technical sections of this document.

Exceptions
If options 1 or 2 cannot be met using combinations of approaches that are technically feasible, alternative procedures should be developed and followed to meet the intent of Section 438. For an exception to apply the facility owner/operator must demonstrate why it is not possible to comply with either option 1 or 2. In doing so, the owner/operator should identify the factors that preclude the use of options 1 and 2 and document any of the factors listed below (or others) that are relevant to and prevent the achievement of these two options.

- The conditions on the site preclude the use of infiltration practices due to the presence of shallow bedrock, contaminated soils, near surface groundwater or other factors such as underground facilities or utilities.
- The design of the site precludes the use of soil amendments, plantings of vegetation or other designs that can be used to infiltrate and evapotranspirate runoff.
- Water harvesting and reuse are not practical or possible because the volume of water used for irrigation, toilet flushing, industrial make-up water, wash-waters, etc. is not significant enough to warrant the design and use of water harvesting and reuse systems.
- Modifications to an existing building to manage stormwater to meet options 1 or 2 are not feasible due to structural or plumbing constraints or other factors as identified by the facility owner/operator.

An exception may also be granted if it is determined that compliance with the Section 438 requirements would result in the retention and or use of stormwater on the site such that an adverse water balance impact may occur to either or both the receiving surface waterbody or groundwater.

In cases where the facility has a defensible exception and can provide adequate documentation of site conditions or other factors that preclude compliance with options 1 or 2, stormwater practices must be designed, built and maintained to infiltrate, evapotranspire and/or harvest and use the maximum amount of stormwater technically feasible. The difference between this volume and the 95th percentile rainfall event volume must be treated, as necessary, to ensure no increase in receiving stream temperature and no increase in the peak runoff rates of stormwater leaving the site such that no adverse effects to channel stability occur.

Each Agency or Department is responsible for ensuring compliance with Section 438. The final design and as-built drawings of each facility shall be reviewed by a registered professional engineer. The Agency or Department shall develop and maintain documentation of the following design criteria:

- Site evaluation and soils analysis
- Calculations for the 95th percentile rainfall event or the pre-development runoff volumes and rates to identify the volume of stormwater requiring management
- The site design and stormwater management practices employed on the site
- Design calculations for each stormwater management practice employed
- The respective volume of stormwater managed by each practice
- Operations and maintenance protocols for the stormwater management system

The submitted documentation shall provide the necessary detail to demonstrate compliance and operation of stormwater management practices for the entire site.

Determination of Maximum Extent Technically Feasible

Compliance with Section 438 requires that stormwater management measures are implemented to the maximum extent technically feasible (METF) to maintain or restore the pre-development hydrology conditions specifically with respect to temperature, rate, volume, and duration of flow. To meet these performance requirements stormwater control practices that are effective in reducing the volume of stormwater discharge must be used. To meet the intent of the statute, the Federal facility must use all known, available and reasonable methods of stormwater retention and/or reuse to prevent the off site discharge of stormwater runoff consistent with the performance standard. In cases when a facility seeks or claims an exception, it is expected that there will be a serious and documented attempt to comply.

For projects where an exemption from the Section 438 requirements is necessary due to technical infeasibility, the designer must document and quantify, to the satisfaction of the agency or department, that the processes of infiltration, evapotranspiration, and harvesting and reuse have been used to the METF, and that full employment of these types of controls are infeasible due to site constraints. Documentation should include, but may not be limited to, engineering calculations, geologic reports, hydrologic analyses, and site maps. A determination that the performance requirements specified in options 1 and 2 cannot be met on site must include analyses that rule out the use of an adequate combination of infiltration, evapotranspiration, and reuse measures. Examples of where site conditions may prevent the full employment of appropriate management techniques include a combination of: small project sites where the lot is too small to accommodate infiltration practices adequately sized to infiltrate the volume of runoff from impervious surfaces, soils that cannot be sufficiently amended to provide for the requisite infiltration rates, situations where site use is inconsistent with the capture and reuse of stormwater or other physical conditions on site that preclude the use of plants for evapotranspiration or bioinfiltration. Note that a single one of these characteristics is very unlikely to preclude meeting the performance standard, but a combination of factors may.

D. Applicability and Definitions

Applicability

1. Who is a **"Sponsor"** of a project?

Section 438 applies to the "**sponsor** of any development or redevelopment project involving a Federal facility . . . ." Section 438 requires that the "sponsor . . . shall use . . . strategies for the property to maintain or restore . . . the predevelopment hydrology. . . ." The "sponsor" should generally be regarded as the Federal department or agency that owns, operates, occupies or is the primary user of the facility and has initiated the development or redevelopment project. If the Federal agency hires another entity to perform activities such as site construction or maintenance, the agency should nonetheless be regarded as the sponsor and be responsible to assure compliance with the requirements of Section 438. Within this legal context, the agency is free to contract out various duties and responsibilities that are associated with achieving compliance.

2. What is a "**Federal facility**?

Section 438 provides that its requirements apply to the "sponsor of any development or redevelopment project involving a **Federal facility . . . .**" Section 401(8) of EISA states: "The term `Federal facility' means any building and lands associated with a development or redevelopment project that are constructed, renovated, leased, or purchased in part or in whole for use by the Federal Government."

3. What is a **"footprint"**?

Section 438 provides that its requirements apply to a "federal facility with a **footprint** that exceeds 5000 square feet". Consistent with the purpose of Section 438 to preserve or restore predevelopment hydrology, the term "footprint" includes all hard surfaces that are constructed as part of the facility, including the building, foundations, access roads, fire lanes, driveways, alleys, walkways, sidewalks, patios, decks, and porches. In addition, consistent with the purpose of Section 438, "footprint" also includes other areas that have been disturbed and modified in a manner that changes the infiltrative and evapotranspirative characteristics of the landscape so that the hydrologic regime of the site is altered, e.g., soil compaction, tree cutting and paving with impervious materials.

4. What is "**the property**"?

Section 438 provides that the project sponsor "shall use site planning, design, construction, and maintenance strategies for the **property** to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the **property".** This clause has been interpreted to mean that the entire site is available to implement the appropriate green infrastructure practices necessary to ensure that the site as a whole functions hydrologically in a manner equivalent to the pre-development (i.e., natural condition) hydrology of the site.

Definitions

95th percentile rainfall event. A rainfall event that is greater than 95% of all rainfall events over a period of record (this period of record should typically be > 30 years unless such data do not exist), **excluding small rainfall events that are 0.1 of an inch or less**. Note: Small rainfall events less than 0.1 of an inch or less have been excluded from this analysis because in general this volume does not result in any measureable runoff due to absorption, interception and evaporation by permeable, impermeable and vegetated surfaces.

Federal facility. The term federal facility means any building and associated land areas that are constructed, renovated, leased, or purchased in part or in whole for use by the Federal Government as defined in §410(8) of the Energy Independence and Security Act.

Development or re-development. For the purposes of this provision this term applies to any action that results in the alteration of the landscape, e.g., grading, construction of buildings and hardscapes, removal of vegetation, soil compaction, etc. such that the changes affect runoff volumes, rates and velocities and infiltration and evapotranspiration patterns. To further clarify the applicability of this requirement, the development or re-development footprint of the project includes all areas physically disturbed by the project activities and does not just include the typical "footprint" or foundation area of the structures and buildings. Examples of projects that would fall under this definition include parking lots or structures that are being reconstructed or replaced. Typical patching or superficial resurfacing of parking lots or other travel areas would not fall under this requirement.

Pre-development hydrology. The predevelopment hydrologic condition of the site is the combination of runoff, infiltration and evapotranspiration rates and volumes that typically existed on the site before human induced land disturbance occurred. In practice, determining the predevelopment hydrology of a given site can be difficult if development has already occurred or there is no suitable reference site. As a result, reference conditions for typical land cover types in the locality often are used to approximate what fraction of the precipitation ran off, soaked into the ground or was evaporated from the landscape. The use of reference conditions can be problematic if suitable data are not available or unique site conditions exist that do not fit within a typical land use cover type for the area, e.g., meadow or forest. The intent of Section 438 is not to restore the site to pre-Columbian conditions, but to develop or redevelop the site to ensure that there is a stable hydrologic regime that protects groundwater and surface waters. It should also be emphasized that the performance based approach in Option 1 is intended to be a surrogate for determining the predevelopment reference condition and this standard can be used in cases where it is difficult or infeasible to identify the relevant reference conditions for the site.

E. Complying with the Performance Requirement

Controlling 100 percent of all rainfall events equal to or less than the 95th percentile rainfall event was selected as the first compliance option because small, frequently-occurring storms account for a large proportion of the annual precipitation volume, and the runoff from those storm events also significantly alters discharge frequency, rate and temperature.

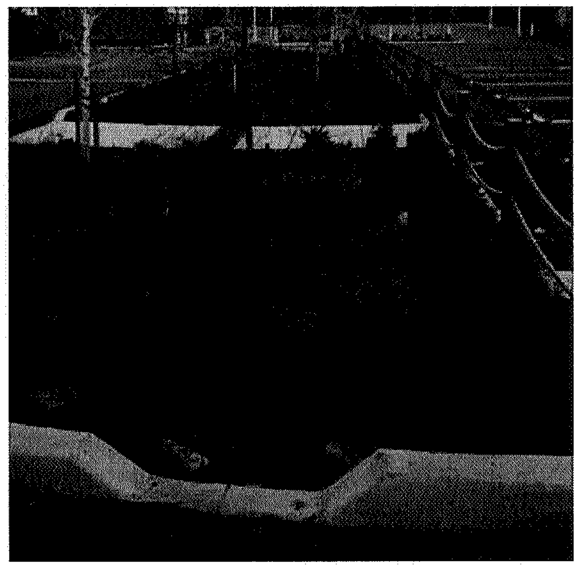


Figure 7. Bioretention facility in Oregon.

The runoff produced by these small storms and the initial portion of larger storms, has a strong negative cumulative impact on receiving water hydrology and water quality. In areas that have been developed, runoff is generated from almost all storms, both small and large, due to the impervious surfaces associated with development and the loss of soils and vegetation. In contrast, natural or undeveloped areas discharge little or no runoff from small storms because the rain is absorbed by the landscape and vegetation. Studies have shown that increases in runoff event frequency, volume and rate can be diminished or eliminated through the use of green infrastructure designs and practices, which infiltrate, evapotranspire and capture and use stormwater.

This option was selected because it is a straightforward approach to meet the intent of Section 438 in contrast to Option 2 which requires the designer to conduct a detailed hydrologic analysis of the site and model potential outcomes based on site specific conditions.

Designers opting to use Option 1 would need to do the following:

1) calculate or verify the precipitation amount from the 95th percentile storm event (this number would be typically expressed in inches, e.g., 1.5", and

2) Employ on-site stormwater management controls that infiltrate, evapotranspire or harvest and use the appropriate design volume.

The 95th percentile event can be calculated by using the following procedures below (summarized from Hirschman and Kosco, 2008, *Managing Stormwater in Your Community: A Guide for Building an Effective Post-Construction Program*, Center for Watershed Protection):

- Obtain a long-term rainfall record from a nearby weather station (daily precipitation is fine, but try to obtain at least 30 years of daily record). Long-term rainfall records can be obtained from many sources, including NOAA at www.nesdis.noaa.gov

- Remove data for small rainfall events that are 0.1 inch or less and snowfall events that do not immediately melt from the data set. These events should be deleted since they do not typically cause runoff and could potentially cause the analyses of the 95th percentile storm runoff volume to be inaccurate.
- Using a spreadsheet or simple statistical package, sort the rainfall events from highest to lowest. In the next column, calculate the percentage of rainfall events that are less than each ranked event (event number/total number of events). For example, if there were 1,000 rainfall events and the highest rainfall event was a 4" event, then 999 events (or a percentile of 999/1000, or 99.9%) are less the 4" rainfall event.
- Use the rainfall event at 95% as the 95th percentile storm event.

Option 2 allows the designer to conduct a full hydrologic analysis to determine the pre-development runoff conditions instead of using the estimated volume approach of Option 1. If the designer elects to use Option 2, the designer would then identify and model appropriate land uses for the pre-development condition of the site and quantify that the post-development runoff volume and peak flow discharges are equivalent to pre-development conditions.

Common Practices to Comply with Section 438

Although Congress did not prescribe specific practices to be used to comply with Section 438 it can be inferred that one of the goals of the Act was to promote the use of innovative stormwater management approaches, designs and practices that better protect receiving water quality, flow regimes and provide other important environmental benefits. Green infrastructure practices are preferred practices, to be supplemented with or replaced with conventional controls when site specific conditions dictate.

The green infrastructure management approaches and technologies that Federal agencies would typically use enhance and/or mimic the natural hydrologic cycle processes of infiltration, evapotranspiration, and reuse. Green infrastructure approaches include biological systems and engineered systems. These include but are not necessarily limited to:

- Green roofs
- Trees and tree boxes
- Rain gardens, bioretention, and infiltration planters
- Vegetated swales and bioswales
- Pocket wetlands
- Permeable pavements
- Reforestation/revegetation
- Protection and enhancement of riparian buffers and floodplains
- Rainwater harvesting for reuse (e.g., irrigation, HVAC make-up, non-potable indoor uses).

Green infrastructure practices were selected to achieve the intent of the Act for the following reasons:

- cost effectiveness
- overall environmental performance

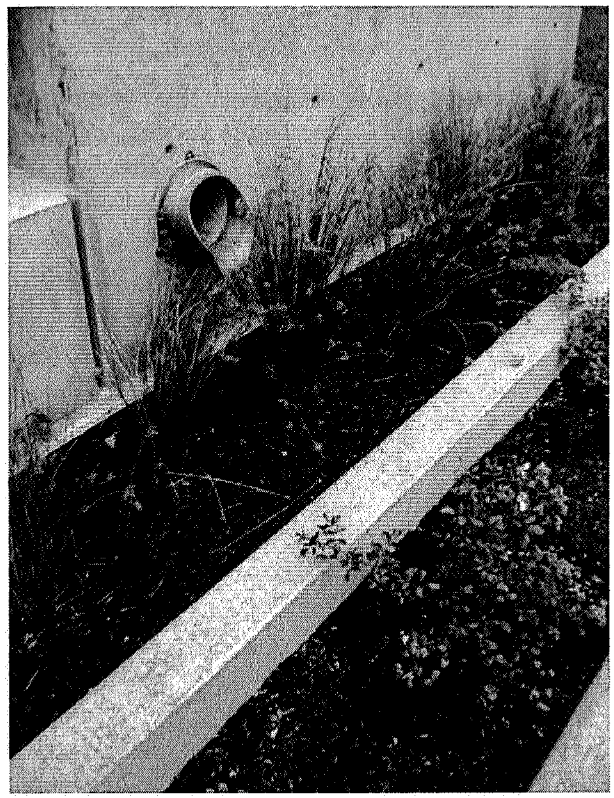


Figure 8. Disconnect downspout discharging to planter box.

- pollutant loading reduction capability
- pollution prevention focused
- effectiveness in managing runoff volumes and rates
- energy efficient and energy conservative
- appropriate in a wide range of site condition and locations
- appropriate for new development and redevelopment projects
- appropriate at multiple scales of development, e.g., site, neighborhood, region

For more information on specific green infrastructure practices and how they function, visit: http://www.epa.gov/greeninfrastructure and www.epa.gov/nps/lid.

Cost of Compliance

The cost of complying with Section 438 may require the use of approaches and techniques that initially may be more costly to design and implement. It is anticipated that as the expertise of the implementing agency or department increases and the demand for green infrastructure materials and equipment increases that the overall costs of the projects will be lower or equivalent to the costs of constructing conventional stormwater practices. Initial studies conducted by EPA and others suggest that the use of green infrastructure practices can be cost competitive. Recent evaluations of green infrastructure projects have identified opportunities for cost savings because of reduced infrastructure and site preparation demands. In addition, longer term studies have indicated that green infrastructure practices are continuing to gain cost efficiency as they are adopted more widely and with greater frequency thus reducing overall implementation costs.

In *Reducing Stormwater Costs through LID Strategies and Practices* (EPA 841-F-07-006, December 2007 - available for download at www.epa.gov/nps/lid), EPA examined 17 case studies in which conventional development costs were compared to green infrastructure costs. In the great majority of cases, the green infrastructure approach was between 15 and 80 percent cheaper and in some cases significantly they were less expensive because the incremental costs of implementing green infrastructure practices were more than offset by the cost reductions achieved by their use and management. Significant cost savings that were identified in the report include:

- Elimination or reduction of detention ponds
- Elimination or reductions of stormwater and CSO treatment and conveyance systems such as pipes, storage structures, stormwater treatment devices, and other related stormwater infrastructure

- Narrower streets with reduced material demands
- Fewer square yards of sidewalks
- Reduced land purchases for stormwater control structures

In addition, other benefits were achieved through the use of green infrastructure such as more beneficial uses of land previously dedicated to stormwater devices, increased livability and higher property values.

F. CALCULATING THE 95^{TH} PERCENTILE RAINFALL EVENT

A long period of precipitation records, i.e., a minimum of 10 years of data, is needed to determine the 95^{th} percentile rainfall event for a location. Thirty years or more of monitoring data are desirable to process an unbiased statistical analysis. The National Climatic Data Center (NCDC) provides long-term precipitation data for many locations of the United States. You can download climate data from their website (http://www.ncdc.noaa.gov) or by ordering compact discs (NOTE: The NCDC charges a fee for access to their precipitation data). Local airports, universities, water treatment plants, or other facilities might also maintain long-term precipitation records. Data reporting formats can vary based on the data sources. In general, each record should include the following basic information:

- Location (monitoring station)
- Recording time (usually the starting time of a time-step)
- Total precipitation depth during the time-step

In addition to the above information, a status flag is sometimes included to indicate data monitoring errors or anomalies. Typical NCDC flags include A (end accumulation), M (missing data), D (deleted data), or I (incomplete data). If there are no flags, the record has passed the quality control as prescribed by the NCDC and has been determined to be a valid data point.

There are several steps of data processing to determine the 95^{th} percentile rainfall event using a spreadsheet. These steps are summarized below:

1. Obtain a long-term 24-hr precipitation data set for a location of interest (i.e., from the NCDC website).

2. Import the data into a spreadsheet. [Data / Import External Data / Import Data]

3. Rearrange all of the precipitation records into one column if the original data set has multiple columns of precipitation records.

	A	B	C	D
1	Date	Prcp		
2	1/2/1921	0.05		
3	1/3/1921	0		
4	1/4/1921	0		
5	1/5/1921	0.33		
6	1/6/1921	0.08		
7	1/7/1921	0.08		
8	1/8/1921	0.19		
9	1/9/1921	0		

4. Review the records to identify if there are early periods with a large number of flagged data points (e.g., erroneous data points). Select a long period of good recording data that represents, ideally, 30 years or more of data. Remove all of the extra data (if not using the entire dataset).

5. Remove all flagged data points (i.e., erroneous data points) from the selected data set for further analysis.

6. Remove small rainfall events (typically less than 0.1 inches), which may not contribute to rainfall runoff. These small events are categorized as depressional storage, which, in general, does not produce runoff from most sites.

	A	B	C	D
1	Date	Prcp		
2	1/5/1921	0.33		
3	1/8/1921	0.19		
4	1/14/1921	1.04		
5	2/6/1921	0.12		
6	2/11/1921	0.63		
7	2/20/1921	1.33		
8	2/28/1921	0.43		
9	3/3/1921	0.13		

Note: Steps 4 through 6 can be processed by applying data sort, delete and re-sort spreadsheet functions. [Data / Sort]

7. Calculate the 95th percentile rainfall amount by applying the PERCENTILE spreadsheet function at a cell: [=PERCENTILE(precipitation data range,95%)]

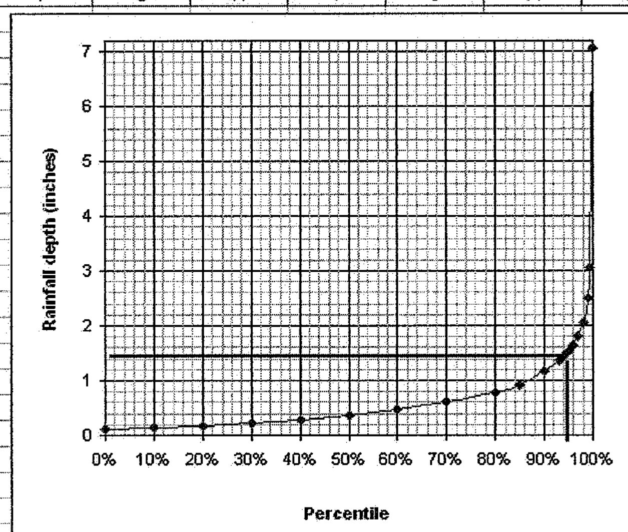
	A	B	C	D	E	F
1	Date	Prcp				
2	1/5/1921	0.33		=PERCENTILE(B:B,95%)		
3	1/8/1921	0.19		1.52		
4	1/14/1921	1.04				
5	2/6/1921	0.12				
6	2/11/1921	0.63				
7	2/20/1921	1.33				
8	2/28/1921	0.43				

Note: The PERCENTILE function returns the n^{th} percentile of value in the entire precipitation data range. We can use this function to decide the 95^{th} percentile storm event that captures all but the largest 5% of storms.

8. The 95^{th} percentile rainfall event can also be determined graphically. Derive a table showing percentile versus rainfall depth to draw a curve shown as shown below. The PERCENTILE spreadsheet function can be used for each selected percent. It is recommended to include at least 6 points between 0% and 100% (several points should be between 80% and 100% to draw an accurate curve).

	A	B	C	D	E	F	G
1	Date	Prcp		Percentile	Rainfall		
2	1/5/1921	0.33		0%	=PERCENTILE(B:B,D2)		
3	1/8/1921	0.19		10%	=PERCENTILE(B:B,D3)		
4	1/14/1921	1.04		20%	=PERCENTILE(B:B,D4)		
5	2/6/1921	0.12		30%	=PERCENTILE(B:B,D5)		
6	2/11/1921	0.63		40%	=PERCENTILE(B:B,D6)		

	A	B	C	D	E
1	Date	Prcp		Percentile	Rainfall
2	1/5/1921	0.33		0%	0.1
3	1/8/1921	0.19		10%	0.13
4	1/14/1921	1.04		20%	0.17
5	2/6/1921	0.12		30%	0.22
6	2/11/1921	0.63		40%	0.28
7	2/20/1921	1.33		50%	0.36
8	2/28/1921	0.43		60%	0.46
9	3/3/1921	0.13		70%	0.6
10	3/9/1921	0.31		80%	0.79
11	3/13/1921	0.46		85%	0.93
12	3/25/1921	0.47		90%	1.16
13	3/28/1921	0.12		93%	1.35
14	4/1/1921	0.36		94%	1.44
15	4/9/1921	0.69		95%	1.52
16	4/15/1921	0.24		96%	1.65
17	4/17/1921	0.32		97%	1.82
18	4/18/1921	0.55		98%	2.068
19	4/23/1921	0.69		99%	2.508
20	4/24/1921	0.19		99.5%	3.049
21	4/30/1921	1.44		100%	7.06



Use the spreadsheet software to create of plot of rainfall depth versus percentile, as shown above. The 95^{th} percentile storm event should correlate to the rainfall depth calculated in step 7, however the graph can be used to calculate rainfall depths at other percentiles (e.g., 50%, 90%).

Part II: Case Studies on Capturing the 95th Percentile Storm Using Onsite Management Practices

INTRODUCTION

This section contains eight case studies that are intended to be representative of the range of projects that are subject to the requirements legislated in Section 438 of the Energy Independence and Security Act. The facility examples in the case studies were selected to illustrate project scenarios for differing geographic locations, site conditions, and project sizes and types. As noted in Part I, all projects with a footprint greater than 5,000 square feet must comply with the provisions of Section 438. This means that both new development and redevelopment projects must be designed to infiltrate, evapotranspirate, and/or harvest and reuse runoff to the maximum extent technically feasible (METF) to maintain or restore the pre-development hydrology of the site. In this guidance, METF has been interpreted to mean the onsite control and management of all storms up to and including the 95th percentile storm event.

Given the site-specific nature of individual projects, the case study scenarios described herein do not include site specific design features such as runoff routing, specific site infiltration rates, the structural loading capacity of buildings, etc. in terms of stormwater practice selection.

It should be noted that an example of Option 2, which requires a detailed hydrologic analysis, has not been provided in this document because of the complexity of factors and the lack of general applicability such an analysis would have.

Background
Numerous approaches exist for determining the volume of runoff to be treated through stormwater management. Controlling stormwater runoff from all events up to and including the 95th percentile rainfall event was selected as Option 1 because small, frequently-occurring storms account for a large proportion of the annual precipitation volume. Using green infrastructure practices to control both the runoff produced by small storms and the first part of larger storms can reduce the cumulative impacts of altered flow regimes on receiving water hydrology, e.g., channel degradation and diminished baseflow. For the purposes of this guidance, control of all storms up to and including the 95th percentile storm event is analogous to maintaining or restoring the predevelopment hydrology with respect to the volume, flow rate, duration and temperature of the runoff for most sites.

Determination of the 95th Percentile Rainfall Event
The 95th percentile rainfall rainfall event was determined using the long-term daily precipitation records from the National Climate Data Center (NCDC, 2007). By analyzing the frequency and rainfall depths from daily rainfall records over 24-hour periods, the 95th percentile storm event can be determined. From a frequency analysis viewpoint, the 95th percentile event is the storm event that is greater than or equal to 95% of all storms that occur within a given period of time. Regional climate conditions and precipitation vary across the U.S. Because of local values, it is essential that the implementing agency or department establish the 95th percentile storm event for

the project site since the control volume may vary depending on local weather patterns and conditions.

Onsite Stormwater Management Practice Determinations
For the purposes of the case study scenarios, the following four categories of practices were selected as the most appropriate practices for implementing Section 438 requirements: bioretention, permeable pavements and pavers, cisterns, and green roofs. These practices were selected based on known performance data and cost. For each case study, the same hierarchy of selection criteria was used, i.e., the most cost effective practices were considered before other practices were considered. Bioretention practices were considered first because these systems generally have the lowest cost per unit of stormwater treated (Hathaway and Hunt, 2007). Thus, if the bioretention system could not be designed to adequately capture the desired runoff volume, permeable pavement and pavers, cisterns, and green roofs were considered in that order based on relative cost. In most cases a combination of practices was selected as part of an integrated treatment system. It should be noted that all treatment systems were designed to accomplish the goal of capturing the 95th percentile rainfall event onsite. Examples of onsite stormwater management practices selected for each site are presented in the results section. For the Boston, MA site, it was assumed that bioretention was not feasible in order to simulate a situation where space was severely limited; as a result, interlocking modular pavers were selected as the most cost effective stormwater management to capture the requisite design volume. To further illustrate the range of site conditions designers may encounter, and how site conditions impact the selection of appropriate control options, Scenario #3 (Cincinnati, OH) was re-analyzed as Scenario #8. In Scenario #8, it was assumed that the site had clay soils and low infiltrative capacity. Given these site conditions, the range of potential control options was more limited and a combination of modular paving blocks, a green roof, and cisterns was ultimately selected based on cost and site suitability factors.

For purposes of these modeling exercises, a number of assumptions were associated with each category of practice. These assumptions are not necessarily an endorsement of a particular design paradigm, but rather to keep a somewhat conservative cap on the scenarios in order to demonstrate feasibility of the approach. For example, bioretention retrofits can and should often be located in prior impervious locations; however, in all modeled scenarios bioretention was restricted to currently landscaped areas. The assumptions were:

- **Bioretention areas**: It is assumed bioretention practices would be installed within currently landscaped pervious areas or that pervious areas would be created for bioretention cells. While termed bioretention, these systems are designed to provide infiltration as well as temporary storage. Bioretention areas would be designed to store up to 10 inches of runoff depth from contributing areas (see Appendix A). The conceptual design of this storage depth would occur within the media and/or could be included as ponded storage. Further design storage beyond the 10 inches would be acceptable (and encouraged) above the media on a site by site basis with ponded depth generally not to exceed 12 inches.

  Uniform infiltration was assumed across the entire base of the bioretention cell. No additional media underneath the amended soils were included in the designs with infiltration rates in this layer governed by the *in situ* soils. Underdrains were not modeled directly but could be applied at the point of storage overflow (at a design depth of 10 inches). This approach was selected to maximize infiltration benefits of these systems. The intent was to provide maximum storage and opportunities for infiltration processes over a pass-through or filtration system which can occur when using an underdrain at the base of the bioretention cell. Because standard underdrains typically discharge from smaller storms as well, underdrain designs, if employed, should ensure adequate retention capacity for the 95th percentile event volume.

The bioretention footprint for modeling purposes was calculated as one uniform area that did not include side slopes. There is an expectation that actual bioretention cell construction would be distributed throughout the site with targeted locations based on hydrology (natural flow paths) and soils with greater infiltrative capacity. Side slopes may increase the surface excavation area required to accommodate the footprint and freeboard of these systems depending on the design or the bioretention system.

- **Porous pavement**: Infiltration was modeled for the entire porous pavement area with drainage pipes used only as overflow outlets. This design was chosen to maximize infiltration capabilities of the system. While many types of porous pavement systems are can be used, modular block type pavers were generally applied in this design category under the assumption that they typically include sufficient volumetric storage in the media layer. Depending on design, other types of porous pavement applications can include similar volumetric storage with equal or improved load bearing benefits.

  For these systems, an equivalent of 2 inches of design storage depth was assumed. This design depth could be achieved by specifying 10 inches of media depth that had 20% void space. Similarly, this could be achieved by designing six inches of media depth above the bottom surface, with specified media containing 33% void space. This alternative would have the overflow outlet at the six inch depth providing an equivalent water storage depth of 2 inches.

  The soils under the paver blocks may require or be subjected to some compaction for engineering stability. As a result, infiltration into underlying soils was modeled conservatively by applying the minimum infiltration rate for each soil type (see Appendix A).

  Generally, porous pavement is not recommended for high traffic areas or loading bays. Because of this the scenarios assumed that only a percentage of total parking and road areas on a site can be converted to porous pavement. The assumed maximum percentage applied in the scenarios was set at 60% of the total paved area.

- **Cistern**: Cisterns were modeled in cases where green roofs were not feasible or where it was necessary to include additional storage volume to meet the goal of on site rainfall runoff capture. The sizes of cisterns would be calculated by site-specific rainfall, site specific spatial and structural conditions, use opportunities and rates, and consideration of cost per volume of storage. For simplicity, cistern volume was reported as a total volume. This total volume could be subdivided into any number of cisterns to provide the total necessary storage but should be relative to the impervious area and runoff quantities which will flow to the cistern. Consideration of the most efficient cost per volume storage would need to be considered on a site by site basis (see Appendix A).

- **Green roof**: Frequently, green rooftop area is limited by structural capacity. In addition, other rooftop equipment may need to be accommodated in this space including HVAC systems and air handlers. For this reason, and to provide a somewhat conservative rate of application, it was assumed for these modeling analyses that up to 30% of a roof's impervious area could be converted into a green roof. Green roof area was assumed to have 1 inch of total effective stormwater storage, i.e., a 2.5 inch media depth with 40% void space (see Appendix A).

General Approach

Using site aerial photos, spatial analysis should be conducted to estimate the land cover types and areas for each site. The surface conditions of each site can be digitized using GIS techniques. Alternatively, CAD drawings can be used to estimate the surface area of each land cover type. The schematic in Figure 9 illustrates the processes used for selecting and determining the overall size of stormwater management practices for each site.

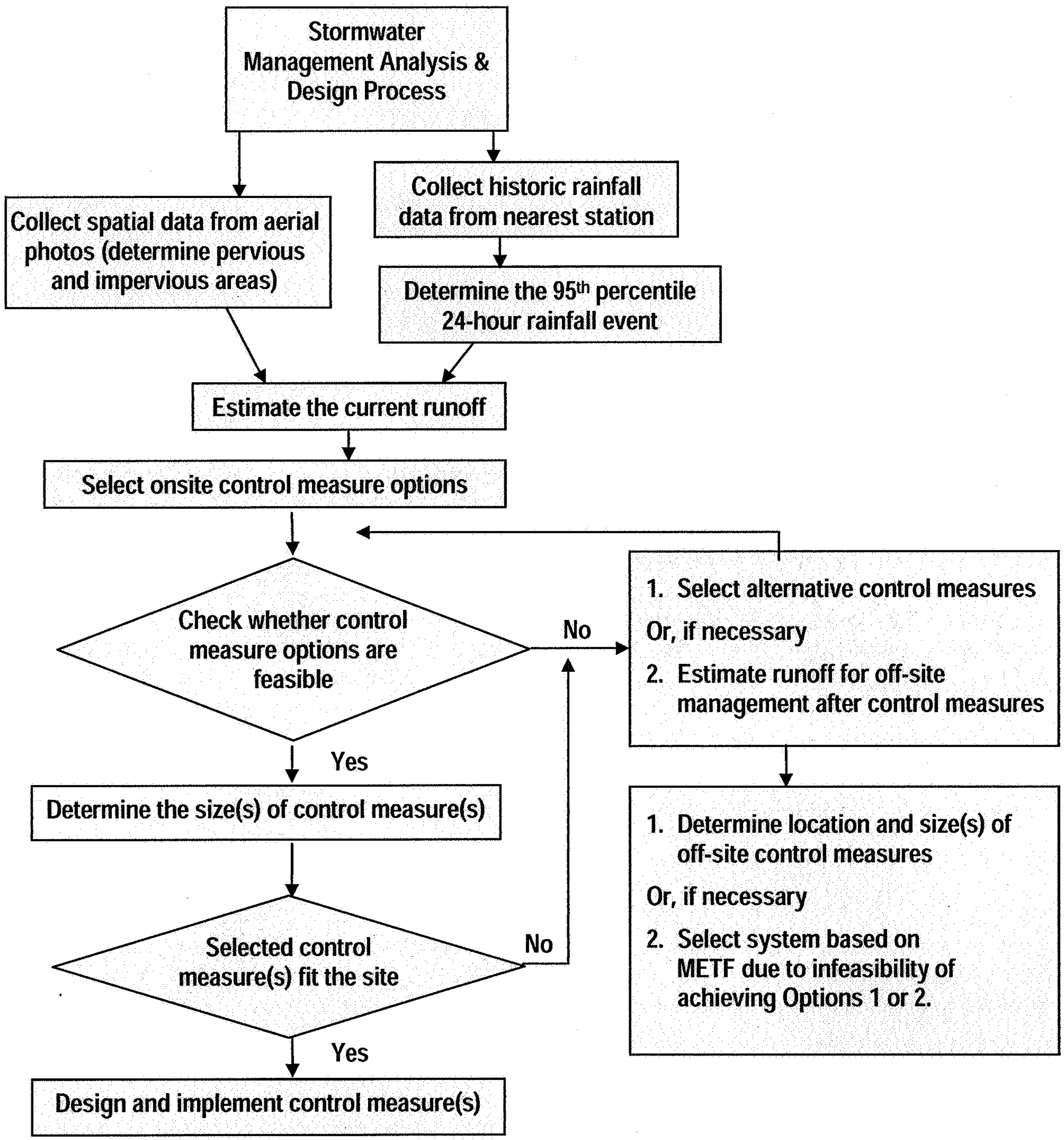


Figure 9. Flow chart depicting the process for determining control measures using the 95th percentile, 24-hour, annual rainfall event.

The following steps provide more detailed information on acquiring and calculating the necessary data to complete the processes indicated in Figure 9. This methodology was used in the scenario analyses that follow.

Collecting spatial data for a site

1. Collect an aerial orthophotograph for the desired site.
2. Digitize land use/land cover conditions using GIS techniques. If CAD drawings of the site exist, they can be used to estimate land cover area (pervious, impervious).
3. Categorize the digitized or planned land use/land cover based on surface hydrologic conditions, e.g., rooftop, pavement, and pervious/landscaped area.
4. Estimate the size of each land use/land cover category (polygon).

Determining the 95th percentile, 24-hr rainfall event

1. Obtain a long-term 24-hr precipitation data set for the location of interest (i.e., from the NCDC website or other source)
2. Import the data into a spreadsheet. *In MS Excel* [Data / Import External Data / Import Data]
3. Rearrange all of the precipitation records into one column if the original data set has multiple columns of precipitation records
4. Remove all flagged data points (i.e., erroneous data points) from the selected data set for further analysis
5. Remove small rainfall events (typically less than 0.1 inches) that may not contribute to rainfall runoff. These small storms often produce little if any appreciable runoff from most sites and for modeling purposes are typically considered as volume captured in surface depression storage.
6. Calculate the 95th percentile rainfall volume by applying the PERCENTILE spreadsheet function at a cell. The PERCENTILE function returns the nth percentile value in the entire precipitation data range. This function can be used to determine the 95th percentile storm event that captures all but the largest 5% of storms. *In MS Excel* [PERCENTILE(precipitation data range,95%)]

Placing onsite control measures to capture the 95th percentile rainfall event

1. Collect spatial data for a site, e.g., rooftop, pavement, and pervious areas as above.
2. Check soil type (USDA mapping, borings, or on-site testing) for the site to determine infiltration parameters. For this modeling, many of the assumptions that pertain to generalized soils groups and their infiltration properties come from the EPA Stormwater Management Model (SWMM 4.x) manual (see Appendix A).
3. Determine the current runoff volume that would occur during a 24 hour period by applying the 95th percentile rainfall to the existing site conditions (land use and soil properties) as above using a hydrologic model (such as TR-55 or SWMM). For this analysis, it is assumed that the rainfall amount is distributed over a 24 hour period. Actual rainfall event duration (and intensity) was not considered for rainfall runoff (however, timing was considered when modeling infiltration).
4. Determine flow paths so that management practices placements are in locations where flows can be intercepted and routed to practices (Note: This step was not included in the scenario exercises). Because this is a site specific effort and may require detailed topographic information or further surveys this would be a task to be completed onsite and therefore is not included as a part of the modeling scenario effort.

5. Select onsite control practices to capture the current 95th percentile runoff event; base the selection of appropriate options on site conditions, areas available for treatment options, and other factors such as use and other constraints.

Note: The steps above have been generalized for the purposes of this guidance. It is recommended that a qualified professional engineer determine or verify that stormwater management practices are sized, placed, and designed correctly. It should also be noted that the methodology to determine rainfall amount was subject to a 24 hour time period based on daily records. Actual rainfall events may have been shorter or longer time periods. Similarly, for modeling purposes, the 24 hour rainfall amount was distributed to pervious and impervious areas (and management practices) as a uniform event occurring during a 24-hour period. A large dataset (greater than 50 years) was used to reasonably represent rainfall depth not necessarily rain event depth. It stands to reason that more frequent, shorter duration precipitation events are better represented than less frequent, longer duration precipitation events.

Modeling Scenarios
Seven locations were selected for the 8 case studies as shown in Figure 10 and Table 3. Case study numbers 3 and 8 were both developed based on the Cincinnati, Ohio facility, although the site parameters were altered to represent differing site conditions and design constraints. Annual average rainfall depths for these locations range from 7.5 inches to 48.9 inches. Analyses of the 95th percentile rainfall events for these locations produced rainfall depths that range from 1.00 inch to 1.77 inches (Table 3).

Figure 10. Locations for Analyzing Onsite Control Measures.

The government facilities in the 8 case studies were selected because they represent generic sites from the major climatic regions of the U.S. These facilities also were selected because the sites have a range of site characteristics that can be used to illustrate different site designs and stormwater management options, e.g., pervious, roof, and pavement areas (Table 4). Site sizes ranged from 0.7 to 27 acres with percent site imperviousness area ranging from 47% to 95% of the site. Aerial photos of the sites are included along with site specific rainfall runoff and soil results.

Table 3. Summary of Rainfall Data for the Seven Locations.

No	Location	NCDC Daily Precipitation Data		Rainfall Depth (inches)	
		Period of record	Coverage	Annual average	95th percentile rainfall event
1	Charleston, WV	1/1/1948 - 12/31/2006 (59 yrs)	99%	43.0	1.23
2	Denver, CO	1/1/1948 - 12/31/2006 (59 yrs)	96%	15.2	1.07
3	Cincinnati, OH	1/1/1948 - 12/31/2006 (59 yrs)	96%	36.5	1.45
4	Portland, OR	1/1/1941 - 12/31/2006 (66 yrs)	98%	35.8	1.00
5	Phoenix, AZ	1/1/1948 - 12/31/2006 (59 yrs)	99%	7.5	1.00
6	Boston, MA	1/1/1920 - 12/31/2006 (87 yrs)	99%	41.9	1.52
7	Atlanta, GA	1/1/1930 - 12/31/2006 (77 yrs)	100%	48.9	1.77

The results of the spatial analyses were summarized and divided into three land cover categories; rooftop, pavement, and pervious area, as shown in Table 4.

Table 4. Summary of Land-use Determinations of the Study Sites.

No	Location	Facility Spatial Info (acres)				Site Imperviousness
		Rooftop	Pavement	Pervious	Total	
1	Charleston, WV	0.1	0.4	0.2	0.7	73%
2	Denver, CO	0.5	1.9	2.0	4.5	55%
3	Cincinnati, OH	1.6	8.0	9.4	19	51%
4	Portland, OR	8.8	16.9	1.3	27	95%
5	Phoenix, AZ	0.2	0.7	1.1	2	47%
6	Boston, MA	0.9	1.5	1.1	3.5	69%
7	Atlanta, GA	3.9	10.8	6.2	21	70%

Methods for Determining Runoff Volume

Direct Determination of Runoff Volume

Runoff from each land cover was estimated using a simplified volumetric approach based on the following equation:

$$Runoff = Rainfall - Depression\ Storage - Infiltration\ Loss$$

Again, this methodology does not consider routing of runoff; therefore slope is not considered when calculating on a volumetric basis.

Infiltration loss is calculated only in pervious areas (e.g., there is no infiltration in impervious areas). In this analysis, infiltration was estimated using Horton's equation:

$$f = f_{\min} + (f_{\max} - f_{\min})\, e^{-kt}$$

where, f = infiltration rate at time t (in/hr)
$f_{\min}$ = minimum or saturated infiltration rate (in/hr)
$f_{\max}$ = maximum or initial infiltration rate (in/hr)
k = infiltration rate decay factor (/hr) and
t = time (hr)

Infiltration loss for the 24-hr rainfall duration was estimated by the following equation with assumptions of a half hour Δt and uniform rainfall distribution in time:

$$\textit{Infiltration Loss} = \sum (f \cdot \Delta t)$$

To more accurately describe the dynamic process of infiltration associated with Horton's equation, infiltration loss was integrated over a 24-hour period using a half hour time step while applying the maximum and minimum infiltration rates (in/hr) with time using the appropriate soil decay factor. The results of this process are further illustrated in Appendix A.

In cases where sites had limited physical space available for stormwater management, a series of practices was used (e.g., treatment train) to simulate the runoff and infiltrative behavior of the system. For example, if there was inadequate area and infiltrative capacity to infiltrate 100 percent of the 95th percentile storm event within a bioretention system another onsite management practice was selected to manage the runoff that could provide the necessary capacity not available by another treatment system. In this manner, excess runoff was routed to another management practice in the series of treatment cells where possible.

Two types of soils were considered for every site: hydrologic soil group B and C (except for scenario 8 in which hydrologic soil group D was used). Group B soils typically have between 10 percent and 20 percent clay and 50 percent to 90 percent sand and either loamy sand or sandy loam textures with some loam, silt loam, silt, or sandy clay loam soil textures placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments. Group C soils typically have between 20 percent and 40 percent clay and less than 50 percent sand and have loam, silt loam, sandy clay loam, clay loam, and silty clay loam soil textures with some clay, silty clay, or sandy clay textures placed in this group if they are well aggregated, of low bulk density, or contain greater than 35 percent rock fragments (USDA-NRCS, 2007). The application of these hydrologic soil groups was intended to give reasonable and somewhat conservative estimates of infiltration capacity.

General hydrologic parameters in this analysis were assumed as follows (see Appendix A for citations of assumptions):

- Depression storage (or initial abstraction)
    - Rooftop: 0.1 inches
    - Pavement: 0.1 inches
    - Pervious area: 0.2 inches

- Horton Infiltration parameters
    - Hydrologic Soil Group B
        - Maximum infiltration rate: 5 in/hr
        - Minimum infiltration rate: 0.3 in/hr
        - Decay factor: 2 /hr

    - Hydrologic Soil Group C
        - Maximum infiltration rate: 3 in/hr
        - Minimum infiltration rate: 0.1 in/hr
        - Decay factor: 3.5 /hr

- Design storage assumptions of control measures
    - Bioretention: up to 10 inches
    - Green roof: 1 inch (2.5 inches deep media with 40% void space)
    - Porous pavement: 4 inches (10 inches deep media with 40% void space)

Other Modeling Methods for Estimating Runoff Volume
Runoff from a site after applying the 95th percentile storm can be estimated by using a number of empirical, statistical, or mathematical methods. Several methods were considered in this analysis. The Rational Method can be used to estimate peak discharge rates and the Modified Rational Method can be used to develop a runoff hydrograph. The NRCS TR-55 model can be used to predict runoff volume and peak discharge. TR-55 can also be used to develop a runoff hydrograph. The EPA Stormwater Management Model (SWMM) can be used to simulate rainfall-runoff, pollutant build-up and wash-off, transport-storage-treatment of stormwater flow and pollutants, backwater effects, etc. for a wide range of temporal and spatial scales. The SWMM model can be fit to model a small site with a distributed system. Hydrologic Simulation Program – Fortran (HSPF, USDA) is a watershed and land use based lumped model that can be used to compute the movement of water and pollutants when evaluating the effects of land use change, reservoir operations, water quality control options, flow diversions, etc. In general, regionally calibrated modeling parameters are applied into HSPF. QUALHYMO is a complete hydrologic and water quality model, which can be used to factor in snowmelt, soil moisture conditions or to simulate system behavior based on infiltration and ET, groundwater storage tracking, baseflow and deep volumetric losses, and other variables.

Many of the existing tools for analyzing distributed systems use some part or all of the principles or formulae of the modeling approaches highlighted above. For example, the Emoryville spreadsheet control measure model (Emoryville, CA) uses a runoff coefficient (i.e., Rational Method) for analyzing lot-level to neighborhood-scale control measure sizing. The Green Calculator (Center for Neighborhood Technologies) estimates the benefit of onsite green infrastructure options on a neighborhood-scale by applying the curve numbers (i.e., TR-55) and the Modified Rational Method. The Northern Kentucky Spreadsheet Tool uses a TR-55 based approach for control measure sizing on neighborhood or site level spatial scales. The WWHM (Western Washington Hydrology Model) is a regionally calibrated HSPF model intended for use in sizing stormwater detention and water quality facilities to meet the Washington State Department of Ecology standards. WBM-QUALHYMO is a Canadian model used in conjunction with the Water Balance Model (WBM). This model can be used to continuously simulate stormwater storage routing, stream erosion, drainage area flow routing, and snowmelt runoff (and ultimately freeze-thaw). Table 5 contains a summary of these different methods based on generic modeling features.

Table 5. Potential Methods for Analyzing Control Measures.

Model Considerations		Rational Method	TR-55	SWMM	Direct Determination	HSPF	QUALHYMO
Temporal scale	Single Event	Yes	Yes	Yes	Yes	Yes	Yes
	Continuous Simulation	No	No	Yes	Possible	Yes	Yes
Spatial scale	Lot-level	Yes	Yes[b]	Yes	Yes	No	No
	Neighborhood	Yes	Yes	Yes	Yes	Possible	Possible
	Regional	Yes	Yes[c]	Yes	No	Yes	Yes
Outputs	Peak Discharge	Yes	Yes	Yes	No	Yes	Yes
	Runoff Volume	Yes	Yes	Yes	Yes	Yes	Yes
	Hydrograph	Yes[a]	Yes	Yes	No	Yes	Yes
	Water Quality	No	No	Yes	Possible	Yes	Yes

[a] Modified Rational Method

[b] No less than 1 acre.

[c] No more than 25 square miles (up to 10 subareas).

From the viewpoint of modeling both lot-level and neighborhood scale projects, the Rational Method, NRCS TR-55, SWMM, and Direct Determination approaches were selected for use in scenario analyses. Strength and weakness of these methods are presented below:

Table 6. Comparison of modeling approaches for determining runoff volume.

Method	Strengths	Weaknesses
Direct Determination	• **Methodology for runoff determination is same as SWMM** • **Models basic hydrologic processes directly (explicit)** • **Simple spreadsheet can be used**	• **Direct application of Horton's method may estimate higher infiltration loss, especially at the beginning of a storm** • **Does not consider flow routing**
Rational Method	• **Method is widely used** • **Simple to use and understand**	• **Cannot directly model storage-oriented onsite control measures**
TR-55	• **Method is widely used** • **Simple to use and understand**	• **May not be appropriate for estimating runoff from small storm events because depression storage is not well accounted for**
SWMM	• **Method is widely used** • **Can provide complete hydrologic and water quality process dynamics in stormwater analysis**	• **Needs a number of site-specific modeling parameters** • **Generally requires more extensive experience and modeling skills**

Each method requires specific modeling parameters for estimating runoff from a site. Runoff coefficients for the Rational Method are assumed to be 0.9 for rooftop and pavement areas, and

0.1 and 0.135 for Group B and C soil pervious areas, respectively (Caltrans, 2003). The slope of the pervious area was assumed to be an average of 2%. Applying these runoff coefficients for each surface, the overall area-weighted runoff coefficient can be determined.

When applying the NRCS TR-55 method, Curve Numbers (CNs) must be determined for each drainage area. For rooftop and pavement areas the CN was assumed to be 98, and pervious area CN was determined on the basis of the hydrologic soil group and the status of grass cover condition. Curve numbers for pervious areas were assumed to be 61 and 74 for Group B and C soils, respectively, with an assumption of over 75% grass cover. The overall CN can be estimated by using an area-weighted calculation (USDA-SCS, 1986).

In SWMM modeling, infiltration was modeled using Horton's equation. The same infiltration parameters and depression storage values used in the direct determination method of runoff treatment volume described earlier were applied to the SWMM analyses. The average slope of the pervious area was again assumed to be 2%. The same uniform rainfall distribution and time step was applied for the SWMM model runs. To verify the assumption that uniform distribution occurred, NRCS 24-hour rainfall distribution was modeled using SWMM.

Modeling Results

Stormwater management practice sizes were determined using the direct determination approach to capture the volume of runoff generated in a 95th percentile rainfall event at each location. Total acreage, impervious area, the 95th percentile rainfall event, the current expected runoff for the 95th percentile rainfall event, and the future runoff with stormwater management controls were reported for each site. Results were summarized for the two soil types (three soil types for scenarios #3 and #8 in Cincinnati). The spatial location of onsite control measures was also illustrated in the site aerial photo figures. Note that site practices were placed only on undeveloped or landscaped areas without regard for true flow paths or technical feasibility. It may be preferred to place practices in existing impervious areas, if possible.

To compare other approaches of runoff estimation, alternate methodologies were also employed for three scenarios. TR-55 was used for Scenario #1 (Atlanta), the Rational Method was applied to Scenario #2 (Denver), and the SWMM was run for Scenario #7 (Charleston).

For flood control purposes, TR-55 was used to model the 10 year frequency design storm for each site under the assumption that all stormwater management practices were in place. The 10-year design storms were selected from the NRCS TR-55 Manual (USDA, 1986) for both the Eastern U.S. and the Western U.S. Precipitation Frequency Maps (http://www.wrcc.dri.edu/pcpnfreq.html). The 10-year frequency design storm was selected because it represents a common design standard used by state and local governments in order to manage peak rates of runoff and prevent flooding.

Scenario #1 - Charleston, WV

A 0.7-acre site with 73% impervious area was selected from Charleston, West Virginia (Figure 11). If the 95th percentile rainfall event (1.23 inches) occurred on the existing site (i.e., with no control measures), 0.82 inches of runoff would be generated and require management. The runoff from the 95th percentile rainfall event could be controlled by the installation of bioretention systems totaling 0.03 acres if hydrologic soil group B is present, or 0.06 acres if hydrologic soil group C (Table 7) is the predominant soil type on the site. Assuming that bioretention practices are placed in areas that are currently pervious or landscaped, a total of 0.2 acres of pervious area would be available for the placement of bioretention systems. The effective design storage depth within the designated bioretention area was assumed to be 8 inches.

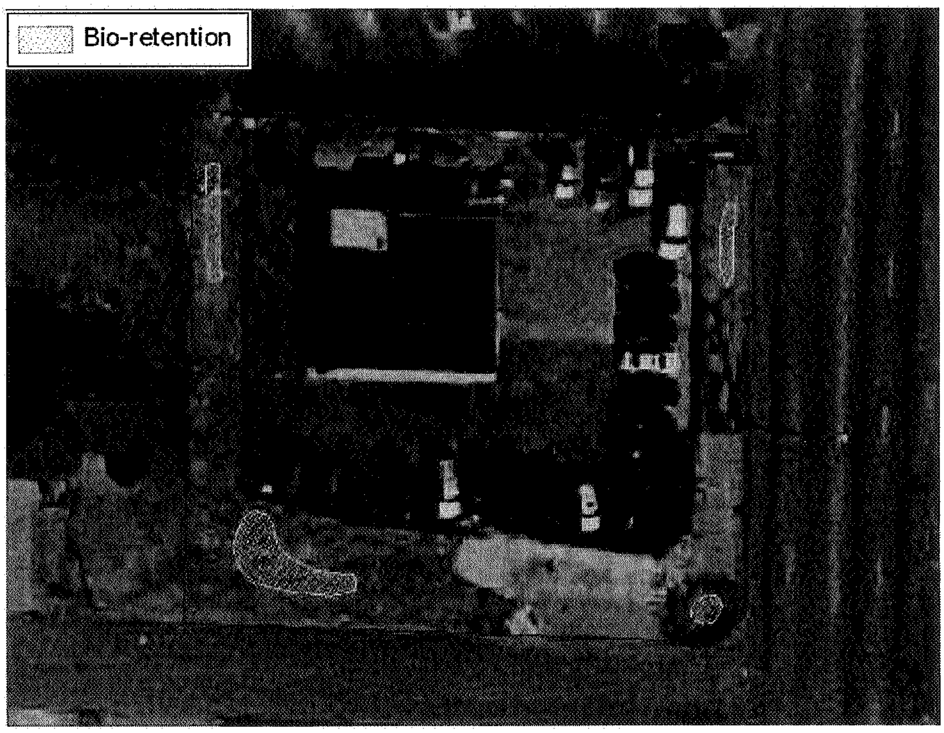


Figure 11. Actual Site and Onsite Control Measures (Charleston, WV)

Table 7. Estimated Sizes of Onsite Control Measures (Charleston, WV)

Total Area (acres)	0.7	
Estimated Imperviousness (%)	73%	
95th Percentile Rainfall Event (inches)	1.23	
Expected Runoff for the 95th Percentile Rainfall Event (inches)	0.82	
Stormwater Management Area Required	Hydrologic Soil Group	
	B	C
Bioretention estimated by Direct Determination method (acres)	0.03	0.06
Bioretention estimated by SWMM (acres)	0.03	0.05
Off-site storage necessary to control the 10-yr event of 3.9 inches (acre-ft)	0.10	0.12

Note: The two hydrologic methods used (direct determination and SWMM) estimated similar bioretention sizes.

Scenario #2 - Denver, CO

A 4.5-acre site with 55% impervious area was selected from Denver, Colorado (Figure 12). If the 95th percentile rainfall event (1.07 inches) occurred on the existing site (i.e., with no control measures), 0.53 inches of runoff from the site would be generated and require management. The runoff from the 95th percentile rainfall event could be controlled by the installation of bioretention systems totaling 0.16 acres if the hydrologic soil group B is present or 0.3 acres if hydrologic soil group C (Table 8) is the predominant soil type on the site. Assuming that bioretention practices are only placed in areas that are currently pervious or landscaped, a total of 2 acres of pervious area is available for the placement of bioretention systems. Given this total available area, the design storage depth of media within the designated bioretention area must be at least 6 inches.

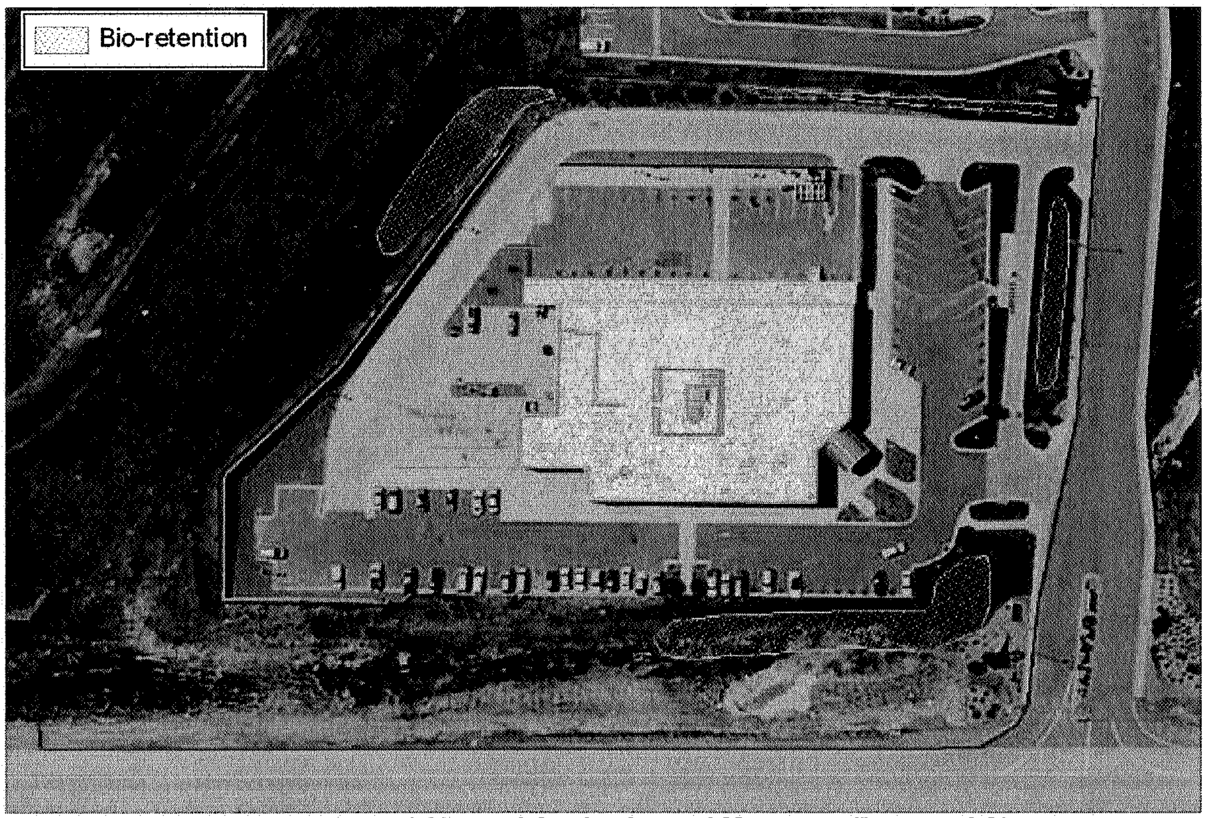


Figure 12. Actual Site and Onsite Control Measures (Denver, CO)

Table 8. Estimated Sizes of Onsite Control Measures (Denver, CO)

Total Area (acres)	4.5	
Estimated Imperviousness (%)	55%	
95th Percentile Rainfall Event (inches)	1.07	
Expected Runoff for the 95th Percentile Rainfall Event (inches)	0.53	
Stormwater Management Area Required	Hydrologic Soil Group	
	B	C
Bioretention estimated by the Direct Determination method (acres)	0.16	0.3
Bioretention estimated by Rational Method (acres)	0.16	0.28
Off-site storage necessary to control the 10-yr event of 3.2 inches (acre-ft)	0.35	0.52

Scenario #3 - Cincinnati, OH

A 19-acre site with 51% impervious area was selected in Cincinnati, Ohio (Figure 13). If the 95th percentile rainfall event (1.45 inches) occurred on the existing site (i.e., no control measures were in place), 0.68 inches of runoff from the site would be generated and require management. The runoff from the 95th percentile rainfall event could be controlled by the installation of bioretention systems totaling 0.8 acres if the hydrologic soil group B is present or 1.3 acres if hydrologic soil group C (Table 9) is the predominant soil type on the site. Assuming that bioretention practices are only placed in areas that are currently pervious or landscaped, a total of 9.4 acres of pervious area is available for the placement of bioretention systems. Given this total available area, the design storage depth of media within the designated bioretention area must be at least 8 inches.

Figure 13. Actual Site and Onsite Control Measures (Cincinnati, OH)

Table 9. Estimated Sizes of Onsite Control Measures (Cincinnati, OH)

Total Area (acres)	19	
Estimated Imperviousness (%)	51%	
95th Percentile Rainfall Event (inches)	1.45	
Expected Runoff for the 95th Percentile Rainfall Event (inches)	0.68	
Stormwater Management Area Required	Hydrologic Soil Group	
	B	C
Bioretention estimated by the Direct Determination (acres)	0.8	1.3
Off-site storage necessary to control the 10-yr event of 4.2 inches (acre-ft)	2.42	3.24

Scenario #4 - Portland, OR

A 27-acre site with 95% impervious area was selected in Portland, Oregon (Figure 14). If the 95th percentile rainfall event (1.0 inches) occurred on the existing site (i.e., no control measures), 0.86 inches of runoff would be generated and require management. This site has the greatest imperviousness among the 7 sites.

Given these site conditions, there is not enough pervious area to manage the entire runoff volume discharged by the 95th percentile rainfall event. As a result, other practices were evaluated and selected. The practices integrated into the design included a green roof, cisterns, and porous pavement. Based on the technical considerations of constructing and maintaining control measures at the site, it was assumed that approximately 30% of the available pervious area could be converted into bioretention cells; 20% of total rooftop area could be converted into green roofs; 40% of paved area could be converted into paver blocks; and 50,000 gallons of total volume could be captured in cisterns for use on this urbanized site. Using this system of four different practices, all runoff for the 95th percentile rainfall event would be controlled (Table 10).

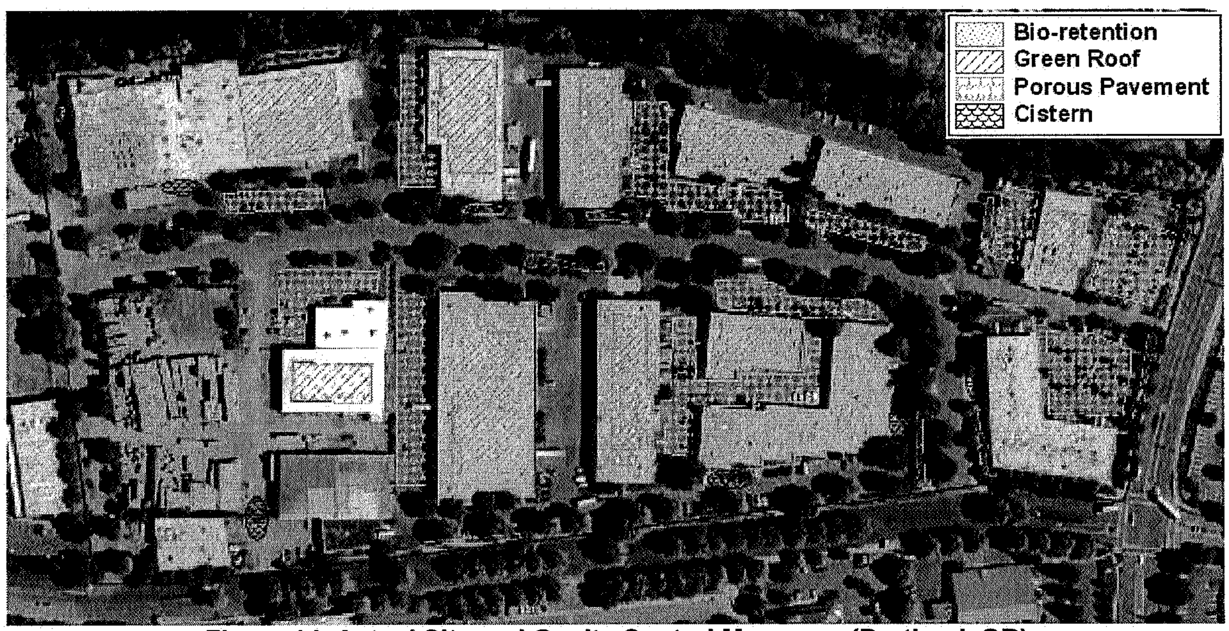


Figure 14. Actual Site and Onsite Control Measures (Portland, OR)

Table 10. Estimated Sizes of Onsite Control Measures (Portland, OR)

Total Area (acres)	27	
Estimated Imperviousness (%)	95%	
95th percentile Rainfall Event (inches)	1.00	
Expected Runoff for the 95th Percentile Rainfall Event (inches)	0.86	
Stormwater Management Area Required	Hydrologic Soil Group	
	B	C
Paver block area estimated by Direct Determination (acres)	1.4	3.5*
Bioretention estimated by Direct Determination (acres)	0.4	
Green Roof estimated by Direct Determination (acres)	1.7	
Cistern volume estimated by Direct Determination (gallons)	50,000	
Off-site storage necessary to control the 10-yr event of 3.7 inches (acre-ft)	5.37	5.62

*The size of porous pavement area was increased because the other control options were maximized based on the site-specific design assumptions.

A total of 1.3 acres of the site is pervious area or landscaped of which, 0.4 acres (30% of the pervious area) could be converted to bioretention cells that have a storage depth of 10 inches. Of the 8.8 acres of current rooftop area, 1.7 acres (20% of the rooftop area) could be retrofitted into green roof areas. Of the 16.9 acres of paved area, 1.4 acres (8% of the paved area) for hydrologic soil group B, or 3.5 acres (20% of the paved area) for hydrologic soil group C, of paver block systems could be implemented. One or more cisterns (as indicated in Figure 14) could be used to capture up to 50,000 gallons of runoff from rooftop areas. Note: The high percentage of imperviousness of the site (95%) requires that all infiltration designs be based on resident soil type and design volumes, or with adequate sub-bases or amended soils.

Scenario #5 – Near Phoenix, AZ

A 2-acre site with 47% impervious area was selected near Phoenix, Arizona (Figure 15). If the 95th percentile rainfall event (1.0 inches) occurred on the existing site (i.e., with no control measures), 0.42 inches of runoff would be generated and require management. The runoff from the 95th percentile rainfall event could be controlled by installing bioretention systems totaling 0.06 acres if the hydrologic soil group B is present or 0.1 acres if hydrologic soil group C (Table 11) is the predominant soil type on the site. Assuming that bioretention practices are only placed in areas that are currently pervious or landscaped, a total of 1.1 acres of pervious area is available for the placement of these practices. Given this total available area, the design storage depth of media within the designated bioretention area must be at least 6 inches. Note: If the design storage depth were increased to 10 inches, the off-site storage necessary for the 10-year event could be reduced to 0.03 acre-ft for type B soils and 0.08 acre-ft for type C soils.

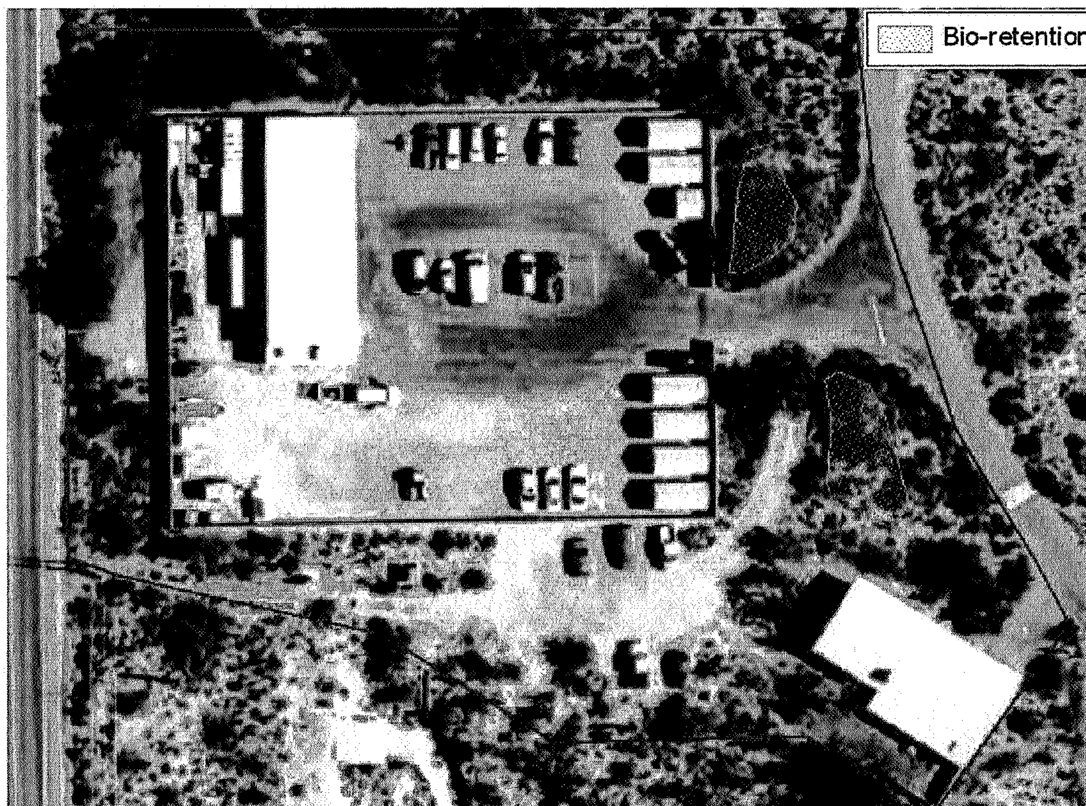


Figure 15. Actual Site and Onsite Control Measures (Phoenix, AZ)

Table 11. Estimated Sizes of Onsite Control Measures (Phoenix, AZ)

Total Area (acres)	2	
Estimated Imperviousness (%)	47%	
95th Percentile Rainfall Event (inches)	1.00	
Expected Runoff for the 95th Percentile Rainfall Event (inches)	0.42	
Stormwater Management Area Required	Hydrologic Soil Group	
	B	C
Bioretention estimated by the Direct Determination (acres)	0.06	0.1
Off-site storage necessary to control the 10-yr event of 2.4 inches (acre-ft)	0.05	0.12

Scenario #6 - Boston, MA

A 3.5-acre site with 69% impervious area was selected in Boston, Massachusetts (Figure 16). If the 95th percentile rainfall event (1.52 inches) occurred on the existing site (i.e., with no control measures), 0.98 inches of runoff would be generated and require management. Given these site characteristics, there is adequate area to place appropriately sized bioretention cells to capture the 95th percentile storm event. However, for the purposes of this analysis, unspecified conditions preclude the use of bioretention. As a result, a paver block system was selected as the best onsite control measure and the system was designed such that the necessary design parameters could be achieved by storing some of the volume in the paver media and by infiltrating the remainder of the volume. The runoff from the 95th percentile rainfall event could be controlled by installing a paver block area totaling 0.4 and 0.8 acres assuming soil types B and C, respectively (Table 12). For the purposes of this case study, a total of 1.5 acres of parking lot was made available to accommodate the paver block system. The area retrofitted with paver blocks would primarily be dedicated for use as parking stalls.

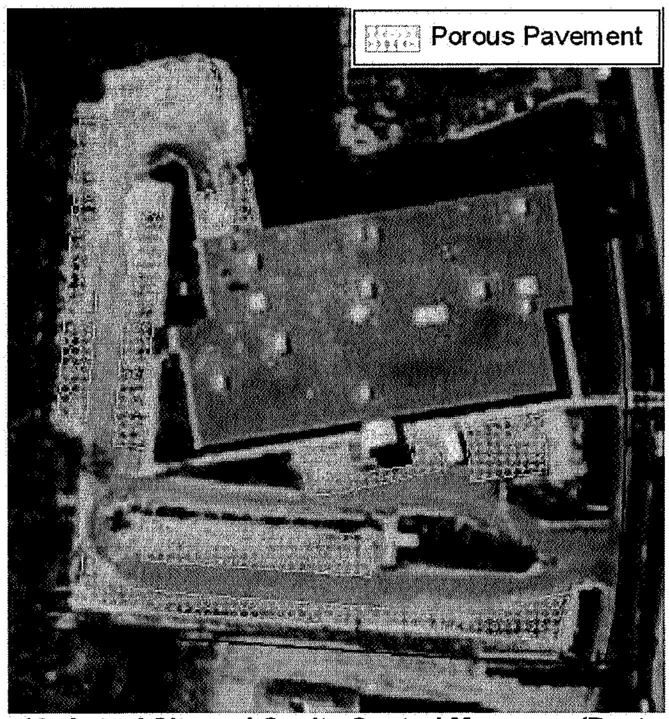


Figure 16. Actual Site and Onsite Control Measures (Boston, MA)

Table 12. Estimated Sizes of Onsite Control Measures (Boston, MA)

Total Area (acres)	3.5	
Estimated Imperviousness (%)	69%	
95th Percentile Rainfall Event (inches)	1.52	
Expected Runoff for the 95th Percentile Rainfall Event (inches)	0.98	
Stormwater Management Area Required	Hydrologic Soil Group	
	B	C
Paver block area estimated by Direct Determination (acres)	0.4	0.8
Off-site storage necessary to control 10-yr event of 4.5 inches (acre-ft)	0.59	0.71

Scenario #7 - Atlanta, GA

A 21-acre site with 70% impervious area was selected in Atlanta, Georgia (Figure 17). If the 95th percentile rainfall event (1.77 inches) occurred on the existing site (i.e., with no control measures), 1.17 inches of runoff would be generated and require management. The runoff from the 95th percentile rainfall event could not be adequately controlled solely with bioretention systems. Based on the technical considerations of constructing and maintaining control measures at the site, it was assumed that up to 15% of the pervious area could be converted into bioretention cells and up to 40% of paved area could be converted into a paver block system. If the stormwater management techniques used on the site include both bioretention and paver blocks as presented in Table 13, then all runoff for the 95th percentile rainfall event would be controlled.

Figure 17. Actual Site and Onsite Control Measures (Atlanta, GA)

Table 13. Estimated Sizes of Onsite Control Measures (Atlanta, GA)

Total Area (acres)	21	
Estimated Imperviousness (%)	70%	
95th Percentile Rainfall Event (inches)	1.77	
Expected Runoff for the 95th Percentile Rainfall Event (inches)	1.17	
Stormwater Management Area Required	Hydrologic Soil Group	
	B	C
Bioretention estimated by the Direct Determination (acres)	0.9	
Paver block area estimated by the Direct Determination (acres)	0.9	3.2*
Bioretention estimated by TR-55	0.8**	0.9
Paver block area estimated by TR-55	0**	1.84
Off-site storage necessary to control 10-yr event of 6.0 inches (acre-ft)	5.85	6.62

*The size of porous pavement was increased because the bioretention was already reached its maximum size based on the site-specific design assumptions.

**Because TR-55 estimated smaller runoff in this scenario, bioretention can control all of the 95th percentile runoff if the site has soil group B.

For the example site in Atlanta, GA, areas of 1.8 acres for hydrologic soil group B, and 4.1 acres for hydrologic soil group C, would be required to manage the runoff discharged from a 95th percentile rainfall event. Assuming that bioretention practices are only placed in areas that are currently pervious or landscaped, a total of 6.2 acres of pervious area is available for the placement of bioretention systems. Given this total available area, the design storage depth of media within the designated bioretention area must be at least 10 inches. Permeable pavement systems could be used to treat the remaining volume on the 10.8 acres of existing paved area.

In applying the TR-55 model, the overall curve numbers for the site were 87 and 91 for Group B and C soils, respectively. TR-55 was used to estimate 0.73 inches of runoff for soil group B and 0.97 inches for soil group C, which are smaller numbers than the 1.17 inches of runoff estimated by the Direct Determination method. As a result, the sizes of the onsite control measures designed using the TR-55 model were smaller than those designed using the Direct Determination method. Note: It is recommended that caution be exercised when using TR-55 to model storms less than 0.5 inches per event. See application of TR-55 in Table 6.

Scenario #8 - Cincinnati, OH

A 19-acre site with 51% impervious area was selected in Cincinnati, Ohio (Figure 18). If the 95th percentile rainfall event (1.45 inches) occurred on the existing site (i.e., with no control measures), 0.68 inches of runoff would be generated and require management. The runoff from the 95th percentile rainfall event could be controlled by the installation of bioretention systems totaling 0.8 acres if the hydrologic soil group B is present or 1.3 acres if hydrologic soil group C (Table 9) is the predominant soil type on the site. Assuming that bioretention practices are only placed in areas that are currently pervious or landscaped, a total of 9.4 acres of pervious area is available for the placement of bioretention systems. Given this total available area, the design storage depth of media within the designated bioretention area must be at least 8 inches.

Scenario #8 represents an alternative to the Cincinnati, scenario in #3 (Figure 13). In this case, hydrologic soil group D was selected to represent the soil characteristics present for the entire site. Alternatively, simulations could have been run under the assumption that the use of infiltration practices were precluded by contaminated soils or high groundwater tables. Under these site conditions, bioretention options are severely limited and cannot be used to adequately capture the entire 95th percentile storm event. As a result, options such as cisterns and green roofs were considered. In the absence of management practices, the 95th percentile rainfall event discharges 1.45 inches of stormwater and 0.53 inches of this runoff is captured by onsite depression storage. The difference, 0.92 inches of runoff, would then require capture and management. Based on the technical considerations of constructing and maintaining controls at the site, it was assumed that up to 20% of pervious area can be converted into bioretention areas; up to 30% of paved area can be converted into porous pavement; and up to 30% of the rooftop area can be converted into green roofs. Cisterns can be added to the system if additional storage volume is required. It should be noted that green roofs were selected lowest in the hierarchy of practices evaluated because of cost and potential structural issues associated with design and placement on existing buildings. By using the four onsite control options as presented in Table 14, all runoff for the 95th percentile rainfall event would be controlled. From a management perspective, it was assumed that the design storage depth within the designated bioretention area was 6 inches because of the low infiltration rates adopted for this scenario.

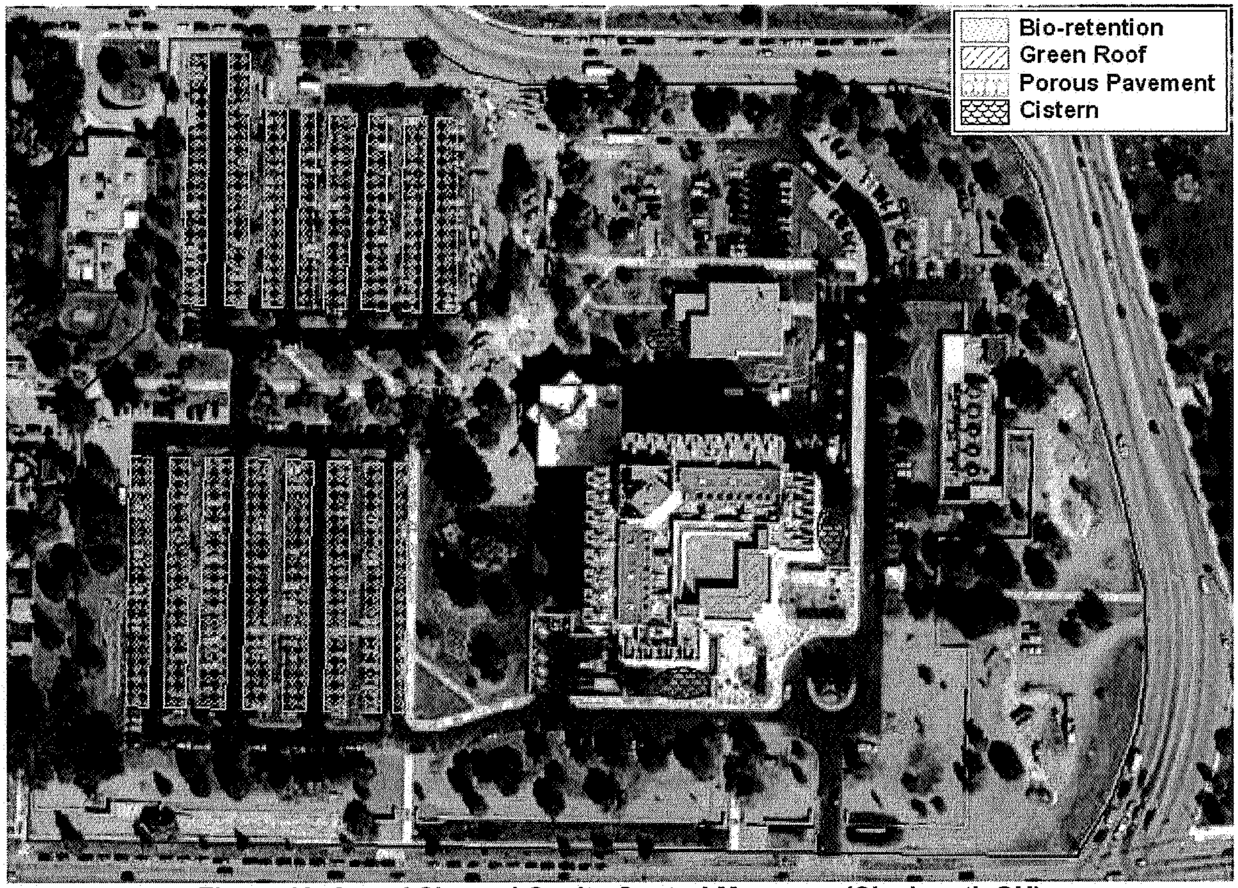


Figure 18. Actual Site and Onsite Control Measures (Cincinnati, OH)

Table 14. Estimated Sizes of Onsite Control Measures (Cincinnati, OH)

Total Area (acres)	19
Estimated Imperviousness (%)	51%
95th Percentile Rainfall Event (inches)	1.45
Expected Runoff for the 95th Percentile Rainfall Event (inches)	0.92
Stormwater Management Applied	Hydrologic Soil Group D
Bioretention estimated by Direct Determination (acres)	1.9
Paver block area estimated by Direct Determination (acres)	2.4
Green Roof estimated by Direct Determination (acres)	0.5
Cisterns estimated by Direct Determination (gallons)	13,000

This site contains a total of 9.4 acres of pervious area, 8.0 acres of paved area, and 1.6 acres of rooftop area. If 1.9 acres (20%) of the pervious area were converted to bioretention cells; 2.4 acres (30%) of parking lot converted to paver blocks; and 0.5 acres (30%) of rooftop area were retrofitted to green roof areas for this site, then 97% of stormwater runoff from the 95th percentile storm would be captured on site. By also adding one or more cisterns (as indicated in Figure 18), an additional 3,000 gallons could be captured, thus illustrating that 100% of the rainfall from the 95th percentile event can be managed onsite with green infrastructure practices.

Comparison of the Runoff Estimation Methods

As illustrated above, runoff of the 95th percentile storm was estimated in order to size onsite control measures. These estimates were produced by applying four different methods: the Direct Determination method, the Rational Method, the NRCS TR-55, and the EPA SWMM. The results comparing each of these methods are presented in Table 15.

Table 15. Comparison of the estimated runoff (unit: inches)

	Method	Direct Determination		Rational Method		TR-55		SWMM	
	Soil Groups	B	C	B	C	B	C	B	C
1	Charleston, WV	0.82	0.82	0.83	0.84	0.36	0.53	0.82	0.83
2	Denver, CO	0.53	0.53	0.57	0.59	0.12	0.26	0.53	0.53
3	Cincinnati, OH	0.68	0.68	0.73	0.76	0.26	0.46		
4	Portland, OR	0.86	0.86	0.86	0.86	0.63	0.71		
5	Phoenix, AZ	0.42	0.42	0.46	0.48	0.06	0.17		
6	Boston, MA	0.98	0.98	0.99	1.00	0.51	0.70		
7	Atlanta, GA	1.17	1.17	1.17	1.19	0.73	0.97	1.19	1.23

As shown in the above table, the estimated runoff results from direct determination, the Rational Method, and SWMM are relatively similar. Runoff volumes using TR-55 are lower than the other estimates. SWMM modeling results using NRCS 24-hour rainfall distributions were nearly identical to the results based on uniform distribution.

Table 16. Applicability of the methods for analyzing onsite control measures

Purpose	Direct Determination	Rational Method	TR-55*	SWMM
Planning Tool	Applicable	Applicable	Applicable	Applicable
Preliminary Design	Applicable	Applicable	Applicable	Applicable
Detailed Design	Not applicable	Not applicable	Not applicable	Applicable
Actual Assessment (Long-term)	Not applicable	Not applicable	Not applicable	Applicable
Water Quality	Not applicable	Not applicable	Not applicable	Applicable

*Use with caution when applying this method for small storms

CONCLUSIONS

Although sites varied in terms of climate and soil conditions, in all of the scenarios selected, the 95th percentile storm event could be managed onsite with green infrastructure systems. There are many more infiltration, evapotranspiration and capture and use stormwater management options available than used in these analyses giving site operators additional flexibility in managing wet weather.

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APPENDIX A: Modeling Parameter Assumptions

Runoff from each land cover was estimated by the following equation:

$$Runoff = Rainfall - Depression\ Storage - Infiltration\ Loss \quad (1)$$

Depression Storage

Reference depression storage (inches)

Reference	Impervious	Pervious
1	0.05 - 0.1	0.1 - 0.3
2	0.01 - 0.11	0.02 - 0.6
3	0.1	0.2

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3. Walesh, S. G. (1989).*Urban Surface Water Management*. John Wiley & Sons, Inc.

Based on the above reference data, depression storage (or initial abstraction) to the direct determination method was assumed as follows:

- Rooftop: 0.1 inches
- Pavement: 0.1 inches
- Pervious area: 0.2 inches

Infiltration

Infiltration loss occurs only in pervious areas. In this analysis, infiltration was estimated by Horton's equation:

$$f = f_{\min} + (f_{\max} - f_{\min})\, e^{-kt} \quad (2)$$

where, f = infiltration rate at time t (in/hr),
$f_{\min}$ = minimum or saturated infiltration rate (in/hr),
$f_{\max}$ = maximum or initial infiltration rate (in/hr),
k = infiltration rate decay factor (/hr), and
t = time (hr).

Reference infiltration parameters

Maximum infiltration rate (in.hr), f_{max}

Infiltration (in/hr)	Partially dried out with		Dry soils with	
	No vegetation	Dense vegetation	No vegetation	Dense vegetation
Sandy	2.5	5	5	10
Loam	1.5	3	3	6
Clay	0.5	1	1	2

Reference: Huber, W. C. and Dickinson, R. (1988). *Storm Water Management Model User's Manual, Version 4*. EPA/600/3-88/001a (NTIS PB88-236641/AS), U.S. Environmental Protection Agency, Athens, GA.

Minimum infiltration rate (in/hr), f_{min}

Hydrologic Soil Group	Infiltration (in/hr)
A	0.45 - 0.30
B	0.30 - 0.15
C	0.15 - 0.05
D	0.05 - 0

A: well drained sandy; D: poorly drained clay
Reference: Huber, W. C. and Dickinson, R. (1988). *Storm Water Management Model User's Manual, Version 4*. EPA/600/3-88/001a (NTIS PB88-236641/AS), U.S. Environmental Protection Agency, Athens, GA.

Decay coefficient, k

Soils	k (sec^{-1})	k (hr^{-1})
Sandy	0.00056	2
⇕	0.00083	3
	0.00115	4
Clay	0.00139	5

Reference: Huber, W. C. and Dickinson, R. (1988). *Storm Water Management Model User's Manual, Version 4*. EPA/600/3-88/001a (NTIS PB88-236641/AS), U.S. Environmental Protection Agency, Athens, GA.

Based on the above reference data, infiltration parameters to the direct determination method were assumed as follows:

- Hydrologic Soil Group B
  - Maximum infiltration rate: 5 in/hr
  - Minimum infiltration rate: 0.3 in/hr
  - Decay factor: 2 /hr
- Hydrologic Soil Group C
  - Maximum infiltration rate: 3 in/hr
  - Minimum infiltration rate: 0.1 in/hr
  - Decay factor: 3.5 /hr
- Hydrologic Soil Group D
  - Maximum infiltration rate: 1 in/hr
  - Minimum infiltration rate: 0.02 in/hr
  - Decay factor: 5 /hr

Infiltration loss for the 24-hr rainfall duration was estimated by the following equations with assumptions of a half hour Δt:

$$\textit{Infiltration Loss at the } n^{th} \textit{ time-step} = (f \cdot \Delta t) = \{(f_{n-1} + f_n)/2) \cdot \Delta t\} \qquad (3)$$

$$\textit{Integrated Infiltration Loss for 24 hours} = \sum (f \cdot \Delta t) \qquad (4)$$

Integrating infiltration loss during 24 hours with a half hour Δt

time-step	t (hr)	Infiltration rate (in/hr) [a]			Infiltration volume (inches) [b]		
		Soil B	Soil C	Soil D	Soil B	Soil C	Soil D
0	0	5	3	1	0	0	0
1	0.5	2.03	0.60	0.100	1.757	0.901	0.275
2	1	0.94	0.19	0.027	0.741	0.198	0.032
3	1.5	0.53	0.12	0.021	0.368	0.076	0.012
4	2	0.39	0.10	0.02	0.230	0.054	0.01
5	2.5	0.33	0.1	0.02	0.179	0.05	0.01
6	3	0.31	0.1	0.02	0.161	0.05	0.01
7	3.5	0.30	0.1	0.02	0.154	0.05	0.01
8	4	0.3	0.1	0.02	0.15	0.05	0.01
9	4.5	0.3	0.1	0.02	0.15	0.05	0.01
10	5	0.3	0.1	0.02	0.15	0.05	0.01
11	5.5	0.3	0.1	0.02	0.15	0.05	0.01
12	6	0.3	0.1	0.02	0.15	0.05	0.01
13	6.5	0.3	0.1	0.02	0.15	0.05	0.01
14	7	0.3	0.1	0.02	0.15	0.05	0.01
15	7.5	0.3	0.1	0.02	0.15	0.05	0.01
16	8	0.3	0.1	0.02	0.15	0.05	0.01
17	8.5	0.3	0.1	0.02	0.15	0.05	0.01
18	9	0.3	0.1	0.02	0.15	0.05	0.01
19	9.5	0.3	0.1	0.02	0.15	0.05	0.01
20	10	0.3	0.1	0.02	0.15	0.05	0.01
21	10.5	0.3	0.1	0.02	0.15	0.05	0.01
22	11	0.3	0.1	0.02	0.15	0.05	0.01
23	11.5	0.3	0.1	0.02	0.15	0.05	0.01
24	12	0.3	0.1	0.02	0.15	0.05	0.01
25	12.5	0.3	0.1	0.02	0.15	0.05	0.01
26	13	0.3	0.1	0.02	0.15	0.05	0.01
27	13.5	0.3	0.1	0.02	0.15	0.05	0.01
28	14	0.3	0.1	0.02	0.15	0.05	0.01
29	14.5	0.3	0.1	0.02	0.15	0.05	0.01
30	15	0.3	0.1	0.02	0.15	0.05	0.01
31	15.5	0.3	0.1	0.02	0.15	0.05	0.01
32	16	0.3	0.1	0.02	0.15	0.05	0.01
33	16.5	0.3	0.1	0.02	0.15	0.05	0.01
34	17	0.3	0.1	0.02	0.15	0.05	0.01
35	17.5	0.3	0.1	0.02	0.15	0.05	0.01
36	18	0.3	0.1	0.02	0.15	0.05	0.01
37	18.5	0.3	0.1	0.02	0.15	0.05	0.01
38	19	0.3	0.1	0.02	0.15	0.05	0.01
39	19.5	0.3	0.1	0.02	0.15	0.05	0.01
40	20	0.3	0.1	0.02	0.15	0.05	0.01
41	20.5	0.3	0.1	0.02	0.15	0.05	0.01
42	21	0.3	0.1	0.02	0.15	0.05	0.01
43	21.5	0.3	0.1	0.02	0.15	0.05	0.01
44	22	0.3	0.1	0.02	0.15	0.05	0.01

45	22.5	0.3	0.1	0.02	0.15	0.05	0.01
46	23	0.3	0.1	0.02	0.15	0.05	0.01
47	23.5	0.3	0.1	0.02	0.15	0.05	0.01
48	24	0.3	0.1	0.02	0.15	0.05	0.01
Sum: Infiltration loss during 24 hours [c]					9.743	3.430	0.769

[a] Calculated infiltration rate at each time by Equation (2)
[b] Calculated infiltration volume from the previous time to the current time by Equation (3)
[c] Integrated infiltration volume for 24 hours with a half hour Δt by Equation (4)

Based on the above calculation, 24-hr infiltration losses for pervious areas and bioretentions were modeled as follows:

- Soil Group B: 9.743 inches
- Soil Group C: 4.430 inches
- Soil Group D: 0.769 inches

Infiltrations of underlying soils at paver blocks were modeled conservatively by applying the minimum infiltration rate for each soil type (Infiltration loss = $f_{min} \cdot 24$) because the soils under the paver blocks may require or be subjected to some compaction for engineering stability. The estimated infiltration losses for each soil are presented below:

- Soil Group B: (0.3 in/hr) · (24 hrs) = 7.2 inches
- Soil Group C: (0.1 in/hr) · (24 hrs) = 2.4 inches
- Soil Group D: (0.02 in/hr) · (24 hrs) = 0.48 inches

Design Storage of Management Practices

Bioretention

Reference	Ponding (inches)	Mulch (inches)	Soil media (ft)	Soil Media Porosity	Underdrain
1	up to 12	2 - 4 (optional)	1 - 1.5	about 40%	bioretention systems utilize infiltration rather than an underdrain
2	6 - 12	2 - 3	2.5 - 4	about 40%	recommended, especially if initial testing infiltration rate < 0.52 in/hr
3	6 - 12		2 - 4		
4		2 - 3	1.5 - 4		if necessary
5	up to 6		1.5 - 2	30 - 40%	Optional
6	6 - 18	as needed	2 - 4		if necessary

1. State of New Jersey. (2004). *New Jersey Stormwater Best Management Practices Manual* http://www.nj.gov/dep/stormwater/tier_A/pdf/NJ_SWBMP_9.1 print.pdf
2. Maryland Department of the Environment (MDE), (2000). *2000 Maryland Stormwater Design Manual, Volumes I & II*, prepared by the Center for Watershed Protection and the Maryland Department of the Environment, Water Management Administration, Baltimore, MD. http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/stormwater_design/index.asp
3. Clar, M. L. and R. Green, (1993). *Design Manual for Use of Bioretention in Storm Water Management*, prepared for the Department of Environmental Resources, Watershed Protection Branch, Prince George's County, MD, prepared by Engineering Technologies Associates, Inc. Ellicott City, MD, and Biohabitats, Inc., Towson, MD.

4. US Environmental Protection Agency. (1999). *Storm Water Technology Fact Sheet: Bioretention.* EPA 832-F-99-012. Office of Water. US Environmental Protection Agency. Washington, D.C. http://www.epa.gov/owm/mtb/biortn.pdf
5. Prince George's County. *Bioretention Design Specifications and Criteria.* Prince George's County, Maryland. http://www.co.pg.md.us/Government/AgencyIndex/DER/ESG/Bioretention/pdf/bioretention_design_manual.pdf
6. City of Indianapolis. (2008). *Indianapolis Stormwater Design Manual.* http://www.sustainindy.org/assets/uploads/4_05_Bioretention.pdf

Paver Blocks

Reference	Media (inches)	Void Space
1	12 or more	40%
2	9 or more	40%
3	12 - 36	40%

1. Univ. of California at Davis. (2008). Low Impact Development Techniques: Pervious Pavement. http://extension.ucdavis.edu/unit/center_for_water_and_land_use/pervious_pavement.asp
2. AMEC Earth and Environmental, Center for Watershed Protection, Debo and Associates, Jordan Jones and Goulding, and Atlanta Regional Commission. (2001). Georgia Stormwater Management Manual Volume 2: Technical Handbook http://www.georgiastormwater.com/
3. Subsurface Infiltration Bed. http://www.tredyffrin.org/pdf/publicworks/CH2 - BMP4 Infiltration Bed.pdf

Green Roofs

Reference	Media (inches)
1	3 - 4
2	1 - 6
3	2 - 6

1. Charlie Miller. (2008). Extensive Green Roofs. Whole Building Design Guide (WBDG). http://www.wbdg.org/resources/greenroofs.php
2. Great Lakes WATER Institute. Green Roof Project: Green Roof Installation. http://www.glwi.uwm.edu/research/genomics/ecoli/greenroof/roofinstall.php
3. Paladino & Company. (2004). Green Roof Feasibility Review. King County Office Project. http://your.kingcounty.gov/solidwaste/greenbuilding/documents/KCGreenRoofStudy_Final.pdf

Based on the above reference data, design storages to the direct determination method were assumed as follows:

- Bioretention: up to 10 inches
- Green roof: 1 inch (2.5 inches deep media with 40% void space)
- Porous pavement: 4 inches (10 inches deep media with 40% void space)

APPENDIX BB

CPS ENERGY UTILITY CONNECTION PROCEDURES

San Antonio Joint Program Management Office

JPMO Construction Bulletin

San Antonio Joint Program Management Office

Accepting the Challenge – Exceeding the Standard!

Issuing Office: CESWF-SA (JPMO) **Issued: 3 October, 2008**

Subject: CPS Energy Utility Connection Procedures **JPMO Bulletin # 003**

Applicability: Programming, Contract Preparation, Contract Management

CPS Energy recently reorganized and created a new customer service division. Called the CPS Energy Service Division, it is set up to be their one-stop-shop for coordinating all system connections for the utilities they manage. Attachment 1 is a simple organization chart for the new division. CPS Energy provides electrical and natural gas services for Ft Sam Houston and electrical service to Camp Bullis.

Construction contractors need to initiate connections directly with the new Service Division and coordinate their requirements with the Ft Sam Houston Garrison Department of Public Works (DPW). This holds true for both temporary power needed for operation on-site and the completed construction project that will be ultimately turned over to the government.

For traditional Design-Bid-Build projects, contractors must provide complete engineering plans and drawings that include electrical and gas equipment requirements, capacity, peak demand, etc. For construction processes such as Design-Build, Integrated-Design-Bid-Build (IDBB), Early Contractor Involvement (ECI), and Construction Management @ Risk (CM@R) types projects where some or all of the required data is not yet available, CPS Energy will make an exception and accept what details are on hand. However, they will not provide a cost estimate for installation and connection fees or actually provide the connections until they have a firm list of electrical and/or gas equipment requirements. In short, they will permit a contractor to start the process, but will not make the connections until all of the necessary details are available.

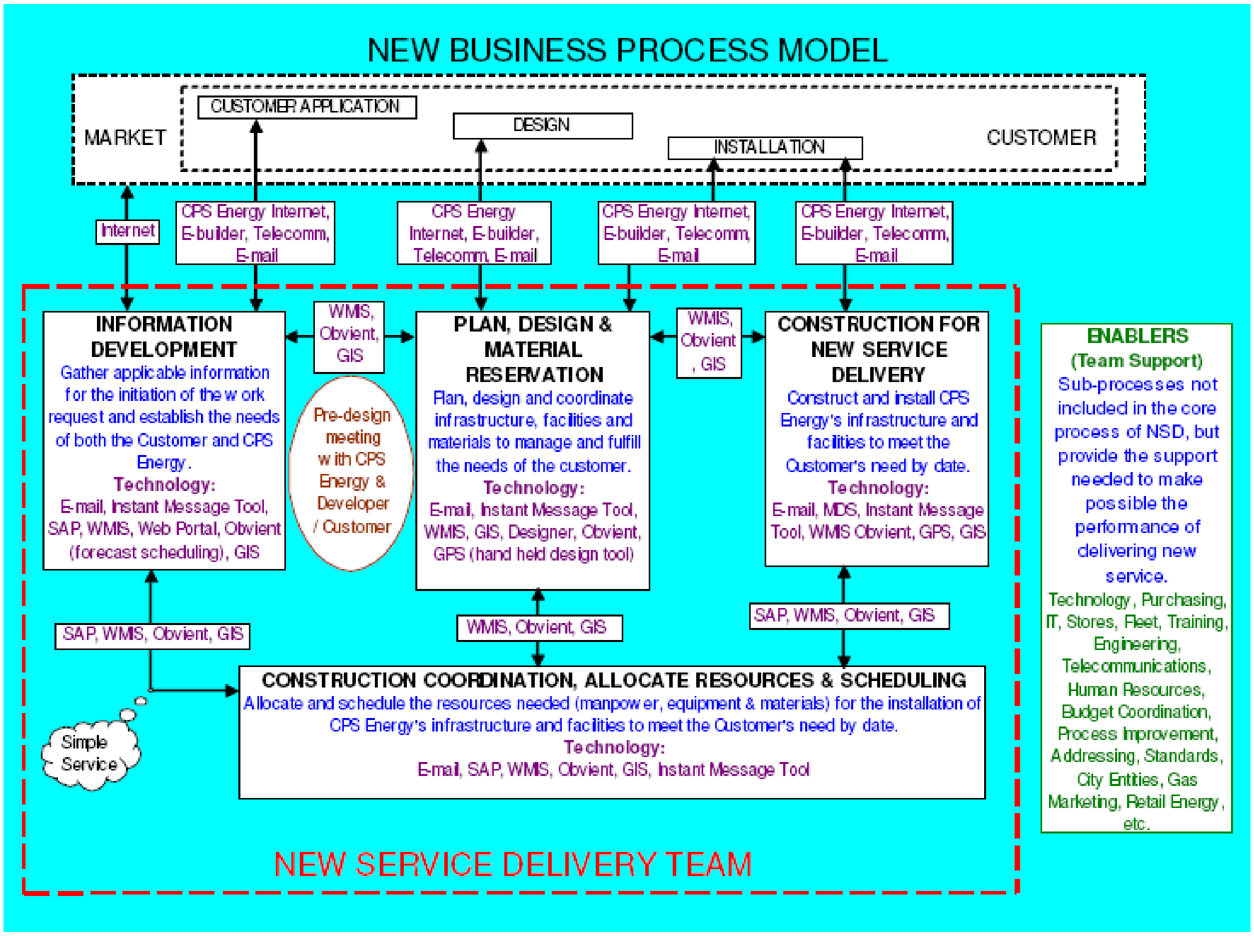
CPS Energy (http://www.cpsenergy.com) has developed several on-line tools to enable contractors and members of the public to find the information they need and file/track work requests (https://secure.cpsenergy.com/wmis/index.jsp). Additionally, they have developed a pamphlet that describes the information requirements and procedures for requesting work by contractors, a copy of which is at attachment 2 and can also be down-loaded from their website at http://www.cpsenergy.com/files/NSD_commercial_gas_electric_service_package.pdf.

M. Leon Carroll

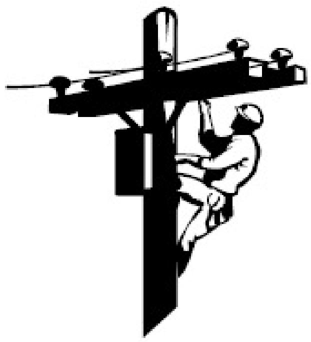
M. Leon Carroll, PE
Chief, Construction Management
San Antonio Joint Program Management Office

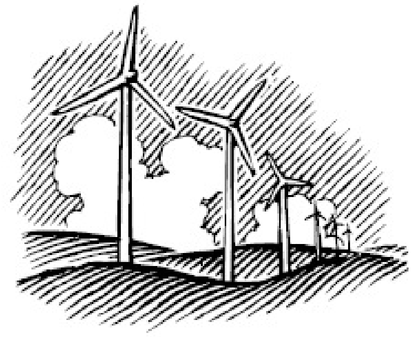
2 Attachments:
CPS Energy's New Business Process Model
New Service Delivery Commercial Gas & Electric Service Package

Attachment 1: CPS Energy's New Business Process Model



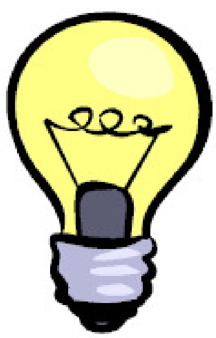
Attachment 2:

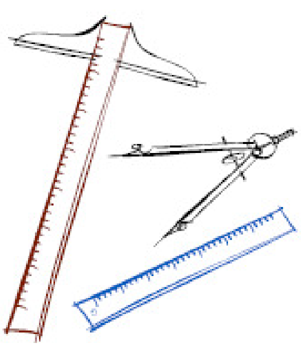




New Service Delivery

Commercial Gas and Electric Service Package





Welcome to New Service Delivery Commercial Planning!

Enclosed you will find specific information regarding requirements and processes for requesting commercial gas and electric services.

Contents:

- **Commercial Gas and Electric Service Application**
- **Gas equipment and load template**
- **Electric equipment and load template**
- **Specification Drawings for:**
  - **3 phase duct bank (riser to pad)**
  - **3 phase transformer pad**
  - **3 phase transformer pad w\tap box**
  - **3 phase riser pole and conduit encasement**
  - **4 ft Removable bollard**
- **Customer Site Ready Criteria**
- **Detail sheet showing easements for gas mains, 3 phase overhead electric and underground electric primary.**

LOAD INFORMATION

Project\Business Name:

Address:

ELECTRICAL EQUIPMENT

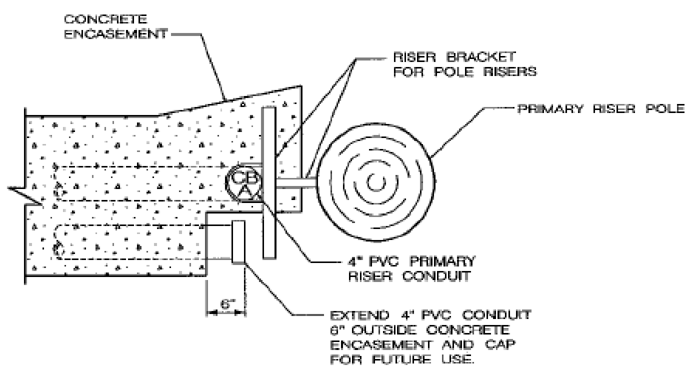
	VA
A/C	
LIGHTING	
RECEPTACALS	
HEATING	
WATER HEATER	
COMPUTERS	
REFRIGERATION	
ELEVATORS	
MOTORS	
OTHER	
TOTAL	

GAS EQUIPMENT

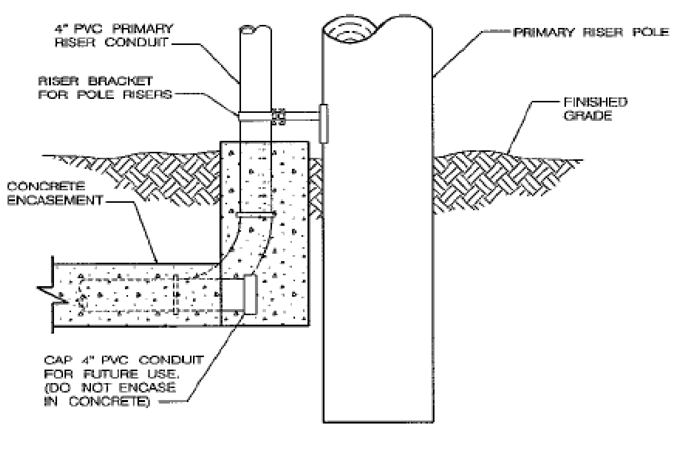
Pressure Required _______________	**BTU**
FURNACE	
BOILER	
COOKING	
WATER HEATER	
POOL\SPA HEATER	
GAS LIGHTING	
OTHER EQUIPMENT	
TOTAL	

NOTE:

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION



RISER POLE AND CONDUIT ENCASEMENT DETAIL – TOP VIEW
NOT TO SCALE

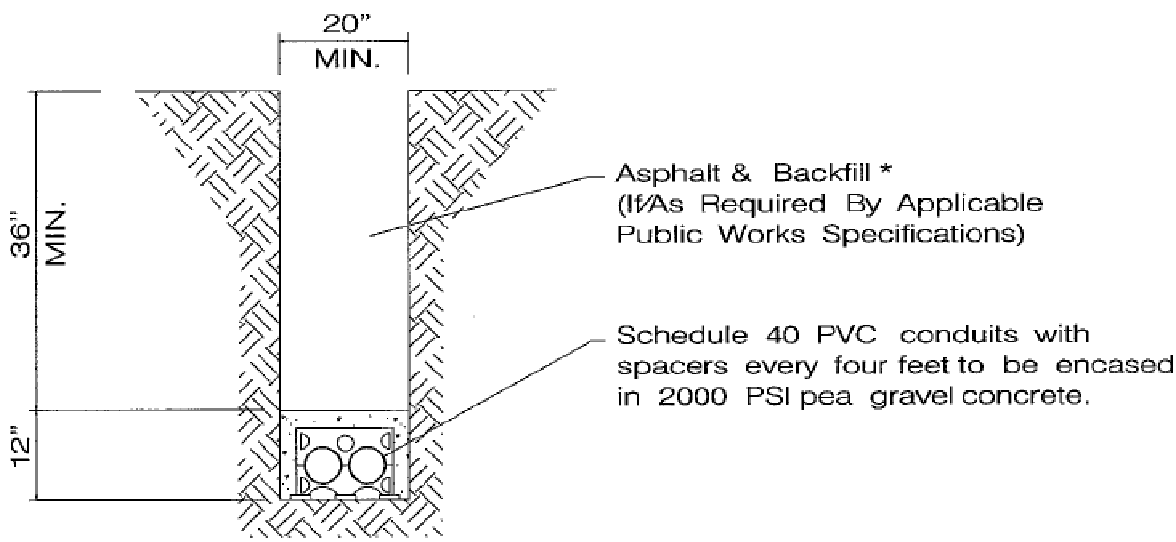


RISER POLE AND CONDUIT ENCASEMENT DETAIL – SIDE VIEW
NOT TO SCALE

CPS ENERGY™

NOTE:

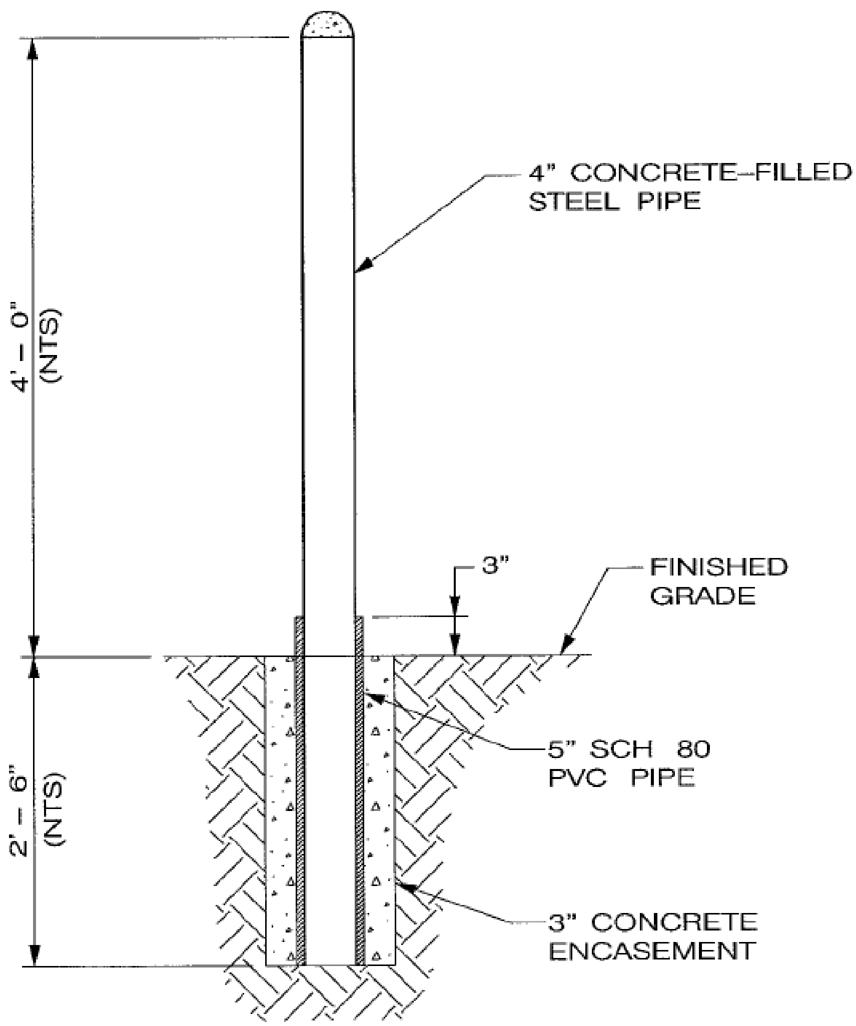
FOR INFORMATION ONLY
NOT FOR CONSTRUCTION



2–4" DUCTLINE DETAIL

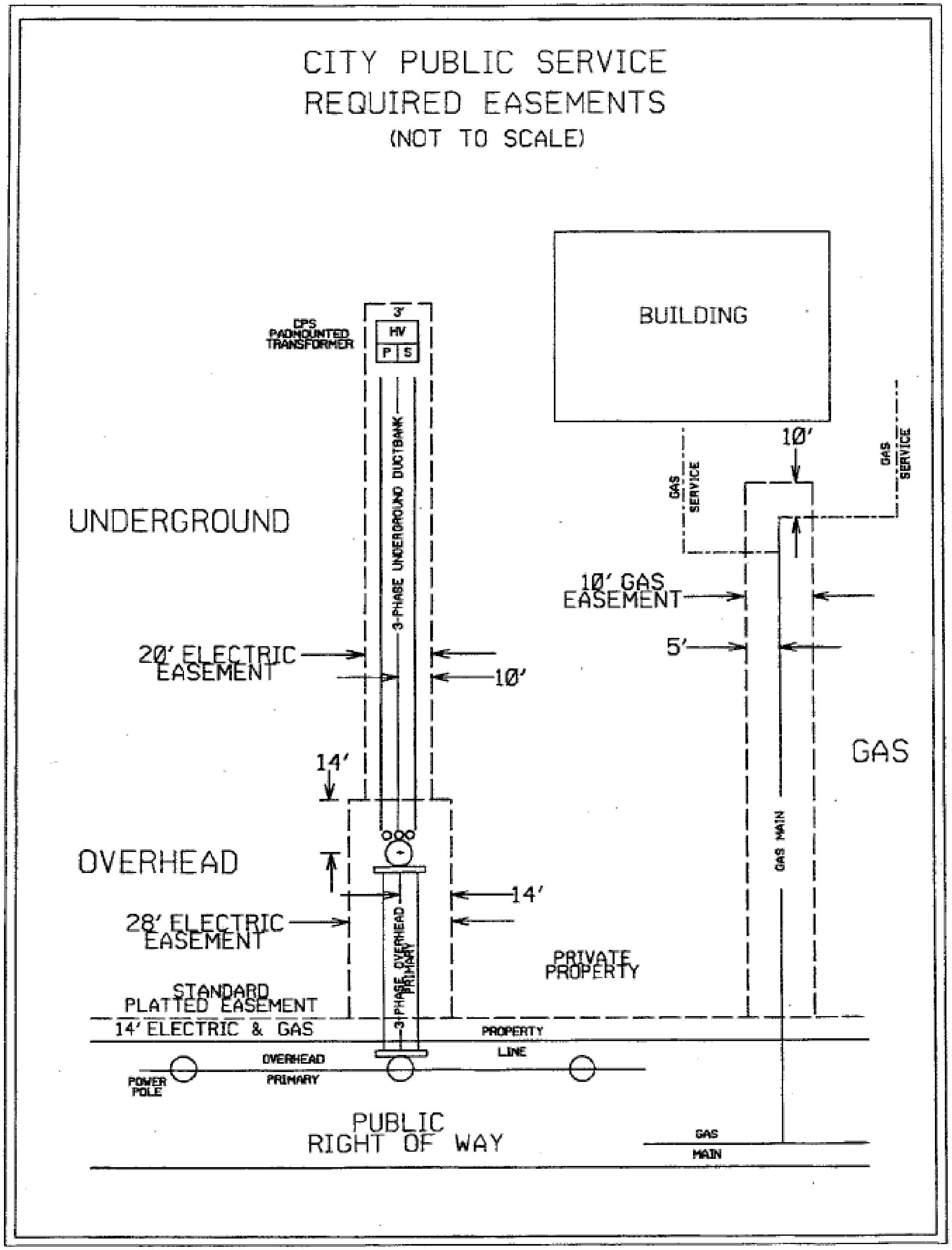
NOTE:

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION



4" REMOVABLE BOLLARD SPECIFICATION

PROFILE VIEW – NOT TO SCALE


CITY PUBLIC SERVICE
REQUIRED EASEMENTS
(NOT TO SCALE)
BUILDING
CPS
PADMOUNTED
TRANSFORMER
3'
HV
P
S
3-PHASE UNDERGROUND DUCTBANK
UNDERGROUND
20' ELECTRIC
EASEMENT
10'
14'
OVERHEAD
28' ELECTRIC
EASEMENT
14'
3-PHASE OVERHEAD PRIMARY
STANDARD
PLATTED EASEMENT
14' ELECTRIC & GAS
PROPERTY
LINE
OVERHEAD
PRIMARY
POWER
POLE
PUBLIC
RIGHT OF WAY
GAS
SERVICE
10'
10' GAS
EASEMENT
5'
GAS
GAS MAIN
PRIVATE
PROPERTY
GAS
MAIN

Appendix CC

Section 01 35 13.00 44
Special Project Procedures for Fort Sam Houston

SECTION 01 35 13.00 44

SPECIAL PROJECT PROCEDURES FOR FORT SAM HOUSTON [AND CAMP BULLIS]
(15Oct07)

PART 1 GENERAL

This Section covers the project requirements unique to Fort Sam Houston {and Camp Bullis], Texas. These unique requirements relate to items such as the digging permit process; utility outages; road closures; post access; backflow prevention assembly documentation; utility installation guidelines and Customer Service Inspection certifications.

1.1 REFERENCES
The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

U.S. ARMY REGULATIONS (AR)
AR 11-9 (28 May 99) Army Radiation Safety Program

FORT SAM HOUSTON (FSH) PUBLICATIONS
FSH 385-11 FSH Memorandum 385-11, 18 May 1998, subject Radiation Safety

1.2 SUBMITTALS

1.2.1 In the SUBMITTALS requirements of this section include the following Specification:

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-13 Certificates

Customer Service Inspection Certification; G.

The Contractor shall supply a "Customer Service Inspection" certificate for the water supply in accordance with the Texas Commission on Environmental Quality (TCEQ) Regulations. The completed and signed certificate shall be submitted to the Contracting Officer for review and final approval. A blank certificate is located at the end of this section. See paragraph CUSTOMER SERVICE INSPECTIONS for additional information.

Backflow Prevention Assembly Tests; G.

Certification of proper operation of backflow preventers shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. To obtain current SAWS backflow documents go to http://www.saws.org/backflow.

Army Radiation Permit; G.

Temporary Utility Plan; G.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION - Construction Contract Permit Requests, Procedures and Information

3.1 FSH Contractor Work Schedule: 0600 – 1800

3.2 USE OR STORING RADIATION SOURCES

3.2.1 Non-Army agencies, including contractors, who intend to use, or store, radiation sources on Fort Sam Houston must obtain proper authorization in accordance with the above references AR 11-9 and FSH 385-11. Non-Army agencies will not use radiation sources on referenced locations without an approved Department of the Army Radiation Permit (ARP). Such equipment typically includes equipment for Soil Density Testing, Lead-Based Paint Analysis (X-Ray fluorescent analyzer), etc.

3.2.2 Non-Army agencies (including civilian contractors) require an Army radiation permit(s) to use or possess ionizing radiation sources on an Army installation (32 CFR 655.10). For the purpose of this paragraph, ionizing radiation source means any source that, if held or owned by an Army organization, would require a specific NRC license or Army radiation authorization – ARA.

3.2.2.1 The non-Army applicant will apply by letter with supporting documentation through the Installation Radiation Protection Officer (IRPO). Submit the letter so that the installation representative receives the application at least thirty (30) days before the requested start date of the permit.

3.2.2.2 The Army radiation permit (ARP) application will specify start and stop dates for the ARP and describe for what purposes the applicant needs the ARP. DA Form 3337, Application for Department of the Army Radiation Authorization– Appendix D, will be used to apply for the permit. The Installation Radiation Protection Officer (IRPO) will approve the application only if the applicant provides evidence to show that one of the following is true.

a. The applicant possesses a valid U.S. Nuclear Regulatory Commission (NRC) license or Department of Energy (DOE) radiological work permit that allows the applicant to use the source as specified in the ARP application.

b. The applicant possesses a valid Agreement State or Radioactive Material License (Texas Department of Health, Bureau of Radiation Control) license that allows the applicant to use radioactive material (RAM) as specified in the ARP application and the applicant has filed NRC Form 241, Report of Proposed Activities in Non-Agreement States, with the NRC in accordance with 10 CFR 150.20. An ARP issued under this circumstance will be valid for no more than 180 days in any calendar year.

c. Dosimetry Service Certification.

d. Radiation Safety Program to include standard operating procedures (SOP), training program and designation of Radiation Protection/Safety Officer.

e. Certificates of Training for personnel utilizing the radioactive material/equipment.

f. Site map defining area where radioactive materials/equipment is to be used.

g. Leak test documentation for the equipment with the radioactive source(s).

h. For naturally occurring or accelerator produce radioactive material (NORM/NARM) and machine-produced ionizing radiation sources, the applicant has an appropriate State authorization that allows the applicant to use the source as specified in the ARP application or has in place a radiation safety program that complies with Army requirements.

3.2.2.3 All ARPs will require applicants to remove all permitted sources from Army property by the end of the work day. (Ft. Sam Houston policy, no radiation producing equipment will be stored on Ft. Sam Houston Army property overnight).

3.2.2.4 Disposal of radioactive material (RAM) by non-Army agencies on Army property is strictly prohibited.

3.2.3 Review, Approval/Disapproval. Review of the permit request and subsequent approval/disapproval requires about 30 days.

3.2.4 Submission of Application. Submit three copies of the application with the required supporting documentation to:

Directorate of Public Safety Point of Contact
Wayne Blanco-Cerda, Installation Radiation Protection Officer (IRPO)
Ft. Sam Houston Garrison Safety Office
2202 15the St., Ste 36, Bldg 4196
Fort Sam Houston, TX 78234-5036
Telephone No: 210.221.3836
FAX No: 210.221.3958
E-mail: wayne.blancocerda@us.army.mil

3.2.5 Additional Information:

BAMC/FSH Radiation Safety Officer (RSO): Donald L. Crady, Jr. CPT, MS
BAMC Health Physics Service
(210) 295-2655, DSN 421, pager: 513-9554
E-mail address: donald.crady@us.army.mil
Building Number is 1029

3.3 PERMITS & REQUESTS - <u>All Requests must include</u>:

a. Site Map (8" x 11" or 8" x 14")
b. Project Name and Number
c. Contractor & Subcontractor Name
d. Brief Description of Work – Identify all buildings and/or facilities possibly affected.
e. Desired Date for Work to Begin
f. Estimated Duration of Work
g. 14 Day Advance Notice minimum, unless otherwise noted.
h. Contractor's Representative Contact Information

i. Corps of Engineers Quality Assurance Contact Information

3.3.1 DIGGING PERMITS. Digging permits must be obtained prior to any digging, drilling or excavation. The Contractor shall obtain digging permits directly from the Fort Sam Houston Post DPW before any drilling, digging, or excavation is undertaken. Provide a completed form “DIGGING PERMIT FOR FORT SAM HOUSTON”- Appendix A, to the DPW building 4196, Fort Sam Houston, Texas for each permit. Allow 14 calendar days for Government review of digging permit requests. A digging permit for a specified area of excavation expires 30 days after the issue date; the Contractor must re-apply for a new permit to perform excavation in the area if the excavation was not started within the 30-day period. Permits will identify all underground utilities within 5 feet (1500 mm) of the designated area. Contractor shall be responsible for all repairs, costs, and damages due to excavating without permit or damaging an identified utility.

All excavation projects shall conform to the FSH Installation Safety Office – Excavation Program FSH Memorandum No. 385-30http://www.samhouston.army.mil/iso/385-30.htm

3.3.1.1 Digging Permit Procedure for Fort Sam Houston – See Appendix A

a. Get form from Carlos Herrera, Customer Support Desk, Building 4196.

b. Return Form to Department of Public Works Project Manager, Building 4196

Irwin Stuart 210-295-4717, DPW PM, Staff Engineering - Room 7
Raul Villar 210-295-4773, DPW PM, Real Property Division
Unknown 210-295-4931, DPW PM, Real Property Division

c. Provide Corps of Engineers Quality Assurance Representative a copy of Digging Permit request.

3.3.2 Utility Outage Permits (Form 1206-J) - Appendix B

a. Contractor shall complete Form 1206-J

b. Return Form to: Building 4196, Room 10, DPW Operations and Maintenance-Engineering Support Supervisor.

c. Provide Corps of Engineers Quality Assurance Representative a copy of Utility Outage request.

3.3.3 Hot Work Permits – Appendix C

a. Contractor shall obtain a Hot Work Permit for any welding, burning, abrasive blasting, hot-riveting, or other fire-producing or spark-producing operations every 30 days.

b. The Hot Work Permit must be filled out by the FSH Fire and Emergency Services. The information needed is located on DA Form 5383-R (Appendix C).

c. The FSH Fire and Emergency Services is located in Building 4196. The non-emergency contact number is 210-221-2727.

3.3.4 Road Closure Requests

1. Street closings will not be permitted without approval. At least one lane of traffic will be maintained at all times. Traffic control signs and barricades will be provided for all street widening and extensions. The Contractor shall include in the traffic control plan for each section of road that will be worked on or impacted as a result of this contract. The traffic control plan shall be in accordance with "Traffic Controls for Street and Highway Construction and Maintenance Operations" of the latest edition of the "Texas Manual on Uniform Traffic Control Devices."

2. A traffic control plan will be submitted to DPW for approval 21 days prior to the proposed construction start, to allow for proper notification of all parties concerned. There is no specific form, however all items listed in 3.3 must be addressed.

a. Provide Corps of Engineers Quality Assurance Representative with all information required above with request for Road Closure.

b. Contact: Ray Acuna - Deputy Provost Marshall
Office Phone 210-221-1490
Post Provost Marshall Office
2404 New Braunfels Avenue Building 2250
Fort Sam Houston, TX 78234

3.4 Gate Access / Post Security

Contact: Alberto Jorge - Chief, Physical Security Branch
Physical Security Office, Building 2250 210-221-0110

3.4.1 ALL construction contractor employees must have:

a. One form of picture identification.

b. A memo from the construction company on company letterhead stating the reason for entry, contract number, and the location at Fort Sam Houston where the jobsite is located.

c. All delivery drivers must have a bill of lading.

3.4.2 Normal Gate Access is as follows:

a. George Beach at IH-35 Gate (BAMC - POV and Commercial)
b. George Beach at Binz-Engleman Gate (BAMC)
c. Binz-Engleman Gate (Binz-Engleman at UPRR)
d. Commercial Gate at Jadwin Road
e. Walters Gate (Scott at Hood)
f. East Harry Wurzbach Gate (Old Austin Highway at Scott)
g. West Harry Wurzbach Gate (Old Austin Highway at Eleanor- POV’s only)
h. Cunningham Gate (Wilson at Pine - POV’s only)

3.4.3 Exceptions

a. Commercial vehicles such as delivery vehicles, shop trucks, public utility, etc., with on-post visitor passes, “RapidGate”, or military installation decals may also enter any of these gates EXCEPT the Cunningham Gate [Wilson at Pine]. Use of the Cunningham Gate by ANY commercial vehicles shall be prohibited.

b. Use of the West Harry Wurzbach Gate [Old Austin Highway at Eleanor] by ANY commercial vehicles is upon approval only.

3.4.4 Prohibited Haul Routes

a. Through ANY housing area (skirting the area is acceptable)

b. Through the Community Center (bounded to the North by Schofield Road, to the East by Schaffer/Patch, to the South by Wilson St., and to the West by Stanley Road.

c. Do not travel on Stanley Road.

d. Travel only on defined roads through the AMEDD Training Campus.

3.4.5 CONTRACTOR ID BADGES: Refer to Appendix OO, Issuance of Access to Non-Common Access Card Contractors, Vendors, and Non-DOD Civilians Requiring Routine Official Installation

Access, in the RFP package.

3.4.6 The RapidGate program provides an ID badge and access to contractors who require routine access to Fort Sam Houston.

3.4.6.1 Contractors may:

a. Enter through any gate (Except Commercial Class A/B)
b. Avoid stopping for Temporary Vehicle Pass gates
c. Reduce waiting time by using designated entrance lanes to enter the post
d. Bypass mandatory screening process at the commercial gate

3.4.6.2 The RapidGate ID's are $199 per company per year, plus $159 per employee per year. The RapidGate badge-holder (employee) does not need a vehicle pass.

3.4.6.3 ALL OCCUPANTS in a vehicle must have a RapidGate badge to use the designated RapidGate lanes. Otherwise, the vehicle must use one of the visitor entrances.

3.4.6.4 To enroll:

a. Company must preauthorize with EID Passport Inc (RapidGate administrator)

Contact Information: Phone 877-675-6943 www.eidpassport.com

b. After company authorization, each individual must enroll with a RapidGate Representative (mass enrollment) or at a RapidGate kiosk (located in Building 367).
c. As a RapidGate participant, you will undergo, and must pass, background screenings on an ongoing basis to verify your eligibility to participate in RAPIDGate.
d. After enrollment, payment, and the individual passes the security screening, the badge will be sent to the Badge and ID Office in Building 367.
e. Badge request to take approximately 15 days from request to issue.

3.4.7 Privately Owned Vehicle (POV) Daily Pass – [no Company/Commercial Markings on vehicle]

3.4.7.1 Temporary Vehicle Daily Pass – Visitors Passes may be obtained at the Walter Gate (Scott at Hood) Visitors Entrance, East Harry Wurzbach, Binz-Engleman, and the George Beach at I-35 BAMC entrances.

3.4.7.2 Permanent Vehicle Decal – Refer to Appendix OO, Issuance of Access to Non-Common Access Card Contractors, Vendors, and Non-DOD Civilians Requiring Routine Official Installation Access, in the RFP package.

3.4.7.3 Company sponsored vehicles – Must have affidavit giving operator permission to use a commercial vehicle as a personal vehicle for an Extended Temporary Vehicle Pass.

3.4.8 Contractor Owned Commercial Vehicle Pass – [vehicles with Company/Commercial Marking]

3.4.8.1 Temporary Vehicle Pass – The Commercial Gate at Jadwin Road (if closed, after 1800, vehicles may enter through the Walters gate). For BAMC, enter the George Beach at IH-35 Gate.

3.4.8.2 Extended Temporary Vehicle Passes - Refer to Appendix OO, Issuance of Access to Non-Common Access Card Contractors, Vendors, and Non-DOD Civilians Requiring Routine Official Installation Access, in the RFP package.

3.4.9 Gate Restrictions – ALL COMMERCIAL Class A/B type vehicles must enter through: (These gates have equipment available to screen/inspect Class A/B type vehicles.)

a. The Commercial Gate at Jadwin Road (if closed, after 1800, vehicles may enter through the Walters gate).

b. For BAMC, all commercial vehicles must enter the George Beach at IH-35 Gate. Commercial vehicles entering the IH-35 gate should have a destination within the BAMC Campus.

1. All commercial vehicles entering the IH-35 Gate are routed onto Rawley E. Chambers, where the commercial vehicle screening point is located. It should be noted that Rawley E. Chambers is one way from the commercial vehicle screening point up to the central energy plant/hospital delivery yard.

3.4.10 Arrangements may be made to waive access protocol to allow Class A/B type vehicles through other gates for special circumstances on a case by case basis. Each case needs a minimum 24 hour notification to the Physical Security Branch, the Contractor name, and number of waivers required.

3.4.11 Gate Options / Alternatives – The use of any "Contractor Only" or "Supplemental" gates is solely at the discretion of and subject to the approval of the FSH Garrison Command.

3.4.11.1 CONTRACTOR ONLY GATES operated by construction project contractors solely for all types of contractor traffic moving across the installation boundary into the project construction site without access to other parts of the installation. Contractor bears cost of infrastructure and fencing to ensure project construction site is physically isolated from all remaining parts of Fort Sam Houston.

a. AT THIS TIME CONTRACTOR GATES might include, but might not be limited to: Tri-Service Lab Project [W.W. White at Holbrook]; BHT Project [Temporary gate from the hospital campus temporary access road]; SAMMC-North/South Garage [Temporary gate from Binz-Engleman]; SAMMC-North/CEP Addition [Temporary gate from the hospital campus temporary access road]; SAMMC-North/Clinic-Admin Tower [Temporary gate from the hospital campus temporary access road]; SAMMC-North/Clinic-Alter Existing [Temporary gate from the hospital campus temporary access road]; SAMMC-North/North Garage [Temporary gate from the hospital campus temporary access road]; GTF 2-CO OPS/VMS [Temporary gate from Hood Street]; BLD 2001 [Temporary gate from Breckenridge Road]; BLD 2000 [Temporary gate from Breckenridge Road]; BLD 2004 [Temporary gate from Breckenridge Road]; BATCH PLANT [Temporary gate from Petroleum/Holbrook Road]. Scott Road gate possible temporary access to Harry Wurzbach.

b. CONTRACTOR GATES are internal to the contractor's operation and, while subject to inspection and oversight by the Provost Marshal/Physical Security Office to insure that access from the project site to the rest of the installation is precluded, do not require any inspection other than that imposed by the contractor. Security within the contractor's area of operation is the responsibility of the Contractor.

3.4.11.2 SUPPLEMENTAL GATES are additional gates operated by the FSH installation gate guard contractor with funding for guard personnel and the "physical construction" (road work, shelter, and all utilities) provided by the construction project.

a. Potential locations for SUPPLEMENTAL GATES might include, but might not be limited to: Old Jadwin Road Gate [adjacent to/North of the Commercial Gate at Jadwin Road]; Scott Road North Gate [Scott Road at Harry Wurzbach], Petroleum/Holbrook Road, Binz-Engleman.

b. SUPPLEMENTAL LANES/GATES operate under the same basic criteria as the existing commercial gates because vehicles passing through these gates have open access to the installation. However, use of SUPPLEMENTAL GATES should be limited to contractor traffic associated with the construction project or projects that are paying for the operation of the gates.

3.5 Locked FSH Gates – Gates can be opened for emergency or unusual situations by contacting the Physical Security Branch, Building 2250.

3.6 Contractor Support - Support of any nature through the FSH garrison will be coordinated through the Corps of Engineers Area Office and paid for by the Contractor. Support refers to any assistance by FSH personnel or use of FSH assets.

3.7 Temporary Utilities UFGS 01 50 02.00 10 Temporary Construction Facilities - All temporary utilities are the responsibility of the Contractor to provide and fund. The contractor shall submit a drawing indicating the location of each temporary electrical, gas, and water meter at each construction site to the DPW Project Manager located in Building 4196.

3.7.1 The Contractor shall coordinate and pay for domestic water and wastewater through the FSH Department of Public Works (DPW).

a. Billing agreements – Contracts and billing agreements applicable to AR 420-41 [Utility Contracting (Acquisition and Sales) Policy and Guidance] Appendix F.
b. Contract P.O.C. John Gonzales, Energy Manager, Building 4196, Engineering Operations Branch, Phone 210-295-4770.
c. Temporary Potable Water (FSH DPW)
    1. Meter will be provided and installed by the Contractor.
    2. Time Frame – 14 Days (will run concurrent with digging permit).
    3. Procedure – See DPW PM for instructions, billing, digging permit, locating, etc.
    4. Fire hydrant taps (meter supplied and water paid for by the Contractor) are possible on a case by case basis.

3.7.2 Temporary Power Procedures (CPS Energy)

a. Installation of temporary electrical service will not begin until the Contracting Officer (CO) approves detailed drawings for each location.
b. Meters will be provided and installed by CPS Energy at the Contractor’s expense.
c. Billing agreements with CPS Energy must be arranged and paid for by the Contractor. The same application can be used for both gas and electric service. The application can be completed by calling the **CPS Energy New Construction/Commercial Application Office at 210-353-3333**.
d. CPS Energy requires a minimum of 14 days advance notification to install temporary electrical service.
e. No permits are required. However, all installations shall abide by the National Electrical Code and CPS Energy Electrical Service Standards.

3.7.3 Temporary Telephone & Communications: The Contractor will coordinate and lease the lines from Fort Sam Houston DOIM. The Contractor must contract separately for the desired telephone service through a private company.

a. Contractor must contact Fort Sam Houston DOIM for approval before applying with privatized phone company. Temporary telephone POC - Trent Marshall 210-221-5909

b. Contractor must request service through privatized phone company. Must include wording in request stating “service will need extension of circuit to end user’s phone jack”.

c. Send copy of work request with assigned phone numbers from phone company to Fort Sam Houston DOIM.

d. Contractor must submit a cancellation notice to the FSH DOIM to be released from lease.

3.8 Permanent Water Meter Installation Requirements

3.8.1 A main water meter shall be installed by the Contractor at each building or facility. Water meters will be equipped with electronic or radio frequency (RF) transmitters for remote monitoring as specifically required by the contract

3.8.1.2 Permanent Potable Water (FSH DPW)

a. Meter will be provided and installed by the Contractor.

b. Billing agreements – will be responsibility of the FSH DPW

c. Time Frame – 14 Days (will run concurrent with digging permit).

d. Procedure – See DPW PM for instructions, digging permit, locating, etc.

3.9 Permanent Recycle Water (SAWS)

a. Meter will be provided by the SAWS, installation will vary according to project.

b. The Government has established billing agreements with SAWS for water use after completion of the project.

c. Time Frame – Follow SAWS Recycle Program for planning. After approved plan is accepted by SAWS and FSH, the Contractor shall coordinate with the DPW PM for instructions, digging permit, locating, etc.

d. Procedure – If there is **ANY** CONNECTION to SAWS Recycle Water on site, all potable water service connections in the vicinity of the project construction limits must be equipped with a reduced-pressure-principle backflow prevention assembly.

e. Fort Sam Houston has a base-wide Recycled Water Service Agreement with SAWS.

f. New projects on Fort Sam Houston there will be installation/relocation expenses required for each project at the Contractor’s expense. However, there will incur no application fees, impact fees or connection fees for any Recycled Water projects.

g. Drawings and Specifications shall be required on each new Recycled Water tap/project. Drawings will show all potable water lines, facilities buildings and other improvements as well as all equipment requiring recycled water.

h. A permit will be required for each Plan Review process, no fee will be accessed for this permit process. SAWS’ Mains and Services Department must approve permit prior to construction.

SAWS Water Recycling - http://www.saws.org/our_water/recycling/

SAWS Water Recycling Handbook - http://www.saws.org/our_water/recycling/handbook/index.shtml

SAWS Construction Website - http://www.saws.org/business_center/

3.10 Permanent Electrical Service

3.10.1 General Notes

a. Both temporary and permanent power for buildings will be provided by CPS Energy.

b. The same application can be used for both gas and electric service. The application can be completed by calling the **CPS Energy New Construction/Commercial Application Office at 210-353-3333**.

c. When application for service is submitted, Contractor shall request IDR meters for buildings larger than 29,000 square feet from CPS Energy. These meters will allow FSH personnel to monitor electrical load data using CPS Energy's Load Tracker data system.

d. CPS will perform electrical field surveys at the D/B Contractors expense

e. The solicitation drawings show a suggested route for distribution based on CPS Energy standard and a separate Bid Item is included in this Request for Proposal with CPS Energy's preliminary cost for this work.

f. There will be an additional charge for any upgrades to the primary distribution system (both overhead and underground) and any changes to the original suggested route shown.

g. After CPS Energy receives the D/B Contractor's final approved and stamped electrical site plan, electrical one-line diagram and a load analysis, CPS Energy will provide a price for the distribution of electrical utilities. The D/B Contractor will negotiate, contract and schedule the work directly with and pay CPS Energy to do the approved work. **Additional costs for 1) design options or 2) resultant defects due to contractor designs AND EXECUTION shall be allowed only to the extent that these actions decrease net design, construction, and other costs to the government.

h. A modification will be issued to the D/B Contractor if the actual CPS Energy cost differs from the CPS Energy budget included in the contract.

i. CPS Energy will build the exterior aerial power distribution system and riser pole after payment has been received from the D/B Contractor.

j. CPS Energy will remove any existing utilities prior to demolition at the D/B Contractor's expense.

k. The D/B Contractor must contact CPS Energy fourteen (14) days prior to the excavation of property or demolition of the utilities.

l. For the underground primary, the D/B Contractor will build the underground ducts (a minimum of 2-4" and 1-2"), concrete slab for the pad mounted transformer, and manholes to CPS Energy standards.

m. The D/B Contractor shall install conduits inside the concrete transformer slab for the primary and the secondary cables.

n. The D/B Contractor shall install CPS Energy furnished ground rods in the transformer slab.

o. CPS Energy will provide and install the pad mounted transformer, pull in primary cables, connect to aerial primary at the D/B Contractor's expense.

p. The D/B Contractor shall install meter rack (if applicable), secondary duct, secondary cables, 2' conduit form meter to DDC panel in building and connect secondary cables to building.

q. CPS Energy will make primary and secondary connections to transformer terminals (contractor to provide secondary lugs) and install metering equipment at the D/B Contractor expense.

r. An additional 2" conduit will be required between pad-mounted transformers and meter enclosures when applicable.

3.10.2 Required information from the D/B Contractor:

3.10.2.1 A Texas professional engineering stamp will be required on the following information:

a. Transformer Detail – show perimeter clearance and the location of the meter. Provide written dimensions with respect to some existing, permanent structure to define transformer location.
b. Electrical One-line Diagram - show the number and size of the secondary conduit and wires.
c. Electrical Layout – show the route of secondary wires to the main distribution switch.
d. Electrical load analysis - show connected load and demand power requirements.
e. Utility Site Plan – show the transformer, riser pole, manhole(s), and preferred layout of the primary duct line.

CPS Energy Electric POC: Mr. Basileo Rocha (210)353-4933 bdrocha@cpsenergy.com.

3.11 Permanent Natural Gas Service

3.11.1 General Notes

a. Permanent and temporary natural gas for buildings will be provided by CPS Energy.

b. The solicitation drawings show a suggested route for distribution based on CPS Energy standards. Final location of natural gas meter to coordinated with CPS Energy. CPS Energy will install natural gas service main to meter. A separate Bid Item is included in the contract with CPS Energy's preliminary cost for Natural Gas work.

c. After CPS Energy receives the Design Build (D/B) Contractor's final approved natural gas site plan and a load analysis, CPS Energy will provide a final price for the distribution of natural gas utilities. The D/B Contractor will negotiate, contract and schedule the work directly with and pay CPS Energy to do the approved work.

d. A modification will be issued to the D/B Contractor if the actual CPS Energy cost differs from the CPS Energy Natural Gas preliminary estimate included in the contract. Additional costs for 1) design options or 2) resultant defects due to contractor designs AND EXECUTION shall be allowed only to the extent that these actions decrease net design, construction, and other costs to the government.

e. CPS Energy will remove any existing utilities prior to demolition at the D/B Contractor's expense. CPS Energy requires a minimum time notification of thirty (30) days to remove or relocate existing natural gas utilities. The D/B Contractor will be coordinate and pay for the removal or relocation of natural gas utilities.

f. CPS Energy (or the qualified contractor of its choice) shall select and install all gas mains, services up to and including the gas meter and regulator set at the D/B Contractor's expense. These facilities are owned and operated by CPS Energy. CPS Energy will provide and connect its own natural gas meters.

g. The D/B Contractor shall provide and install all gas piping and related facilities between the CPS Gas Meter and the building.

h. The D/B Contractor shall be responsible to locate all underground utilities prior to CPS Energy work.

i. The D/B Contractor must coordinate the location and sizes of all gas sleeves with CPS Energy. Note that open trenching of new sidewalks or roads will not be allowed.

j. The D/B Contractor will need to fulfill all requirements of the Digging Permit for Fort Sam Houston and coordinate installation with the Army Corps of Engineers PM.

3.11.2 Required information from the D/B Contractor. The following information will be required by CPS Energy to obtain natural gas service:

a. File an application for service. The same application can be used for both gas and electric service. The application can be completed by calling the **CPS Energy New Construction/Commercial Application Office at 210-353-3333**.

b. Supply a site drawing of the project with orientation of structures on the property, approximate location gas line will enter structure and dimensions of related areas.

c. Supply the required load demand information in cubic feet per hour (CFH) or British Thermal Units (BTU) and the required pressure at the meter in pounds per square inch (psi).

CPS Energy Gas POC: Mr. Daniel Davila (210)353-5845 drdavila@cpsenergy.com.

3. 12. Permanent Telecommunications

3.12.1 General FSH Communication Drawing Notes:

1. The Contractor shall provide the specified number of 4" concrete enclosed conduits for incoming communications – not less than 2 each 4" conduit. The conduits shall extend from the existing communications manhole to the Main Telecommunications Room (MTR). The Contractor shall core and drill and completely seal all conduit penetrations. The Contractor shall provide pull wires in all empty conduits.

2. The Contractor shall contact the DOIM at (210) 221-4357 for approval of the exact locations and orientation of conduit penetrations within the existing manholes prior to starting work.

3. The Contractor shall provide and install the Protected Entrance Terminal(s) (PET) with sufficient ports to support the building occupants. Contractor shall provide and install 110 punch-down blocks, sized to support the PET. The Contractor shall provide cross-connect wiring (bulk) for PET to 110 punch-down blocks (the DOIM will terminate cross-connects). The Contractor

will provide and install Riser cabling from 110 punch-down blocks to voice patch panels (the DOIM will terminate jumpers).

4. The Contractor shall provide and install floor mounted 7' high racks, ladder trays & Velcro banding in each communication room. Each rack shall have a Fiber Optic Patch Panel (FOPP) with FC connections. DOIM will provide and install switch and UPS for each rack.

5. Contractor shall install one 220VAC 30 AMP circuit in the primary rack and one quad outlet, 120VAC in each secondary rack to provide power for DOIM installed electronic equipment. Outlet placement will be on the bottom of the racks (attached to support rail).

6. Maximum distance for cable runs are 295 feet, end device to cross-connect jumper. Cable runs longer than 295 feet require an intermediate distribution point with electronics and fiber connection to the main building network switches (PET and FOPP).

7. Contractor shall provide, install, and test all contractor installed cable and equipment. All cable/equipment test results will be given to the DOIM.

8. After final Contractor testing, the DOIM will provide and install the cable from existing manhole to new MTR room. The DOIM will coordinate with the USACE PM and contractor prior to building entrance. DOIM will terminate the incoming government copper to the Contractor furnished PET and will perform the final cross-connections and jumpers to the patch panels. The incoming government fiber will be terminated by the DOIM on a Contractor furnished FOPP using Contractor furnished LC connectors. DOIM will install Contractor furnished LC to MTRJ jumpers to switch and Contractor furnished FOPP. Contractor will provide LC to LC jumpers for premise distribution patch panel(s).

9. Provide wire way, pull string and necessary boxes for all door access points.

10. Each DOIM telecommunications room (TR) will be equipped with a single phone jack near the TR door and each TR door will be equipped with a network (cipher) lock.

11. All mechanical rooms shall be supplied with a single phone jack. Provide a separate data connection for the HVAC to the UMCS that will be connected to the UMCS system.

12. Communications shall be provided from all elevators to the appropriate MTR/TR.

3.12.2. Commercial Cable Transmission Media

1. Fort Sam Houston has a privatized, contractor run commercial cable TV network. Cable is RG6. Terminate at jack on standard TV outlet. Place termination equipment in rack or on back board.

2. Contractor will provide secure space or commercial closet for all commercial cable TV equipment. No commercial cable TV or customer related equipment will be housed in the official MTR/TR.

3. Provide minimum of 2 - 2” conduits, underground through floor slab, for commercial cable TV/telephone. It shall be installed from commercial/utility closet and extend five (5) feet beyond the exterior face of the building (approved by the COR). All ducts shall be capped on the exterior

and fire stopped on the interior of the building. Exterior building placement (stub out) shall be marked with a metallic end location.

3.13 Contractor Staging Areas. The contractor's staging area will be within the contract grading limits. Proposed staging areas and concrete plant sites outside the grading limits will be approved prior to indicating the location in the bid documents. If the contractor requires a staging area outside the grading limits or in conjunction with renovation of existing facilities a request showing the limit of the staging area must be submitted for approval prior to use of such area. All staging and storage areas shall be fenced and screened. All staging areas near residential areas shall be fenced and locked during non work hours.

3.14 Recycle Materials: There is no current recycle program on Fort Sam Houston. However, the Contractor shall recycle any material feasible. Documentation of material recycled must be reported to the Government including the type and approximate amount salvaged. The Contractor shall be responsible for removing all unused material and refuse from Fort Sam Houston and disposed of appropriately.

3.15 Unless specifically shown or required otherwise, all unused material, refuse, concrete and asphalt rubble resulting from demolition or site improvements shall be removed from Fort Sam Houston at the expense of the Contractor and disposed of appropriately.

3.16 Where demolition of multiple building construction requires phasing, the phasing shall be established prior to and published for advance final review.

3.16.1 Where alterations or rehab work requires work done in or to existing buildings, the Contractor shall ensure that a proper survey of all potentially hazardous materials is done and proper specifications for removal and disposal are included in the project. Fort Sam Houston DPW prefers that materials generated by demolition be disposed of by the Contractor when allowed by disposal regulations. Provide lists of hazardous material to be disposed of on drawings or in specs.

3.17 CUSTOMER SERVICE INSPECTIONS: Water Connections:

1. The Texas Commission on Environmental Quality (TCEQ) Rules and Regulations for Public Water Systems requires a "Customer Service Inspection Certification (example, Appendix G) be completed prior to providing continuous water service to new construction, on the existing system when the water purveyor has reason to believe cross-connections or other unacceptable plumbing practices exist, or after improvements, corrections, or additions to plumbing facilities." This rule was effective 1 Jan 96.

2. Personnel qualified to make the certifications are plumbing inspectors licensed by the Texas State Board of Plumbing Examiners, certified waterworks operators, and licensed plumbers (for single-family residential services).

3. The Customer Service Inspection records must be retained 10 years and be available for commission review. Please forward all completed inspection forms for work completed after 1 Aug 98 to DPW, Environmental Office, Building 4196 ATTN: David Walker.

4. Backflow prevention tests are monitored by the DPW Sanitation Shop

The Contractor shall test backflow prevention assemblies as required by 31 TAC 290.44(h). At the completion of inspection, the Contractor must submit a Test Report in compliance with TCEQ: 30

Texas Administrative Code (TAC) Chapter 290.47(f), see sample Appendix H. The Contractor shall verify and assure the products specified as capable of being field tested, i.e., have test ports, cocks, etc., as needed. Any use of recycled water shall be done in compliance of SAWS and TCEQ.

Certification Requirements

The Rules and Regulations for Public Water Systems (TCEQ publication number RG-195) require a customer service inspection certification before providing continuous water service for the following conditions: New construction involving plumbing or mechanical systems; or Material improvement, correction, or addition to plumbing or mechanical systems.

Inspection

The Customer Service Inspection certifies that for work done under this contract:

A. No direct connection between the public drinking water supply and a potential source of contamination exists;

B. No cross-connection between the public drinking water supply and a private water system exists;

C. No connection exists which would allow the return of water used for condensing, cooling industrial processes back to the public water supply;

D. No pipe or pipe fitting which contains more than 8.0 percent lead exists in private water distribution facilities installed on or after July 1, 1988; or

E. No solder or flux which contains more than 0.2 percent lead exists in private water distribution facilities installed on or after July 1, 1988.

Inspection Personnel

Customer Service Inspections must be performed by personnel meeting the requirements described in the *Rules and Regulations for Public Water Systems*. Examples are individuals licensed by the Plumbing Examiners Board (Licensed Plumbers or Plumbing Inspectors) or Certified Waterworks Operators and members of other water-related professional groups who hold an endorsement granted by the commission or its designated agent (have been to the 10 hour training approved by TCEQ).

Inspection Certification Form

Original copies of the Customer Service Inspection Certification shall be provided to the Contracting Officers Representative prior to final inspection and acceptance. Certification forms will be maintained by the Fort Sam Houston DPW Water and Wastewater Utility representative. A sample form is provided at the end of this section. Appendix G

DIGGING PERMIT FOR FORT SAM HOUSTON
(Please Print or Type)

SERVICE ORDER NO: ____________________
(Task Code for Service Order: DP01)
OR
CONTROL NUMBER: __________________ WORK REQUEST NO: ____________________ DATE: __________________
(Phase Code for Work Requests: 102)

Note: This form is used to coordinate required work with key post activities, protect underground utilities and keep customer inconvenience to a minimum.

BRIEF DESCRIPTION OF PROJECT/WORK: ____

Clearance is requested to proceed under Contract No.: ______________________ involving excavation at the location shown on attached drawing. (Contractor shall attach 5 annotated copies of area to be excavated)

Requestor/Contractor: ____________________ Company Name: ________________ Phone: ______________

The following date and time has been scheduled by PWBC for the contractor to meet and coordinate with locate personnel (10 working days are required for scheduling)

DATE: ______________________ TIME ______________________________

Meet at: ____
(Date requested by contractor MAY be adjusted by PWBC representative to avoid overbooking of locate personnel)

THIS IS NOT A ROAD CLOSURE OR UTILITY OUTAGE REQUEST. Requester is responsible for assuring that required road closures and utility outage requests are processed separately and timely.

ORGANIZATION	LOCATE PERSONNEL PRINTED NAME/SIGNATURE	MARKED (CIRCLE ONE)	REMARKS: DEPTH (IF KNOWN), NONE FOUND, OR OTHER
*** Directorate of Public Works			
(1) Water, Sewer & Drainage		/YES NO /	
(2) Electrical		/YES NO /	
		/YES NO /	
		/YES NO /	

*** CONTRACTOR IS RESPONSIBLE FOR NOTIFYING/SCHEDULING THE FOLLOWING CLEARANCES/LOCATES:

(5) Communications 221-1418	/YES NO /	
Southwestern Bell	/YES NO /	
(7) CPS (Gas Lines, Electr.) 1-800-245-4545/Texas One Call System	/YES NO /	
Time Warner Cable	/YES NO /	
(9) SAWS (Gray Water Line) 233-2000	/YES NO	
(10) Sprint (Lodging) (210) 357-6200	/YES NO /	

*** CONTRACTOR SHALL ALSO CALL DEPARTMENTS LISTED BELOW BEFORE DIGGING AND OBTAIN CONCURRENCE:

Directorate of Environmental and Natural Resources:

(11) COMPLIANCE 221-4842 ______________ Signature: ______________
(12) HISTORICAL 221-4842 ______________ Signature: ______________

Other:

(13) FSH Fire Dept 221-2727 ______________ Signature: ______________
(14) PM Traffic Sec. 221-0212 ______________ Signature: ______________
(15) Post Safety 221-3857 ______________ Signature: ______________

CONTRACTOR SHALL RETURN THIS FORM TO DIRECTORATE OF PUBLIC WORKS, ENGINEERING OPERATIONS BRANCH, FORT SAM HOUSTON FOR FINAL APPROVAL UPON COMPLETION OF ALL ABOVE COORDINATION AND SIGNATURES (Bldg. 4196, Room 23).

Quality Assurance Representative: ______________________ PHONE: ______________
(Government Point of Contact)

FINAL APPROVAL: ______________________________ DATE: ______________
Ch, Engineering Operations Branch, BASOPS MEO

REVISED: 09Dec05,RGH G:\DPW\Engr_Ops\Engr Ops FORMS_SOPs\Dig Permit

Appendix A

Digging Permit Instructions – amended by SAAO

1. The Contractor shall fill out the permit and attach the contract utility plans, site/grading plan and any other plan sheets showing limits of excavation (5 complete copies) and submit to the San Antonio Area Office Corp of Engineers Representative.

The San Antonio Area Office Corp of Engineers Representative is responsible for filling in the Work Request Number to be used by the PWBC shops and other personnel working the digging permit for charging their time. If the entire project is being accomplished on a service order then use the project service order number. A separate or new service order will not be generated for the digging permit only, except in the case of COE/MILCON projects which will require a service order initiated by the San Antonio Area Office Corp of Engineers Representative at the time of the submission of the digging permit.

The San Antonio Area Office Corp of Engineers Representative is also responsible for stating the desired date for work to begin and the estimated duration of work. 14 Day Advance Notice minimum, unless otherwise noted.

2. Clearance date is the date the contractor will meet the locate personnel at the site to witness locating of known utility lines and obtain signatures.

a. **Allow 10 working days** to schedule FSH personnel and for review of existing utility plans.

b. **Clearances will be accomplished only on Tuesday, Wednesday or Thursday at either 0800 or 1300 Hours in general**.

c. **Contractor is responsible for notifying** Southwestern Bell, Communications/Network Branch, CPS Energy, Time Warner Cable and Directorate of Environmental and Natural Resources (Bldg 4196). Contractor must take the digging permit to the Provost Marshall's Office in Bldg 2244 to get the permit signed (#14). Call to ensure the appropriate person is going to be in the office before you go.

3. Locate Personnel must accomplish the following on the clearance date:

a. Known utilities must be located and marked.

b. Original digging permit must be legibly annotated as follows:

(1) **Printed name and signature of FSH Representative who cleared the permit**.

(2) Indicate if utility is present and marked.

(3) Any necessary remarks (i.e. Depth of line or state unknown)

(4) Identify all buildings and/or facilities possibly affected.

4. Requestor shall be the contractor or the on-site supervisor.

5. San Antonio Area Office Corp of Engineers Representative must also sign and date the permit.

6. Completed form (upon initial request) is submitted to the San Antonio Area Office Corp of Engineers Representative and Contractor (together) for scheduling to the Fort Sam Houston Representative in the DPW Customer Support Division (Bldg 4196). Final form with signatures is returned to the same office by Contractor and San Antonio Area Office Corp of Engineers Representative for final approval and signature by the Fort Sam Houston DPW Representative. Contractor shall not dig until this is accomplished.

7. Short suspenses will be reviewed and processed on a case by case basis.

Appendix A Cont.

REQUEST FOR UTILITY OUTAGE

FROM:	DATE:
CONTRACT NUMBER:	DESCRIPTION AND LOCATION OF CONTRACT:
TO:	
DATE OF OUTAGE:	TYPE OF OUTAGE:
LOCATION AFFECTED BY OUTAGE:	
DESCRIPTION OF WORK TO BE PERFORMED AND OTHER UTILITIES AFFECTED:	

DURATION OF OUTAGE: HRS:	START: HRS	COMPLETED: HRS:

Contractor Representative Date Contracting Officer's Representative Date

☐ APPROVED DPAE Represnetative Date Phone

☐ APPROVED DPAE Representative Date Phone

☐ EXCEPTIONS (Describe below):

DPAE Representative Date Phone

FORM
SWF 7 Mar 80 1206-J

(CESWF-CD-C SOP)

Appendix B

HOT-WORK PERMIT

For use of this form, see AR 420-90; the proponent agency is ACSIM

1. LOCATION	2. DATE	3. PERMIT NO.
4. TYPE OF WORK	5. START TIME	6. FINISH TIME
7.a. NAME OF PERSON RESPONSIBLE FOR HOT-WORK AT JOB SITE *(Contractor/Government Employee)*	7.b. SIGNATURE	

PRECAUTIONS BEFORE OPERATIONS

CHECKLIST	CHECK ONE	
	YES	NO
8. Did Fire Department Inspector inspect site?		
9. Are there procedures for Fire Department emergency notification? *(Emergency No.)*		
10. Are combustibles in area noted?		
11. Should combustibles be covered? *(If yes, note in remarks)*		
12. Are proper extinguishers on hand?		
13. Is wet-down necessary? *(If yes, note in remarks)*		
14. Is smoking permissible at work sites?		
15. Is continuous fire watch required?		
16. Is Fire Department standby required?		
17. Are other precautions required? *(If yes, note in remarks)*		

18.a. FIRE DEPARTMENT INSPECTOR'S SIGNATURE	18.b. DATE

PRECAUTIONS AFTER OPERATIONS

CHECKLIST	CHECK ONE	
	YES	NO
19.a. Was Fire Department notified after hot-work operation was completed?		
19.b. Time:		
20.a. Did Fire Department inspector inspect work site?		
20.b. Time:		
21. Are after work conditions safe? *(If no, note in remarks)*		
22. Are heat producing devices safe if left at work site?		

23.a. FIRE DEPARTMENT INSPECTOR'S SIGNATURE	23.b. DATE

24. REMARKS

NOTE: PERMIT VALID ON DAY OF OPERATION AT ONE LOCATION ONLY

DA FORM 5383-R, SEP 92 EDITION OF JAN 85 IS OBSOLETE USAPPC V1.00

Appendix C

APPLICATION FOR ARMY RADIATION AUTHORIZATION

For use of this form, see AR 11-9; the proponent agency is DAS

1. THIS IS AN APPLICATION FOR *(Check appropriate item)*
   - ☐ NEW ARA
   - ☐ AMENDMENT TO ARA NUMBER ____________
   - ☐ RENEWAL OF ARA ____________

2. NAME, MAILING ADDRESS, AND E-MAIL ADDRESS OF APPLICANT *(Include ZIP Code)*

3. ADDRESSES WHERE AUTHORIZED IONIZING RADIATION SOURCES WILL BE USED OR POSSESSED

4. NAME OF PERSON TO BE CONTACTED ABOUT THIS APPLICATION

5. TELEPHONE NUMBER AND FAX NUMBER

Items 6 through 12 may be continued on the following page or on 8 1/2 x 11 inch paper. The type and scope of information to be provided should be adequate to show complete compliance with applicable regulations and guidance. *(If you can link use of radioactive material to a valid Nuclear Regulatory Commission (NRC) license, provide number and expiration date of the license and only submit items that differ from the NRC license application and associated documents.)*

6. RADIATION SOURCE(s)

a. RADIOACTIVE MATERIAL *(Element and mass number, chemical and/or physical form, and maximum amount that you will possess at any one time.)*

b. ACCELERATOR(s) AND X-RAY SYSTEM(s) CAPABLE OF PRODUCING A "HIGH RADIATION AREA" OR "VERY HIGH RADIATION AREA" *(Describe)*

7. PURPOSE(s) FOR WHICH IONIZING RADIATION SOURCE(s) WILL BE USED

8. INDIVIDUAL(s) RESPONSIBLE FOR RADIATION SAFETY PROGRAM AND THEIR TRAINING AND EXPERIENCE

9. TRAINING FOR INDIVIDUALS WORKING IN OR FREQUENTING RESTRICTED AREAS

10. FACILITIES AND EQUIPMENT *(Describe rooms or areas, sheidling, safety devices, monitoring equipment, and so on.)*

11. RADIATION SAFETY PROGRAM

12. WASTE MANAGEMENT

13. CERTIFICATION

The applicant understands that all statements and representations made in this application are binding upon the applicant. The applicant and any official executing this certification on behalf of the applicant, named in Item 2, certify that all information contained in this application is true and correct to the best of their knowledge and belief.

14. NAME, RANK, AND TITLE OF CERTIFYING OFFICER

15. SIGNATURE

16. DATE *(YYYYMMDD)*

20070806

DA FORM 3337, MAY 1999 DA FORM 3337, MAR 80, IS OBSOLETE APD V1.00

Appendix D

APPLICATION FOR FORT SAM HOUSTON IDENTIFICATION (ID) BADGE

The proponent of this form is MCCS-BLE

PRIVACY ACT STATEMENT

AUTHORITY: 5 U.S.C., Section 301; 10 U.S.C., section 3013(g).

PRINCIPLE PURPOSE: To provide a record of identification cards and badges issued: to restrict entry into the installation/activities; and to ensure positive identification of personnel authorized access to restricted areas.

ROUTINE USE: To identify all non-DOD civilians and contractor personnel conducting official business on the installation.

MANDATORY/VOLUNTARY DISCLOSURE AND EFFECT ON INDIVIDUAL NOT PROVIDING INFORMATION: The disclosure of personal identification is voluntary; however, failure to provide information required may preclude entry to the installation/activities. Information will not be released to third parties.

1. NAME *(LAST, FIRST, MI)*				2. ID BADGE EXPIRATION DATE *(YYYYMMMDD)*
3. SOCIAL SECURITY NUMBER		4. DATE OF BIRTH *(YYYYMMMDD)*		
5. HEIGHT	6. WEIGHT	7. HAIR COLOR	8. EYE COLOR	9. SEX *(M/F)*
10. ORGANIZATION	11. POSITION TITLE			12. WORK PHONE NUMBER
13. HOME ADDRESS				14. HOME PHONE NUMBER
15. APPLICANT'S SIGNATURE				16. DATE
17. AUTHORIZING OFFICIAL'S TYPED NAME *(LAST, FIRST, MI)*				18. AUTHORIZING OFFICIAL'S PAY GRADE *(IF APPLICABLE)*
19. TITLE				20. DUTY PHONE NUMBER
21. AUTHORIZING OFFICIAL'S SIGNATURE				22. DATE
TO BE COMPLETED BY ISSUING OFFICE				
23. ID BADGE SERIAL NUMBER				24. ID BADGE ISSUE DATE
25. ISSUING OFFICIAL'S SIGNATURE				26. DATE

CSFS FORM 4318-R, AUG 2004

CSFS V1.10

Appendix E

MEMORANDUM FOR RECORD

SUBJECT: Acknowledgment of Installation-Badge Holder Responsibilities

1. Reference Garrison Commander's Policy Letter #54, Issuance of the Fort Sam Houston (FSH) Identification (ID) Badges, Aug 2004.

2. As a FSH Installation Badge holder, I acknowledge the following:

a. All persons, their personal property, U.S. Government property, and vehicles may be searched on entry, while within the confines of, or when leaving U.S. Forces installations. Persons attempting to gain entry who refuse to identify themselves or consent to search will be denied access.

b. I am not authorized to sponsor individuals onto the installation.

c. Installation Badges are U.S. Government property. Any military police (MP) official or Chenega Security Officer may confiscate an Installation Badge that has expired, is being used fraudulently, is being presented by a person other than the person to whom it was issued, or is obviously altered, damaged, or mutilated.

d. I must surrender my badge when--

(1) It is replaced (except when lost or stolen).

(2) I no longer require access.

(3) My sponsor status changes.

(4) I resign or retire, am terminated, or am no longer officially sponsored.

e. If I lose my Installation Badge or if it is stolen, I must immediately notify either the MP or the Installation Access Control Office that issued the pass. Failure to do so is grounds for denying a replacement pass and barring from the installation.

f. Violations of security policies may be grounds for denying access to the installations and lead to confiscation of installation-access documents.

3. I acknowledge by my signature below that I have read and understand the policy, requirements, and responsibilities above.

Print Last, First, MI	Signature	Date

Reverse of CSFS FORM 4318-R, AUG 2004

Appendix E cont.

Attached to and made a part of Contract No ____________

SPECIAL PROVISIONS C (S)
WATER SERVICE

For use of this form, see AR 420-41; the proponent agency is the Office of the Chief of Engineers

1. ESTIMATED REQUIREMENTS.
   Estimated maximum demand ____________
   Estimated annual consumption ____________

   (The parties hereto are not obligated to deliver or receive, nor are they restricted to, the above amounts.)

2. POINT OF DELIVERY. The point of delivery of water shall be the point of connection with Government's water main, and located ____________

3. QUALITY OF WATER. The Government will supply the same quality of potable water as supplied to ________ by means of its water system located at the said ____________

4. RATES. The rates to be charged the Purchaser by the Government for the water service described herein, are as follows:

5. METERING AND BILLING. Water will be measured by ____________ inch meter(s) to be furnished, installed and maintained by the Purchaser. The meter(s) will be read by the Utilities Sales Officer, or his or her authorized representative, and bills will be rendered monthly to the Purchaser by the Government. All such bills will be due and payable 15 days after receipt thereof by the Purchaser.

6. ALTERATIONS AND ADDITIONS.

DA FORM 2103-R, 1 JUN 76 EDITION OF 1 AUG 69 IS OBSOLETE USAPA V1.00

Appendix F

Texan Administrative Code - 30 TAC §290.47(d)

Customer Service Inspection Certificate

Name of PWS ____PWS I.D.# _____________

Location of Service

Reason for Inspection:

New construction..❐

Existing service where contaminant hazards are suspected ....❐

Major renovation or expansion of distribution facilities ....❐

I ___________________________, upon inspection of the private water distribution facilities connected to the aforementioned public water supply do hereby certify that, to the best of my knowledge:

Compliance	Non-compliance		
❐	❐	1.	No direct connection between the public drinking water supply and a potential source of contamination exists. Potential sources of contamination are isolated from the public water system by an air gap or an appropriate backflow prevention assembly in accordance with Commission regulations.
❐	❐	2.	No cross-connection between the public drinking water supply and a private water system exists. Where an actual air gap is not maintained between the public water supply and a private water supply, an approved reduced pressure-zone backflow prevention assembly is properly installed and a service agreement exists for annual inspection and testing by a certified backflow prevention assembly tester.
❐	❐	3.	No connection exists which would allow the return of water used for condensing, cooling or industrial processes back to the public water supply.
❐	❐	4.	No pipe or pipe fitting which contains more than 8.0% lead exists in private water distribution facilities installed on or after July 1, 1988.
❐	❐	5.	No solder or flux which contains more than 0.2% lead exists in private water distribution facilities installed on or after July 1, 1988.

I further certify that the following materials were used in the installation of the private water distribution facilities:

Service lines	Lead	❐	Copper	❐	PVC	❐	Other	❐
Solder	Lead	❐	Lead Free	❐	Solvent Weld	❐	Other	❐

I recognize that this document shall become a permanent record of the aforementioned Public Water System and that I am legally responsible for the validity of the information I have provided.

Remarks:

___________________________________ ___________________________

Signature of Inspector Registration Number

___________________________________ ___________________________

Title Type of Registration

____

Date

Appendix G

TCEQ : 30 Texas Administrative Code §290.47(f)

§290.47(f) Appendix F. Sample Backflow Prevention Assembly Test and Maintenance Report.

The following form must be completed for each assembly tested. A signed and dated original must be submitted to the public water supplier for record keeping purposes:

BACKFLOW PREVENTION ASSEMBLY TEST AND MAINTENANCE REPORT

NAME OF PWS: ______________________________
PWS I.D. #: ______________________________
MAILING ADDRESS: ______________________________
CONTACT PERSON: ______________________________
LOCATION OF SERVICE: ______________________________

The backflow prevention assembly detailed below has been tested and maintained as required by commission regulations and is certified to be operating within acceptable parameters.

TYPE OF ASSEMBLY

☐ Reduced Pressure Principle
☐ Double Check Valve
☐ Pressure Vacuum Breaker
☐ Reduced Pressure Principle-Detector
☐ Double Check-Detector
☐ Spill-Resistant Pressure Vacuum Breaker

Manufacturer: ______________________ Size: ______________________
Model Number: ______________________ Located At: ______________________
Serial Number ______________________

Is the assembly installed in accordance with manufacturer recommendations and/or local codes? ______

	Reduced Pressure Principle Assembly			Pressure Vacuum Breaker	
	Double Check Valve Assembly				
	1st Check	2nd Check	Relief Valve	Air Inlet	Check Valve
Initial Test	Held at ___ psid Closed Tight ☐ Leaked ☐	Held at ___ psid Closed Tight ☐ Leaked ☐	Opened at ___ psid Did not open ☐	Opened at __ psid Did not Open ☐	Held at ____ psid Leaked ☐
Repairs and Materials Used					
Test After Repair	Held at _____ psid Closed Tight ☐	Held at _____ psid Closed Tight ☐	Opened at ___ psid	Opened at __ psid	Held at ____ psid

Test gauge used: Make/Model ______________________ SN: __________ Calibration Date: ________

Remarks: ______________________________

The above is certified to be true at the time of testing.

Firm Name: ______________________ Certified Tester: ______________________

Firm Address: ______________________ Cert. Tester No.: ____________ Date: ______

Firm Phone #: ______________________

* TEST RECORDS MUST BE KEPT FOR AT LEAST THREE YEARS

** USE ONLY MANUFACTURER'S REPLACEMENT PARTS

Appendix H

Appendix DD

Technical Supplement to the Design Guide

Technical Supplement to the Design Guide for Fort Sam Houston

DIVISION 2 –

Earthwork   See File 7-ConstructionMinMtsReqTestFreq

Construction Minimum Materials Requirements and Testing Frequencies

Excavation and Fill

1. Verify if SAMMC Disposal area is available. Comply with Specification 9 – SAMMC/BAMC Disposal Area Access. Include the following provisions for use. See Files 9-SAMMC-BAMC-Disposal Access Area for map & 9-Spoils Area Specs

2. All borrow or spoil operations shall be off Government controlled property at the responsibility and expense of the Contractor except that the Contractor may utilize the SAMMC Spoil Area indicated on the haul route drawings to deposit spoils. The SAMMC Spoil Area is available for clean fill only. Although available for this contract, note that this area is primarily for the SAMMC contracts. The Contractor shall coordinate with the Contracting Officer's Representative for scheduling, location, and specific instructions regarding spoil deposits. The Contractor must maintain and repair the haul road and spoils area consistent to their own use, as well as, contributing to the overall shared maintenance and repairs for this area. The Contractor will provide flagmen to direct traffic anytime a vehicle makes a left-hand turn onto the haul road. The Contractor may only deposit clean fill in the SAMMC spoil area. Fill will be placed in (1) one foot lifts and compacted with a minimum of two passes of a soil compactor to achieve a minimum of 85% compaction. The Contractor shall test for compaction as directed by the Contracting Officer's Representative. Minimum testing is anticipated pending satisfactory performance. Clean fill is any material classified as a satisfactory material but can not contain roots and other organic matter. Concrete and asphalt rubble void of reinforcing steel, and rocks and stones no larger that (4) four inches in diameter. Clean fill shall not contain more than 100 parts per million (PPM) of total petroleum hydrocarbons (TPH) and not more than 10 PPM of the sum of benzene, toluene, ethyl benzene, and xylene (BTEX).

02050 Demolition - Any hand receipted items shall always be salvaged and turned over to the Defense Reutilization and Marketing Office (**DRMO**), located in Building 4195.

02051, 02080, 02091- General Hazardous Material Disposal procedures:

Standard procedures are as follows: Environmental Office will sign manifests for all material disposed off post. Materials of different types cannot be mixed in the same container. If there are any questions on this, call David Walker, Chief Environmental Compliance at 210-221-4967. While in use for collection at demo sites, waste containers must be properly marked, and closed and secured at all times when sites are not manned. It is suggested that no storage for over a week be allowed. The Contractor shall pay all landfill and disposal fees. The Contractor will pay asbestos removal charges to state. A survey will always be required for rehab or any projects involving building demo. Usually a building survey is done (upon start of a project) by the Fort Worth District team, DPW in-house forces, or an AE team. The survey and its results should be discussed with Environmental Management Office project manager during the concept design conference and all succeeding conferences, to ensure a clear scope of work and a clear understanding as to how all wastes are removed and disposed of. Disposal sites for clean debris (including uncontaminated concrete, soil, masonry and rubble) may be designated by DPW on large projects such as barracks rebuild. On any project with large amounts of waste soil, contact DPW for a disposal site. Building alteration specs and especially Division 2 specs such as Section 02051 should be carefully edited.

The following specific items are addressed:

1. Asbestos Containing Material (ACM)

a. All ACM waste being disposed of will be the Contractor's responsibility, DPW Environmental will sign manifests as has been standard procedure. In total demolition of buildings, mastic and floor tile (non-friable) must be disposed of properly by the Contractor.

b. All notifications of asbestos removal to the state shall be signed by Chief, DPW Environmental Compliance Office.

2. All lead-based paint waste being disposed off post is the Contractor's responsibility.

3. CPS Energy will check electrical equipment for polychlorinated biphenyls (PCB's) on an as needed basis. Any equipment, including light ballasts, found to contain PCB's will be disposed of by the DPW Environmental Office, Bldg. 4196. If ballasts are unmarked, they will have to be considered PCB contaminated and also turned over to the DPW Environmental Office.

4. Mercury containing bulbs (including most fluorescent) will be disposed of by the Contractor. Every effort must be made to keep from breaking - packing boxes are available which will help. The same will apply to thermostats containing mercury.

5. Regulated refrigerants in old refrigerators, compressors, etc. will be purged in accordance with state regulations and the refrigerant turned in to DPW Supply. Pre-arrangement for delivery of the refrigerant is required. Contact DPW Environmental Compliance Office for instructions.

6. If the presence of any unusual items such as tritium powered exit lights, cesium element smoke detectors, etc. is confirmed, contact DPW Environmental Compliance Office for instructions.

DPW Environmental Compliance Office POC – Chief David Walker, phone (210) 221-4967.

02222 Excavation, Trenching, and Backfilling for Utilities Systems

1. A tracer wire and marking tape shall be installed with all water, force main, and gas utilities service and distribution lines. Tracer wire shall be #10 direct burial solid copper. Tracer wires shall be installed below pipe and bedding, so wire is not disturbed during repairs. The tracer wire shall be continuous between valves, handholds, and manholes. The tracer wire shall surface at

each manhole, handhold, and valve box. A coil of at least one foot of wire shall be left in each manhole, and valve box. The tracer wire shall be tested and proved continuous prior to final inspection with DPW. Marking tape shall be color coded, installed 12" below grade, no foil or conductive backing. Comply with Encl. 4 for typical detail.

2. Grade 5 and Grade 6 crushed rock backfill may be used for backfill provided this material is installed in no more than 1 foot lifts and compacted with a vibrating plate. All backfill around manholes and valves shall be cohesive type. The cohesive material will allow any leakage of defective valves or joints to surface so they can be identified for repair.

02225 Earthwork

1. Do not allow stockpiling of any material or parking vehicles or equipment with tree drip lines. Provide for temporary fencing along outside perimeter of drip line, not 5’-0" from trunk.

02660 Water Lines

Water Meter Installation Requirements

A water meter will be required at each building or facility. Water meters will be equipped with electronic or radio frequency (RF) transmitters for remote monitoring. The method of remote monitoring via RF transmitters must be coordinated with the installation UMCS/EMCS system. Remote monitoring will be coordinated with the individual installation. To have all water meters reading back to a central location would be expensive and is not justified. The designer will consider the placing of selected or zoned water meters in the UMCS/EMCS system. The above guidance will be interpreted as meaning remote reading to a nearby location as in the case of water meters located within buildings, basements, or generally inaccessible areas. Such installations will provide remote reading capabilities to a convenient location outside the building or structure to simplify the reading of the meter.
Also see Specification 01 35 13 – SPECIAL PROJECT PROCEDURES FOR FORT SAM HOUSTON. Include FSH water metering instructions for the contractor.

Use of Reclaimed/Recycled Water

Water Purveyor: San Antonio Water Systems (SAWS) is the regulatory body governing the use of Reclaimed/Recycled Water. The recycled water definition applies to reclaimed, reuse, and non-potable water.

http://www.saws.org/Our_Water/recycling/handbook/index.shtml

All facilities designed for the use of Reclaimed/Recycled Water System shall follow Texas Commission of Environmental Quality (TCEQ) rules and regulations, Chapter 210 for the Use of Reclaimed Water, and Chapter 290 Rules and Regulations for Public Water Systems.

Additionally all facilities requiring the user of Reclaimed/Recycled Water will follow all rules and regulations set forth by the Water Purveyor (SAWS) as described in the San Antonio Water

Systems Recycled Water User Handbook, and San Antonio Water Systems Cross Connection Control and Backflow Protection Program. To obtain current SAWS Backflow documents go to http://www.saws.org/business_center/specs/

SAWS Reclaimed Water POC: Pablo Martinez 233-3673.

02685 Gas Distribution System

1. Provide a gas pressure regulator and meter detail. All buildings served, except family housing units, shall be metered. The meter shall have a valved bypass so if the meter is removed for servicing, the building can still be supplied with gas. Provide three quarter inch plugged taps on each side of the pressure regulator so the pressure regulator can be checked for proper operation.

2. Provide Poly valves in lieu of metal for underground gas valves.

3. CPS Energy will make the determination whether or not the distribution pressure gas service is sufficient to serve the proposed project. CPS Energy will indicate the location where the distribution pressure gas will be tapped.

4. A tracer wire and marking tape shall be installed with all gas service and distribution lines. Tracer wire shall be #10 insulated solid copper. Tracer wires shall be installed below pipe and bedding, so wire is not disturbed furring repairs. The tracer wire shall be continuous between valves, handholds and manholes. The tracer wire shall surface at each manhole, handhold, and valve box. A coil of at least one foot of wire shall be left in each handhold and valve box. Tracer wire shall come up at regulator 18 inches and wrap around riser for access. The tracer wire shall be tested and proved continuous prior to final inspection with CPS Energy. Marking tape shall be color coded, installed 12" below grade, foil backing is not necessary.

5. Provide anodeless riser to regulator.

6. Lines to regulators shall be not less than one inch.

7. Use PE rather than ferrous metal underground when feasible, to avoid requirement for cathodic protection. PE valves are available up to 8 inches – try to limit gas valves to 8 inch. Ensure valve boxes are at least 6 inches or larger to provide access for wrench.

8. Comply with Specification 01 35 13 – SPECIAL PROJECT PROCEDURES FOR FORT SAM HOUSTON. Include permanent site natural gas and CPS Energy requirements.

CPS Energy Gas POC: Mr. Daniel Davila (210)353-5845 drdavila@cpsenergy.com.

02720 Storm Drainage System

The minimum size culvert pipe under roads and entrances shall be 24 inches in diameter. DPW has determined that the smaller diameters are too difficult to clean when silted up.

02730 Sanitary Sewers

1. Minimize the use of sewer lift stations. If lift stations are required, provide a packaged unit assembled of coated metals that do not easily corrode. Provide an audible and visible alarm in case of a malfunction. In remote areas an FM signal shall be sent to DPW- coordinate with existing electronic systems. Make sure that the location of the lift station is accessible for DPW service trucks. If the location is remote and away from the main roads, provide a gravel surfaced road to the lift station.

2. If a drop manhole is needed, detail same on the bid documents. Use a drop manhole if the elevation change is more than 18 inches (per standard criteria).

3. Provide exact coordinates to an accuracy of six inches and invert elevation to an accuracy of one tenth foot for the sewer connection to the building. Provide this information on both the plumbing and civil drawings so the plumber and utility contractors are forced to talk to each other.

4. Use SDR-26 PVC pipe for sewer piping. Use PVC rather than ferrous metal underground, to avoid requirement for cathodic protection. ***Waiver required***

5. Minimum size sewer main is 8 inches. Variance of 6” sewer will be allowed if existing sewer pipe tie-in line is 6”.

6. Minimum 6 inch sewer connection to buildings so the maintenance personnel can jet rather than rod a plugged sewer line.

7. Provide two way cleanouts every 150 feet along a sewer branch connection from a building.

8. Provide two way cleanouts at the sewer building connection.

9. Provide a manhole at every change of direction of the sewer line and every 400 feet.

10. A tracer wire is not required with a sewer pipe system.

11. All sewer lines under buildings shall be PVC, SDR-26 in lieu of cast iron.

12. **Master Planer Sanitary Sewer POC: Mr. Robert “Bobby” Mengden (210) 233-3679 rmengden@saws.org.**

02752 - TELEVISION INSPECTION OF SEWERS – See file 11-TelevisionSewerSECTION02752

PART 1 – GENERAL

1.01 Scope of Work - This section shall apply to all internal building mains and to the public sewer system and covers the internal inspection of all sewers by a closed circuit television camera to observe the conditions in the sewer lines. The Sewer Inspection Contractor shall furnish all necessary material, labor, equipment, and services required for the internal inspection of 100% of the sewer lines, including but not limited to, all recording and playback equipment, material, and supplies. Inspections shall be performed in the presence of the Contracting Officer or his representative.

1.02 General - The Contractor shall determine by internal inspection the location, and condition within each sewer section. All the infiltration and/or inflow sources, structural defects, service connections, abnormal conditions, and other pertinent observations shall be recorded.

1.03 All inspections shall be witnessed by the Contracting Officer or his representative and be performed one manhole section at a time.

1.03 EQUIPMENT

1.01 The television camera used for the inspection shall be one specifically designed and constructed for such inspection. Lighting for the camera shall be suitable to allow a clear picture for the entire periphery of the pipe. The camera shall be of a 360 degree radial view design capable of operating in 100 percent humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing a minimum 700 line resolution video picture. Picture quality and definition shall be to the satisfaction of the Contracting Officers Representative and if unsatisfactory, shall be redone at the Contractor’s expense.

1.02 All videotapes shall be new in VHS format.

PART 2 – PRODUCTS (NOT USED)
PART 3 – EXECUTION

3.01 PROCEDURE

1. The camera shall be moved through the line in either direction at a uniform rate stopping when necessary to insure proper documentation of the sewer’s condition but in no case will the television camera be pulled at a speed greater than 30 feet per minute. Manual winches, power winches, TV cable, and powered rewinds or other devices that do not obstruct the camera view or interface with proper documentation of the sewer conditions shall be used to move through the sewer line. If, during the inspection, operation of the television camera will not pass through the entire section, the Contractor shall re-setup his equipment in a manner so that the inspection can be performed from the opposite manhole, or clean out.

2. Movement of the television camera shall be temporarily halted at each visible point of interest (service line, defects, etc.) so that the radial view camera may better examine each object.

3.02 Recording of Field Observations

1. Television Inspection Logs - Information obtained shall be recorded on internal inspection logs with a format furnished or approved by the Contracting Officer's Representative. The following information shall be recorded for each reach inspected:

Location and length of reach
Pipe size and material
Location and descriptions of service connections
Locations and descriptions of defects
Items video taped and/or photographed.

2. Photographs - Instant developing, 35mm or other standard size photographs of the television monitor or problem areas shall be taken by the Contractor upon the request of the Contracting Officer's Representative to document unusual, questionable, or severe conditions found during the course of the work.

3. Video Tape Recording - The purpose of tape recording shall be to supply a visual and audio record of the problem areas of the lines that may be replayed both daily and at future presentations by the Government. All video tape recordings shall be made at standard speed (SP) for maximum clarity. Slow motion or stop motion play back features shall be supplied at the option of the Contractor. All video tapes and logs are considered property of the Government and shall be submitted prior to release of retainage. The Contractor shall be responsible for all the repairs necessary.

4. The Contracting Officer's Representative to insure acceptability of work and record keeping procedures of the Contractor shall witness all television inspection.

02831 Fence, Chain-Link

1. Any modification to post perimeter security fencing will visually and structurally match fencing at the existing location of modification.

2. All temporary project site fencing shall be installed and maintained by the contractor.

02840 Traffic Signal Light System

Do not recommend or support any traffic signals.

Turfing / Sodding General: Include the following provisions See file 8-TurfingDBmin in specification ____ or statement of work paragraph _________

1. Establishment of Turf: This job will use organic horticultural practices. It is very important that all planting beds be well prepared and contain high levels of organic material such as peat moss, processed rotted bark, compost and lava sand and taxes green sand at the rate of 40-60 lbs per 100 sqft for drainage.

Top Soil

Within 5 days after receipt by the contractor of Notice to Proceed the contracting officer shall be notified of the off-site sources from which topsoil is available and all topsoil shall be approved by the contracting officer before stripping operation are begun. Topsoil shall be natural fertile friable soil having a textural classification of silt or clay loam and stripped from surface 4-to 6-inch layer of soil.

2. Landscaping: The planting season for trees, shrubs, and vines shall be from 1 January to 15 March; planting shall be accomplished during the first planting season or portion thereof but not less then 15 days following substantial completion of the building construction. Actual planting shall be performed during the specified period only when weather and soil conditions are suitable and in accordance with locally accepted practice as approved by the contracting officer. Deviation from the planting dates will be permitted only when approved in writing by the contracting officer, if planting must be done outside of the planting season the contractor shall notify the contracting officer and shall submit for approval, a schedule for special care and maintenance. And not less then 45 calendar days. Re-fertilizing shall commence not earlier then 5 weeks after commencement of maintenance and shall be completed not later then 3 days after commencement. No payment will be made for establishment of planting until all requirements for planting are adequately performed and accepted as determined by the contracting officer.

3. Site Stabilization - Establish permanent stabilization by turfing. Storm water control structures shall not be removed until establishment of permanent stabilization and approval of the COR. Final stabilization is established at the disturbed site when all soil disturbing activities at the site have been completed and a uniform perennial vegetative cover with a density of 70% of the native background vegetative cover for the area has been established on all unpaved areas and areas not covered by permanent structures, or other stabilization measures (such as riprap, gabions, or geotextile)

4. The turfing work shall be accomplished only when satisfactory results can be expected during PLANTING SEASON periods indicated. When conditions such as drought, excessive moisture, high winds, or other factors prevail to such an extent that satisfactory results are not likely to be obtained, the Contracting Officer may, at his own discretion, stop any phase of the work. The work shall be resumed only when, in the opinion of the Contracting Officer, the desired results are likely to be obtained. All turfing operations shall be conducted across the slope. Establishment of turf shall be accomplished on all unpaved, graded, and disturbed areas that are the result of the Contractor's operations and as specified herein.

5. MAINTENANCE OF TURFING WORK. The Contractor shall maintain all planted areas during the planting period and for an additional period of not less than 120 calendar days

following the final acceptance of an acceptable stand of turf, but no earlier than 120 calendar days following the completion of PLANTING SEASON and/or replanting operations if required. Maintenance shall consist of watering, replanting, mowing, maintaining existing grades, and repair of erosion damage.

6. Stand
A stand shall be defined as the planted area achieving a uniform live grass coverage having a density where the total bare spots do not exceed 2 percent of the total turfed area, bare spots are not larger than 6 inches square, and the grass is of a height sufficient to be capable of being mowed as specified in the mowing requirements contained in this contract.

7. Replanting
If, after the typical period a successful germination of a potential stand of grass is not present, the area shall be reseeded prior to the end of the planting season, or within the next 7 days after the 14-day germination period if after the plant season as specified.

8. Maintenance of Grades and Repair of Erosion Damage
It shall be the responsibility of the Contractor to maintain the original grades of the planted turf areas after commencement of planting operations and during the specified maintenance period. Any damage to the finished surface from Contractor's operations shall be promptly repaired. In the event erosion occurs from either watering operations or from rainfall, such damage shall be repaired within 10 days from the date of the noted damage. Ruts, ridges, tracks, and other surface irregularities shall be corrected and replanted where required prior to acceptance.

9. Mowing Lawn Areas:
Vegetation shall be kept under control by mowing. Any time that the weed or grass growth reaches a height of 4 inches, the areas shall be mowed. Mowing shall be done with approved mowing machines in such manner that will leave a vegetation height of between 2 inches and 2 1/2 inches.

10. WATERING (LAWN AREAS)
Watering shall be done on a regular basis to maintain healthy vigorous growth of grass and to avoid decline of the established turf. Watering shall continue as necessary until final acceptance. The contracting officer also may direct the contractor to water the turf areas as he deems necessary. The contractor shall avoid damaging adjoining areas when watering. He shall also take steps to avoid excessive water from getting on the pavement, walks or entering active work areas creating muddy work conditions. Mud that is tracked onto the pavement and or walks shall be cleaned up by the contracting officer.

Division 3:

Earthwork See File 7-ConstructionMinMtsReqTestFreq

Construction Minimum Materials Requirements and Testing Frequencies

03100 Structural Concrete Form Work

Do not detail or specify carton forms for the support of grade beams. This item had failed repeatedly at Fort Sam Houston due to the inferior quality of carton forms available in the area. Grade beam bottoms shall be formed in lieu of carton forms.

<u>Division 4:</u>

04200 Masonry

All design criteria shall abide by the Fort Sam Houston Installation Design Guide. All exterior design must be coordinated with / approved by the Fort Sam Houston Environmental and Natural Resources Preservation Architect.

Specifications will be edited to address the following:

1. Brick Industry Association-technical note 7- Water Penetration Resistance - Design and Detailing.
2. Brick Industry Association-technical note 7A- Water Penetration Resistance – Materials.
3. Brick Industry Association, Tech Notes - 7B - Water Penetration Resistance - Construction and Workmanship.
4. Brick Industry Association, Tech Notes - 28B - Brick Veneer/Steel Stud Walls.
5. Brick Industry Association, Tech Note - 18A - Accommodating Expansion of Brickwork
6. Brick Industry Association, Tech Note - 21B - Brick Masonry Cavity Walls – Detailing.
7. National Concrete Masonry Association (NCMA) - 2008 Concrete Masonry Standards.

<u>Division 5:</u>

05055 Welding, Structural

Requirements include a welding inspector to visually inspect and report all job welded joists, beams and moment connections.

05120 Structural Steel

1. Detail all moment connections; do not leave this item to the steel fabricator.

2. If moment connections are required above the foundation, use bolted rather than welded connections if possible.

3. Completely detail length and size of all welds.

4. Indicate location of all A325 bolts.

5. Indicate all framed openings on the structural drawings and the framing material size and shape.

Division 6:

No information in Division 6 at this time.

Division 7:

All design criteria shall abide by the Fort Sam Houston Installation Design Guide. All exterior design must be coordinated with / approved by the Fort Sam Houston Environmental and Natural Resources Preservation Architect.

Roofing – The following minimum specifications shall apply:

~~1.~~ Metal roof systems shall be a minimum 24 ga. Galvalume or other galvanized steel with a factory-applied type finish of 1.0 mil total thickness

2. Both Metal and membrane roofs shall have a 20 year "No Dollar Limit" warranty issued by a manufacturer that has been in the business a minimum of 10 years. All Metal Roofs should also have a 20 year Material (base metal) and Finish (paint) warranty from the manufacturer, along with a 2 year installation warranty from the roofing installer. It should also be required from the General Contractor to provide a 5-year "No Penal Sum Warranty" bond.

Specifications will be edited to address the following:

1. EIFS Industry Members Associate (EIMA) EIFS Standards of Design and Construction.

Division 8:

08700 Hardware

According to the Army Installation Design Standard, as of FY07 Programmable Electronic Key Card Access Systems must be included in projects for the following facility types: Unaccompanied Enlisted Personnel Housing, Transient Lodging, Officers Quarters, Operational Readiness Training Complexes, Battalion/Brigade Headquarters, Company Operations Facilities, Tactical Equipment Maintenance Facilities, and Administrative Buildings.

Per paragraph 3.5.11.3 of the Army Installation Design Standard, each Army installation will develop a master plan for the Electronic Key Card Access system. The master plan should specify that all buildings will use equipment from a single manufacturer so that there is consistency, compatibility, and sustainability across installed Electronic Key Card Access equipment. Each installation will be responsible for obtaining the appropriate sole source justification for their installation in coordination with the IMA region.

See the Army Installation Design Standard Paragraph 3.5.11 Locks and Locking Devices for reference to the electronic key card access system policy memorandum issued 14th December 2004.

All design criteria shall abide by the Fort Sam Houston Installation Design Guide. All exterior design must be coordinated with / approved by the Fort Sam Houston Environmental and Natural Resources Preservation Architect.

Division 9:

All design criteria shall abide by the Fort Sam Houston Installation Design Guide. All exterior design must be coordinated with / approved by the Fort Sam Houston Environmental and Natural Resources Preservation Architect.

Specifications will be edited to address the following:

1. ASTM C28 / C28M - 00(2005) Standard Specification for Gypsum Plasters.
2. ASTM C926 - 06 Standard Specification for Application of Portland Cement-Based Plaster.
3. ASTM C1177 / C1177M - 08 Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

Division 09510 Acoustical Ceilings (09 51 00)

FSH DPW prefers the use of 2’ x 2’ tegular ceiling tile. Tegular suspended ceiling panels have a reveal edge design that allows them to extend below the supporting grid, making the grid less conspicuous.

Division 10:

Fire Extinguishers (10 44 16)
1. Ensure that a sign with the building number and proper fire extinguishers are provided. FSH Fire Department will not provide fire extinguishers.

Division 14:

No information in Division 14 at this time.

Division 15: (Division 23)

15400 Plumbing, General Purpose (22 00 00)

1. A tracer wire and marking tape shall be installed with all water service, irrigation, and distribution lines. Tracer wire shall be #10 insulated solid copper. Tracer wires shall be installed below pipe and bedding, so wire is not disturbed during repairs. The tracer wire shall be continuous between valves, hand holes and manholes. The tracer wire shall surface at each manhole, handhold, and valve box. A coil of at least one foot of wire shall be left in each manhole, and valve box. The tracer wire shall be tested and proved continuous prior to final inspection of DPW. Marking tape shall be color coded, installed 12" below grade, foil backing is not necessary.

2. Provide a six inch shutoff valve with each fire hydrant.

3. If bollards are provided around a fire hydrant in a paved area, make sure they are spaced to allow the fireman to turn the hydrant on.

4. Provide a tamper switch with each fire main Post Indicator Valve (PIV), tamper switch shall be connected to building fire alarm panel, to activate a trouble alarm remote to main fire station, alarm shall be specific alarm if possible. If the PIV is located in a concrete pave area, show a electrical conduit routed under the pavement.

5. Preference is C-900 for 18" and smaller and ductile iron or CSC (Hanson) for 20" and larger. Do not want PE plastic pipe, reinforced thermosetting resin pipe, galvanized steel pipe or types of material unless the conditions warrant it. Our Maintenance personnel want to minimize the materials they have to repair and maintain and we have had a lot of success with the C900, CSC and ductile iron piping.

6. Provide isolation valves at underground tees of crosses. Example: At tees provide 2 valves at crosses provide 3 valves.

7. Use PVC rather than ferrous metal underground when feasible, to avoid requirement for cathodic protection. Ensure valve boxes are at least 6 inches or larger to provide access for wrench.

8. The Contractor shall identify recycle and potable water lines by color codes and posting signs IAW – TCEQ and SAWS.

9. BACKFLOW PREVENTERS are to be installed above grade in Hot Boxes. Although the TCEQ allows double check valve assemblies to be place underground under certain conditions (properly draining water tight vault and plugged test cocks), the Fort Sam Houston standard is to place all backflow devices above ground. Drains in vault can eventually clog and fill with water and plugs in the test cocks can leak. Backflow devices can be installed in a vault on a temporary basis, but must be installed above grade in a hot box for permanent installations.

10. Use gas equipment if the resulting design is more energy efficient.

11. Ultra Low flow urinals are required in all applicable facilities.

12. Install dedicated floor drains for HVAC equipment in mechanical rooms.

13. Install floor drains for normally wet areas such as dressing areas in physical fitness centers.

14. Install shut off valves to allow isolation of building areas.

15. Install ball valves on hot water return lines.

16. Fort Sam Houston has active expansive soils and will require specific design and construction provisions to prevent piping damage and failure due to pipe / building differential movement. The first design submittal shall indicate how piping systems will be protected against

damage or backfill due to soil heave (from penetration of slab to the 5 foot building line). Where underground piping will serve chillers, cooling towers, etc, the design shall include features to control forces, at the point of connection to the equipment, resulting from soil heave. Solutions should include, but not 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, piping should be suspended from the structure with adequate space provided below the pipe for the anticipated soil movement.

17. that pipe insulation in mechanical rooms and other rooms where pipe insulation may be damaged shall be protected up to 72 inches high with PVC or metal jacket.

18. Provide information for thermometers and pressure gauges and mention that temperature ranges and pressure guage ranges are to be indicated on the drawings in Paragragphs 5.6 and 5.8. Also provide information as to where thermometers and pressure gauges are to be located, i.e. heat exchangers, coils, boilers, pumps, etc.

19. Provide information on vibration isolation of plulmbing and mechanical systems

20. Provide a sentence in Paragraph 5.8 to provide warning tapes and tracer wiring above the piping for protection of the underground close circuit condensing water piping. Also add that the minimum depth of cover shall be 36-inches for the underground condenser water pipes.

HVAC Design Criteria (Division 23 00 00)

1. Build mechanical rooms with maintenance in mind. All valves and devices shall be at or near (4) feet off floor whenever possible. Show coil pull areas on the plans and pipe with union and valves and dismantling the piping system. Permanently mark piping with color coded identification of fluid carried and direction of flow. Do not put mechanical rooms below grade. Use large manually operated rollup doors where possible for equipment access to mechanical equipment. Plan for chemical treatment and backflow prevention.

2. Provide hard surface drive to each ground level, main mechanical room that is not accessible to a loading dock.

3. Provide all main mechanical rooms with floor sloped to a floor drain.

4. Use electronic/electric DDC controls that are Fort Sam Houston (FSH) Industrial Grade Direct Digital Control System (IGDDCS. Do not use pneumatic controls. Electric actuators are preferred. Use USACE Army Standard Control sequences rather than custom sequences. Comply with Specification 15954, FORT SAM HOUSTON HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) CONTROLS SYSTEMS DESIGN-BUILT MINIMUM REQUIRMENTS (GENERIC) (Reference Section 15954, 15990 & 15995)

5. The Contractor shall not install steam boilers unless for special requirements. The contractor shall avoid ceiling installations. All equipment shall be installed at ground level and should allow ample area to work on equipment.

6. Central plants with multiple cooling units are preferred, to permit loss of the largest unit while maintaining at least 65% design capacity. Where master plan calls for multiple buildings in an area, provide for later expansion of a central plant. Use chilled water for 150 ton and above (with stainless steel cooling tower when water cooled) rather than air cooled for under 150 ton units. Comply with ASHRAE 15 where refrigerant must be contained inside a building.

7. Use hot water generators/boilers for heat (multiple units in central plants) and gas-fired domestic water heaters – use onboard steam generators on equipment requiring steam (or a small steam boiler just for the year round steam load.).

8. Provide GFCI electrical outlet, hose connection and floor drain in mechanical rooms for use while performing maintenance.

9. Provide Lo-NOx hot water heaters and boilers in accordance with TCEQ Chapter 117 (NOx Guidance and Methods).

10. Contractor shall install completely accessible filter racks on all units.

11. Avoid exposed ductwork unless absolutely necessary. All ductwork shall be metal in accordance with SMACNA HVAC Duct Construction Standards.

12. Use exterior wrap insulation for maintenance purposes.

13. Prefer all HVAC systems are 4-pipe hydronic systems instead of 2-pipe systems.

14. Provide ducted return in lieu of door louvers, above ceiling (except in medical facilities) and equipment room plenums. Air quality and ventilation are becoming as important as temperature and humidity control. Care must be exercised in locating sources for outside air in relationship to gas regulator vents, generator and boiler flues, etc. (Sometimes code minimum clearances are not enough.)

15. Check the architectural design explicitly for maintaining a vapor barrier and insulation barrier around the insulation envelope of the building. Without a well constructed vapor barrier and building pressurization (0.05" wc) you will create an environment for growing mold.

16. Request that the Architect provide non-hygroscopic finishes and ceiling tile suitable for use in a 90% humidity environment. When thin wood veneers are used in the furniture finishes of the facility you must design carefully for high humidity control.

17. Perform additional part load analysis with indoor relative humidity greater than 55% as a failure criteria in addition to temperature control. Perform this analysis with the equipment that was sized to the normal 97.5% summer criteria but with the load analysis at moist spring and fall temperate conditions.

18. Install air compressors and air dryers under a shelter even though these items are rated to be outdoors.

15566 Warm Air Heating Systems (23 82 01)

1. Always use indirect fired make up air systems for Maintenance Shops rather than the direct fired.

2. Flues for gas fired equipment shall be in accordance with NFPA 54, concerning routing of flue piping when connecting flues from different sized equipment.

15650 Central Refrigeration Air-Conditioning System (23 66 00)

1. Provide freeze protection for all exposed piping and components for outdoor packaged chiller units.

2. The preferred water chiller unit is the outdoor packaged unit with the air cooled refrigerant condenser rather than the water cooled condensers; chilled water rather than DX. If 150 tons or more the preference is go to water cooled type.

3. Provide alarm/detection/exhaust/ventilation of refrigerant in mechanical rooms and confined spaces in accordance with ASHRAE 15 (Safety Code for Refrigeration). Do not use 123 refrigerant systems, use 134A refrigerant systems.

4. Single Zone draw through air handling units must have a preheat and a reheat coil. Provide supply air to the facility that will not create a high humidity condition during any season. Variable temperature chilled water single zone units are not acceptable without a reheat coil to prevent high humidity in spaces.

5. Variable temperature, variable air flow systems shall be provided only with humidity control. Variable volume, constant temperature systems are preferred due to the cold deck's ability to drop moisture from the air stream.

15935 Ventilation and Exhaust Systems (23 00 00)

1. Use centrifugal exhaust fans for maintenance shop ventilation rather than the vane axial fans. (Noise level max should be specified.)

2. Use power roof fans with back draft dampers rather than ridge vents for warehouse and vehicle maintenance shops. The ridge vents allow too much infiltration and fail to close during the winter time.

3. Assure that all maintenance pits in the vehicle maintenance shops have exhaust to rid the pit of fumes.

4. Provide explosion proof power exhaust for all battery rooms interlocked with battery chargers. If the exhaust is not operating the battery chargers cannot be energized. Prefer collection hoods for battery charging areas rather than area exhaust.

5. Provide ventilation in accordance with ASHRAE 62 (Ventilation for Acceptable Indoor Air Quality) with special attention to the outdoor air source and controlled relief.

SECTION 15954 Heating, Ventilation and Air Conditioning (HVAC) Control Systems (23 09 33.00 40)

Comply with Specification 15954 FORT SAM HOUSTON HEATING, VENTILATION, AND AIR CONDITIONING (HVAC) CONTROLS SYSTEMS DESIGN-BUILT MINIMUM REQUIRMENTS (GENERIC) (Reference Section 15954, 15990 & 15995)

SECTION 15990 Testing and Air Balancing

Provide Testing, Adjusting and Balancing (TAB) in accordance with National Environmental Balancing Bureau (NEBB) on all mechanical systems greater than 5 tons.

SECTION 15995 Commissioning:

Provide Commissioning on all mechanical systems greater than 10 tons.

Division 16: (Division 26)

Comply with Specification 01 35 13 – SPECIAL PROJECT PROCEDURES FOR FORT SAM HOUSTON   Includes permanent site electrical and CPS Energy requirements.

16370 Electrical Distribution Systems, Underground

1. Use minimum ¾” ground rods.

2. All underground primary is to be encased in conduit and concrete with color coded PE secondary use marker tape, minimum 12 inches below finished grade, except in isolated areas.

3. All underground communications is to be encased in conduit and concrete with marker tape, minimum 12 inches below finish grade.

4. CATHODIC PROTECTION: The contractor shall utilize the services of a professional Corrosion Engineer for the design of the cathodic protection systems for all underground systems. A certified/stamped report by the Corrosion Engineer shall be submitted with the first design submission indicating methods proposed for protection of each system (solutions shall be

in accordance with NACE guidelines). Final solutions shall be coordinated with the installation to insure a common approach is accomplished.

16415 Electrical Work Interior (26 20 00)

1. Provide a 15% space/spare for electrical panels. The panels always have circuits added during and after construction.

2. Investigate the need for parallel conductors. If parallel conductors are used from the main switchgear or switchboard to distribution panel boards, etc. or from the distribution panel boards to branch circuit panels, provide design guidance to assure that the panel board gutter space is large enough to handle the conductors. Standard panels sized with a gutter to match only the size of largest breaker may not accommodate a panel that has numerous parallel circuits.

3. Conductors indicated to be No. 6 AWG or smaller diameter shall be copper. Conductors indicated to be No. 4 AWG and larger diameter shall be either copper or aluminum, unless type of conductor material is specifically indicated, or specified, or required by equipment manufacturer.

a. The use of aluminum conductors in mission critical facilities, dormitories, officers' housing, and transient living facilities is limited to service entrance conductors only, sizes No. 4 AWG and larger.

b. Aluminum conductors shall be AA-8000 series electrical grade aluminum alloy conductors. Type EC/1350 aluminum is not acceptable. Should Contractor choose to provide aluminum for conductors No. 4 AWG and larger diameter, Contractor shall be responsible for increasing conductor size to have same ampacity as copper size indicated; increasing conduit and pull box sizes to accommodate larger size aluminum conductors in accordance with NFPA 70; ensuring that pulling tension rating of aluminum conductor is sufficient; providing panel boards [and motor control centers] that are UL listed for use with aluminum, and so labeled; relocating equipment, modifying equipment terminations, resizing equipment; and resolving problems that are direct results of providing aluminum conductors in lieu of copper.

4. Provide a safety disconnect at all motor driven equipment. The disconnect must conform to code requirements and shall normally be mounted adjacent to the motor. The Contractor shall install phase protection on all motor driven equipment.

5. Provide an equipment grounding conductor in all raceways. Do not use the conduit as the equipment grounding conductor.

6. Indicate on the contract drawings an equipment grounding and grounded electrode conductor schematic. Show bonding jumpers between the structural steel, copper water supply and ground rod(s).

7. Do not provide more than 3 circuits per conduit.

8. Use circuit breakers made specifically for high intensity discharge lighting (HID Type).

9. All interior lighting shall conform to UFGS 26 51 00 (Interior Lighting).

10. Off-hour and exterior lighting will by eliminated, except when it is essential for safety and security purposes as required by AR 190-11.

16721 Fire Detection and Alarm Systems (21 00 00)

1. The primary fire protection criteria reference for all DOD facilities is the UFC 3-600-01.

2. Fort Sam Houston Fire and Emergency Services (FSHF&S) utilizes the Monaco D-21 receiver system.

3. All fire protection systems shall use the Monaco BT-XF RF transceiver or USACE approved equivalent.

4. All fire protection devices must be addressable.

5. All fire protection panels and devices shall be keyed alike using a “B” Key.

6. Heat detector policy is established as Fixed Temp only. Rate of rise is not authorized for use on Fort Sam Houston. Corrosive resistant heat detectors will be used in boiler rooms and other wet areas, or areas subject to corrosive atmospheres.

7. Duct smoke detectors shall be provided in supply and return air ducts in accordance with NFPA 90A. Duct smoke detectors shall conform to the requirements of UL 268A. Duct smoke detectors shall have perforated sampling tubes extended into the air duct. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have manual reset. Detectors shall be rated for air velocities that include air flows between 500 and 4000 fpm. Detectors shall be powered from the HVAC control panel. Detectors shall have two sets of normally open alarm contacts and two sets of normally closed alarm contacts. Detectors shall be connected to the building fire alarm panel for alarm initiation.

8. A Knox box shall be provided for each new facility. The location of the Knox box shall be determined by the Fort Sam Houston Fire Department; generally the location will be immediately adjacent to the closest entrance to the building from the fire lane. The following features shall be included:
a. Adequate room for all master keys for the facility, including but not limited to fire alarm and mass notification keys.

b. Flush mounted.

c. Hinged lid.

d. Tamper switches connected to the fire alarm system; activation of these switches shall transmit a supervisory signal through the Monaco to the supervising station.

e. Dark bronze finish.

f. Knox-Vault 4400 Series (Single Lock Model).

9. Fire Department (Emergency) Vehicle Access

a. All-Weather Ground Access. All buildings greater than 465 m (5,000 sq ft), or more than two stories in height must have at least one means of all-weather ground access to allow emergency vehicles unimpeded access to the building. All-weather ground access must be paved, start from the road, and terminate no farther than 10 m (33 ft) from the building.

b. Exception: An engineered all-weather surface that is not paved may be provided if approved by the AHJ.

c. Access to Residential Facilities - Residential facilities must be provided with all-weather ground access to 3 sides, with a minimum of 2 sides having access to sleeping rooms.

d. Vehicle Access - All force protection equipment, such as bollards or gates, must not require more than one person to remove or open. Access may require fire apparatus to drive over a curb. Any locking device controlling vehicle access must be under control of the Fire Department or 24-hour security personnel located at the specific facility. Dimensions of fire lanes and turnarounds must comply with NFPA 1, Uniform Fire Code.

e. Aerial Apparatus Access - New facilities four stories or more in height and all new warehouses must be provided with suitable all-weather ground access surface for aerial apparatus on a minimum of two sides of the perimeter of the structure.

f. Fire Department Connection - Facilities with fire department connections for sprinkler or standpipe systems must be provided with suitable all-weather ground access surface for pumper apparatus within 45 m (150 ft) of such fire department connections.

10. Roof Access - All enclosed exit stairs that extend to the top floor in any building three or more stories in height must have, at the highest point of the stair tower, an approved hatch opening to the roof with an appropriate ladder that conforms to 29 CFR 1910.27, *Fixed Ladders*. The hatch must be not less than 1.5 m^2 (16 ft^2) in area, with a minimum dimension of 610 mm (2 ft). At least one stairway must terminate at a standard door opening leading onto the roof surface, unless the roof has a slope greater than 4 in 12.

16742 Telephone System, Outside Plant (33 82 00)

1. Comply with Specification 01 35 13 – SPECIAL PROJECT PROCEDURES FOR FORT SAM HOUSTON. Include FSH DOIM requirements and DOIM/Construction Contractor separation of work.

2. The Contractor shall provide 4" concrete enclosed conduits for incoming communications. The number of conduits required can be determined by the following:

- a.) 2 each 4" conduits for 0-100 occupants
- b.) 4 each 4" conduits for 100-200 occupants
- c.) 6 each 4" conduits for 200-400 occupants
- d.) 9 each 4" conduits for 400-700 occupants
- e.) 12 each 4" conduits for 701 + occupants

3. The conduits shall extend from the existing/new communications manhole to the new Main Telecommunications Room (MTR). The Contractor shall core and drill and completely seal all conduit penetrations. The Contractor shall provide pull wires in all empty conduits.

4. The Contractor shall contact DOIM at (210) 221-4374 for approval of the exact locations and orientation of conduit penetrations within the existing manholes prior to starting work.

16743 Local Area Network Signal distribution System

1. The D/B Contractor shall coordinate UMCS data equipment with the USACE PM/DPW and DOIM prior to procuring equipment (IP Scheme, compatible equipment and routing).

2. The D/B Contractor shall provide and install the building premise distribution system in accordance with the following:

a) New installations must be compatible with Fort Sam Houston ITBC standards and architecture.

b) All outlets will be terminated on 8 pin RJ45 jacks on surface or flush mounted outlet boxes and on RJ45 patch panels in the MTR/TR.

c) MTR/TR premise distribution will include all associated equipment in each: e.g. patch panels (RJ45), 110 punch-down blocks, fiber patch panels (w/FC connectors), equipment racks, grounding, wire management, Protect Entrance Terminal (PET), fire retardant communications backboard(s), etc.

d) Cabling and infrastructure from the MTR to each supporting TR (e.g. cable trays and conduit, tie/riser cables, etc).

e) Cabling and equipment from each TR to the wall outlets specified by the user.

f) Data/voice jumpers/patch cords from wall outlet to the computer & phone locations. Routing or placement of communications jumpers through systems furniture in classrooms modular office furniture as required.

g) Labeling and tagging scheme used throughout project will be, labeled: room number, jack number and port letter. All outlets will be labeled A&B for voice C&D for data, unless otherwise specified. If quad drop ports are all data, ports will be labeled C, D, E, F (TIA/EIA-606).

3. The D/B Contractor shall provide and install the proper sized fiber optic patch panels to support fiber strand count, e.g. 48 strands single mode fiber would require a 48 port fiber optic patch panel.

4. The Contractor shall provide and install the Protected Entrance Terminal(s) (PET) with sufficient ports to support the building occupants. Contractor shall provide and install 110 punch-down blocks, sized to support the PET. The Contractor shall provide cross-connect wiring (bulk) for PET to 110 punch-down blocks (the DOIM will terminate cross-connects). The Contractor will provide and install Riser cabling from 110 punch-down blocks to voice patch panels (the DOIM will terminate jumpers).

5. The D/B Contractor shall provide and install floor mounted 7' high racks with wire management, ladder trays, cable rack & Velcro banding in each communication room. Each rack shall have a Fiber Optic Patch Panel (FOPP) with FC connections. DOIM will provide and install switch and UPS for each rack.

6. Contractor shall install one 220VAC 30 AMP circuit in the primary rack and one quad outlet, 120VAC in each secondary rack to provide power for DOIM installed electronic equipment. Outlet placement will be on the bottom of the racks (attached to support rail).

7. The D/B Contractor shall install and terminate all premise wiring (fiber and copper risers between TRs, voice and data outlets to patch panels, etc).

8. The D/B Contractor shall provide, install, and test all Contractor installed cable and equipment. All cable/equipment test results will be given to the DOIM appointed POC.

9. After final Contractor testing, the DOIM will provide and install the cable from existing manhole to new MTR room. The DOIM will coordinate with the USACE PM and contractor prior to building entrance. DOIM will terminate the incoming government copper to the Contractor furnished PET and will perform the final cross-connections and jumpers to the patch panels. The incoming government fiber will be terminated by the DOIM on a Contractor furnished FOPP using Contractor furnished LC connectors. DOIM will install Contractor furnished LC to MTRJ jumpers to switch and Contractor furnished FOPP. Contractor will provide LC to LC jumpers for premise distribution patch panel(s).

Building Telecommunications Cabling System (27 10 00)

1. The D/B Contractor shall coordinate final design through the USACE Project Manager with the Fort Sam Houston Director of Information Management (DOIM) Project manager prior to final design acceptance.

2. The Fort Sam Houston Directorate of Information Management (DOIM) shall be responsible for all Outside Plant cabling (Fiber Optic and Copper) installation and termination. The DOIM will also be responsible for the following communications work in support of this project:

a) Procurement, configuration and installation of special circuits, e.g. ICIDS III, ISDN, etc.

b) Installation/cross connection of fiber optic/copper jumpers from the premise distribution system to building demarcation and at the servicing telecommunication/data switch node.

c) Procurement, programming and installation of telephone devices.

d) Procurement, configuration and installation of network wired and wireless (LAN) electronic equipment.

3. All wiring/cabling and equipment used shall conform to the approved, current industry standard (CAT-6 or what is approved at time of contract signing).

4. All specifications shall conform to TIA/EIA-568-B Wiring Standards and/or I3A communications infrastructure standards.

5. System should be designed by individual that is a Registered Communications Distribution Designer (RCDD).

6. The grounding of the communications shall be in accordance with TIA/EIA 607A.

Telecommunications Rooms (TRs) within building(s):

1. There shall be a minimum of one communications room per floor (more may be required depending on the size of the structure provided per I3A standard - 10k sq ft) and all communications rooms will be stacked (2^{nd} floor is above 1^{st} floor communication room….).

2. The size of the communications room shall meet the requirements of I3A (total 1.1% of building GSF). As a minimum 70 sq ft with the main TR being at least 110 sq ft.

3. Maximum distance for cable runs shall be 295 feet, end device to cross-connect jumper. Cable runs longer than 295 feet require an intermediate distribution point with electronics and fiber connection to the main building hubs (PET and Fiber Optic Patch Panel).

4. Each DOIM telecommunications room shall be equipped with a phone jack.

5. All mechanical rooms shall be supplied with a single phone jack. Provide a separate data connection for the HVAC to the UMCS that will be connected to the UMCS system.

6. Communications connections shall be provided from all elevators to the appropriate MTR/TR.

7. Each DOIM telecommunications room will be equipped with a network (cipher) lock enabling remove authentication and access. The network lock will be compatible with the FSH lock system and provide for both PIN input and keyed access.

8. The contractor shall provide the appropriate number of patch cords, 6’ in length, for each outlet.

9. Comply with Specification 01 35 13 – SPECIAL PROJECT PROCEDURES FOR FORT SAM HOUSTON. Include FSH DOIM requirements and DOIM/Construction Contractor separation of work.

Commercial/Customer Communications Room

1. Demarcation for commercial service shall be in a physically separate communications room outside the official Government TR.

2. The D/B Contractor shall provide secure space or commercial closet for all CCTV equipment. Space for Commercial service or customer equipment shall be provided outside official Government communication room.

3. The D/B Contractor shall engineer and integrate into construction plans, a complete Access Control and CCTV system distribution design. The design will include, but will not be limited too identification of proposed access control stand-a-lone/networked devices (locks) and CCTV equipment locations; for work requiring data/video transport, all supporting conduit and pull box (work box) locations, size and number of conduits to be installed. Conduits should be engineered to terminate in a secure closet (not in the Official MTR/TR). Additional conduit(s) should be design to extend cabling from the secure closet to the Watch or Charge of Quarters (CQ) desk location. CCTV and access control devices and cabling to be installed by others.

4. Provide minimum of 2 - 2” conduits, underground through floor slab, for commercial cable TV/telephone. It shall be installed from commercial/utility closet and extend five (5) feet beyond the exterior face of the building (approved by the COR). All ducts shall be capped on the exterior and fire stopped on the interior of the building. Exterior building placement (stub out) shall be marked with a metallic end location.

5. The Contractor shall provide wire way, pull string and necessary work boxes for all door access points.

16794 Coaxial Cable Data Transmission Media (27 05 14.00 10)

1. Fort Sam Houston has a privatized, contractor run commercial cable TV network. Cable is RG6. Terminate at jack on standard TV outlet. Place termination equipment in rack or on back board.

2. Contractor will provide secure space or commercial closet for all commercial cable TV equipment. No commercial cable TV or customer related equipment will be housed in the official MTR/TR.

3. Provide minimum of 2 - 2” conduits, underground through floor slab, for commercial cable TV/telephone. It shall be installed from commercial/utility closet and extend five (5) feet beyond the exterior face of the building (approved by the COR). All ducts shall be capped on the exterior and fire stopped on the interior of the building. Exterior building placement (stub out) shall be marked with a metallic end location.

Mass Notification (28 31 76)

1. Mass Notification is required in all new inhabited, primary gathering, and billeting buildings.

2. Mass notification is required in some existing buildings when implementing a project exceeding the replacement cost threshold specified in UFC 4-010-01.

3. The mass notification shall be connected to the fire alarm and detection system in accordance with the UFC 4-021-01.

4. Battery standby shall meet or exceed the requirements for the fire alarm and detection system. If no criteria are provided for the fire alarm and detection system, then standby and alarm time described in UFC 4-021-01 shall govern.

5. The design and installation of a mass notification system shall meet the criteria described in UFC 4-021-01 as well as be capable of integrating with the Fort Sam Houston Area Mass Notification System (Giant Voice)

    Manufacturer: Federal Signal Corporation
    Control Unit – SS2000 encoder
    UltraVoice Controller (controller module, amplifiers, and battery cabinet)
    DPTMS POC: Don Wyman 210-221-0935

6. The local operator consol (LOC) shall be mounted in a publicly accessible area and shall not be keyed. The microphone shall have a key to operate switch.

7. The LOC shall have the capacity for a minimum of eight (8) pre-recorded messages to be activated using individual manual push buttons.

8. The HVAC emergency off button shall be located in the LOC and shall shut off all incoming fresh air into the building.

9. Mass notification equipment shall be installed in the communications room whenever possible.

10. The mass notification equipment shall be keyed alike, using CAT-15.

11. The mass notification shall be preprogrammed with the standard messages for Fort Sam Houston. These messages shall be obtained from the Contracting Officer.

12. Provide one (1) - 1”conduit to from each mass notification panel (or fire alarm/mass notification panel if combined) to the telecommunication cable-tray or telecommunication room for future connection to the base-wide control system.

13. The control panels and building notification devices for the mass notification system and the fire alarm system may be integrated to form one combined system that performs both functions in accordance with currently anticipated revisions to the UFC.

14. Provide one (1) – 1" conduit from the mass notification panel to the fire alarm panel (not needed if fire alarm/mass notification integrated into one panel) for future connection to the base-wide control system.

Appendix EE

Section 23 09 23.00 10

SECTION 23 09 23.00 10

HEATING, VENTILATING AND AIR CONDITIONING (HVAC) CONTROL SYSTEMS
FORT SAM HOUSTON (FSH)
INDUSTRIAL GRADE DIRECT DIGITAL CONTROL SYSTEM (IGDDCS)

07/07

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.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 500-D	(1998) Laboratory Methods of Testing Dampers for Rating

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.15	(1990) Solid-State Demand Registers for Electromechanical Watthour Meters

ASME INTERNATIONAL (ASME)

ASME B40.100	(2006) Pressure Gauges and Gauge Attachments

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 142	(1991; Err 2006) Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book (Color Book Series)
IEEE Std 802.3	(2005; R 2006) Standard for Information Technology Telecommunications and Information Exchange Between Systems Local and Metropolitan Area Networks Specific Requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications
IEEE C62.41	(1991; R 1995) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 61131-3	(2003) Programmable Controllers - Part 3: Programming Languages

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ST 1	(1988; R 1994; R 1997) Specialty Transformers (Except General Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005; TIA 2005) National Electrical Code
NFPA 90A	(2002; Errata 2003; Errata 2005) Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 268A	(1998; Rev thru Apr 2006) Smoke Detectors for Duct Application
UL 508	(2005) Standard for Industrial Control Equipment

1.2 GENERAL REQUIREMENTS

The heating, ventilating and air-conditioning (HVAC) control system shall be the Fort Sam Houston (FSH) Industrial Grade Direct Digital Control System (IGDDCS). The IGDDCS is a Programmable Logic Controller (PLC) based system. The IGDDCS system shall be a complete system suitable and intended for HVAC system control. All individual building Energy Monitoring and Control Systems (EMCS) employing the IGDDCS shall be locally networked to the postwide Utility Monitoring and Control System (UMCS) Front End, located in Bldg. 4196, via Ethernet TCP/IP over various protocols. The system shall me compatible with and capable of being monitored and controlled by the Fort Sam Houston postwide UMCS system. The postwide UMCS Front End operating software is RS View, Version 4.0 by Rockwell.

1.2.1 Nameplates, Lens Caps, and Tags

Nameplates and lens caps bearing legends as shown and tags bearing device-unique identifiers as shown shall have engraved or stamped characters. A plastic or metal tag shall be mechanically attached directly to each device or attached by a metal chain or wire. Each airflow measurement station shall have a tag showing flow rate range for signal output range, duct size, and identifier as shown.

1.2.2 Verification of Dimensions

The Contractor shall become familiar with all details of the work, shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

1.2.3 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required.
The Contractor shall carefully investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, shall arrange such work accordingly, and shall furnish all work necessary to meet such conditions.

1.2.4 Power-Line Surge Protection

Equipment connected to ac circuits shall be protected from power-line surges. Equipment protection shall meet the requirements of IEEE C62.41. Fuses shall not be used for surge protection.

1.2.5 Surge Protection for Transmitter and Control Wiring

IGDDCS system control-panel equipment shall be protected against surges induced on control and transmitter wiring installed outside and as shown. The equipment protection shall be tested in the normal mode and in the common mode, using the following two waveforms:

a. A 10-microsecond by 1,000-microsecond waveform with a peak voltage of 1,500 volts and a peak current of 60 amperes.

b. An 8-microsecond by 20-microsecond waveform with a peak voltage of 1,000 volts and a peak current of 500 amperes.

1.2.6   System Overall Reliability Requirement

The system shall be configured and installed to yield a mean time between failure (MTBF) of at least 40,000 hours. Each IGDDCS panel shall be designed, configured, installed and programmed to provide for stand alone operation with minimal performance degradation on failure of other system components to which it is connected or with which it communicates.

1.2.7   Control Panel Enclosures

All control panel enclosures will be rated NEMA4 (splashdown). All enclosures will be provided with a lockable handle keyed to FSH requirements. Control Panel size and configuration shall be as deemed necessary by FSH for the intended application.

1.2.8   Multiple IGDDCS Panel Requirement

Where the system to be controlled by the IGDDCS system is located in multiple mechanical rooms, each mechanical room shall have at least one IGDDCS control panel.

IGDDCS control panels shall be located in the same room as the equipment being controlled or in an adjacent space which has direct access to the equipment room. IGDDCS control panels shall not control equipment located in a different mechanical room.

Each building Main Mechanical Equipment Room shall be furnished with a Color Touch Screen, equal to Allen-Bradley PanelView Plus 1000 Color Touchscreen, with full monitoring and control capabilities for the respective building HVAC system.

1.2.9   System Accuracy and Display

The system shall maintain an end-to-end accuracy for 1 year from sensor to operator's console display for the applications specified and shall display the value as specified. Each temperature shall be displayed and printed to nearest 0.1 degree F.

1.2.9.1   Space Temperature

Space temperature with a range of 50 to 85 degrees F plus or minus 0.75 degree F for conditioned space; 30 to 130 degrees F plus or minus 1 degree F for unconditioned space.

1.2.9.2   Duct Temperature

Duct temperature with a range of 40 to 140 degrees F plus or minus 2 degrees F.

1.2.9.3   Outside Air Temperature

Outside air (OA) temperature with a range of minus 30 to plus 130 degrees F plus or minus 2 degrees F; with a subrange of 30 to 100 degrees F plus or minus 1 degree F.

1.2.9.4   Water Temperature

Water temperature with a range of 30 to 100 degrees F plus or minus 0.75 degree F; the range of 100 to 250 degrees F plus or minus 2 degrees F; and water temperatures for the purpose of performing Btu calculations using differential temperatures to plus or minus 0.5 degree F using matched sensors.

1.2.9.5   High Temperature

High temperature with a range of 200 to 500 degrees F plus or minus 2.0 degrees F.

1.2.9.6   Relative Humidity

Relative humidity with a range of 20 to 80 percent plus or minus 6.0 percent of range (display and print to nearest 1.0 percent).

1.2.9.7   Pressure

Pressure with a range for the specific application plus or minus 2.0 percent of range (display and print to nearest psi).

1.2.9.8   Flow

Flow with a range for the specific application plus or minus 3.0 percent of range, and flows for the purpose of thermal calculations to plus or minus 2.0 percent of actual flow (display and print to nearest unit, such as gallons per minute).

1.2.9.9   KWh and kW Demand

KWh and kW demand with a range for the specific application plus or minus 1.0 percent of reading (display and print to nearest kWh or kW).

1.2.9.10   Analog Value Input

An analog value input to the system's equipment via an AI with a maximum error of 0.50 percent of range, not including the sensor or transmitter error. This accuracy shall be maintained over the specified environmental conditions.

1.3   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. The following shall be submitted in accordance with 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

HVAC Control System

Drawings shall be on full-size (34-inch by 22-inch) sheets in the form and arrangement shown. The drawings shall use the same abbreviations, symbols, nomenclature and identifiers shown. Each control-system element on a drawing shall have a unique identifier as shown. All HVAC Control System Drawings shall be delivered together as a complete submittal. Deviations shall be approved by the Contracting Officer. Drawings shall be submitted along with Submittal Description SD-03 Product Data.

HVAC Control System Drawings shall include the following:

Sheet One: Drawing Index, HVAC Control System Legend
Sheet Two: Valve Schedule, Damper Schedule
Sheet Three: Not used
Sheet Four: Control System Schematic and Equipment Schedule
Sheet Five: Sequence of Operation and Data Terminal Strip Layout
Sheet Six: Control Loop Wiring Diagrams
Sheet Seven: Motor Starter and Relay Wiring Diagram
Sheet Eight: Communication Network and Block Diagram
Sheet Nine: DDC-PLC-PLC Panel Installation and Block Diagram

Repeat Sheets Four through Seven for each AHU System

The HVAC Control System Drawing Index shall show the name and number of the building, military site, State or other similar designation, and Country. The Drawing Index shall list all HVAC Control System Drawings, including the drawing number, sheet number, drawing title, and computer filename when used.

The HVAC Control System Legend shall show generic symbols and the name of all devices shown on the HVAC Control System Drawings.

The Valve Schedule shall include each valve's unique identifier, size, flow coefficient (Cv), pressure drop at specified flow rate, spring range, actuator size, close-off pressure data, dimensions, and access and clearance requirements data. Valve schedules may be submitted in advance but shall be included in the complete submittal.

The Damper Schedule shall contain each damper's and each actuator's identifier, nominal and actual sizes, orientation of axis and frame, direction of blade rotation, spring ranges, operation rate, locations of actuators and damper end switches, arrangement of sections in multi-section dampers, and methods of connecting dampers, actuators, and linkages. The Damper Schedule shall contain actuator selection data supported by calculations of the torque required to move and seal the dampers, access and clearance requirements. Damper schedules may be submitted in advance but shall be included in the complete submittal.

The HVAC Control System Schematics shall be in the form shown, and shall show all control and mechanical devices associated with the HVAC system. A System Schematic drawing shall be submitted for each HVAC system.

The HVAC Control System Equipment Schedule shall be in the form shown. All devices shown on the drawings having unique identifiers shall be referenced in the Equipment Schedule. Information to be included in the Equipment Schedule shall be the Control Loop, Device Unique Identifier, Device Function, Set point, Input Range, and additional important parameters (i.e. output range). An Equipment Schedule shall be submitted for each HVAC system.

The HVAC Control System Sequence of Operation shall reflect the language and format of this specification, and shall refer to the devices by their unique identifiers as shown. No operational deviations from specified sequences will be permitted without prior written approval of the Contracting Officer. Sequences of Operation shall be submitted for each HVAC Control System including each type of terminal-unit control system.

The HVAC Control System Wiring Diagrams shall be functional wiring diagrams which show the interconnection of conductors and cables to HVAC control panel terminal blocks and to the identified terminals of devices, starters and package equipment. The wiring diagrams shall show all necessary jumpers and ground connections. The wiring diagrams shall show the labels of all conductors. All sources of power required for HVAC control systems and for packaged-equipment control systems shall be identified back to the panel-board circuit breaker number, HVAC system control panel, magnetic starter, or packaged equipment control circuit. Each power supply and transformer not integral to a controller, starter, or packaged equipment shall be shown. The connected volt-ampere load and the power supply volt-ampere rating shall be shown. Wiring Diagrams shall be submitted for each HVAC control system.

Commissioning Procedures:

The Commissioning Process for both the building HVAC Control System and the Post-wide UMCS Front End, located in Bldg. 4196, shall be conducted simultaneously with contact and communications between the IGDDCS being commissioned in respective building or buildings and the UMCS Front End in Bldg. 4196. It shall be the responsibility of the HVAC Controls Contractor to furnish two qualified HVAC Controls Systems Technicians' for the commissioning process. One technician shall be physically located in the UMCS Front End screen viewing area with the second tech in the building being commissioned at various locations as required to document the HVAC Controls systems response to demands given. It shall be the responsibility of the technician to make adjustments to dampers, valves, actuators, switches and linkage as required to furnish an HVAC Systems that is fully operational.

Six copies of the HVAC Control System Commissioning Procedures, in booklet form and indexed, 60 days prior to the scheduled start of commissioning. Commissioning Procedures shall be provided for each HVAC control system, and for each type of terminal-unit control system. The Commissioning Procedures shall reflect the format and language of this specification, and refer to devices by their unique identifiers as shown. The Commissioning Procedures shall be specific for each HVAC system, and shall give detailed step-by-step procedures for commissioning of the system.

The Commissioning Procedures shall include detailed, product-specific set-up procedures, configuration procedures, adjustment procedures, and calibration procedures for each device. Where the detailed product-specific commissioning procedures are included in manufacturer supplied manuals, reference may be made in the HVAC Control System Commissioning Procedures to the manuals.

Commissioning Procedures Equipment List shall be included that lists the equipment to be used to accomplish commissioning. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

Performance Verification Test Procedures;

Six copies of the HVAC Control System Performance Verification Test Procedures, in booklet form and indexed, 60 days before the Contractor's scheduled test dates.

The Performance Verification Test Procedures shall refer to the devices by their unique identifiers as shown, shall explain, step-by-step, the actions and expected results that will demonstrate that the HVAC control system performs in accordance with the sequences of operation, and other contract documents.

An HVAC Control System Performance Verification Test Equipment List shall be included that lists the equipment to be used during Performance Verification Testing. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

SD-03 Product Data

General Equipment Requirements

Electrical and Electronic Equipment
Tubing
Wiring
Actuators
Automatic Control Valves
Dampers
Smoke Detectors
Instrumentation
Thermostats
Pressure Switches and Solenoid Valves
Indicating Devices
Control Devices and Accessories
Field Equipment Panel Hardware
Field Equipment Panel Software
Central Operator Workstation Human Machine Interface (HMI)
LAN Equipment
Equipment Compliance Booklet

The HVAC Control System Equipment Compliance Booklet (ECB) shall be in booklet form and indexed, with numbered tabs separating the information on each device. It shall consist of, but not be limited to, data sheets and catalog cuts which document compliance of all devices and components with the specifications. The ECB shall be indexed in alphabetical order by the unique identifiers. Devices and components which do not have unique identifiers shall follow the devices and components with unique identifiers and shall be indexed in alphabetical order according to their functional name. The ECB shall include a Bill of Materials for each HVAC Control System. The Bill of Materials shall function as the Table of Contents for the ECB and shall include the device's unique identifier, device function, manufacturer, model/part/catalog number used for ordering, and tab number where the device information is located in the ECB. The ECB shall be submitted along with Submittal Description SD-02 Shop Drawings.

SD-06 Test Reports

Commissioning Report

Six copies of the HVAC Control System Commissioning Report, in booklet form and indexed, within 30 days after completion of the system commissioning. The Commissioning Report shall include data collected during the HVAC Control System Commissioning Procedures and shall follow the format of the Commissioning Procedures. The Commissioning Report shall include all Configuration Check sheets with final values listed for all parameters, setpoints, P, I, D setting constants, calibration data for all devices, results of adjustments, and results of testing.

Performance Verification Test

Six copies of the HVAC Control System Performance Verification Test Report, in booklet form and indexed, within 30 days after completion of the test. The HVAC Control System

Performance Verification Test Report shall include data collected during the HVAC Control System Performance Verification Test. The original copies of all data gathered during the Performance Verification Test shall be turned over to the Government after Government approval of the test results.

SD-10 Operation and Maintenance Data

Operation Manual

Six copies of the HVAC Control System Operation Manual for each HVAC control system, in booklet form and indexed, 30 days before the date scheduled for the Training Course. The Operation Manual shall include the HVAC Control System Sequence of Operation, and Procedures for the HVAC System Start-up, Operation and Shut-down. The Operation Manual shall include all As-Built HVAC Control System Detail Drawings. The Operation Manual shall include the As-Built Configuration Check sheets, the Procedures for Changing HVAC Control System Setpoints, and the Procedures for Placing HVAC System Controllers in the Manual Control Mode.

The Procedures for Changing HVAC Control System Setpoints shall describe the step-by-step procedures required to change: the process variable setpoints, the alarm setpoints, the bias settings, and setpoint reset schedules.

The Procedures for Placing HVAC System Controllers in the Manual Control Mode shall describe step-by-step procedures required to obtain manual control of each controlled device and to manually adjust their positions.

Maintenance and Repair Manual

Six copies of the HVAC Control System Maintenance and Repair Manual for each HVAC control system, in booklet form and indexed in hardback binders, 30 days before the date scheduled for the Training Course. The Maintenance and Repair Manual shall include the Routine Maintenance Checklist, a Recommended Repair Methods List, a List of Recommended Maintenance and Repair Tools, the Qualified Service Organization List, the As-Built Commissioning Procedures and Report, the As-Built Performance Verification Test Procedures and Report, and the As-Built Equipment Data Booklet. The Routine Maintenance Checklist shall be arranged in a columnar format. The first column shall list all devices listed in the Equipment Compliance Booklet, the second column shall state the maintenance activity or state no maintenance required, the third column shall state the frequency of the maintenance activity, and the fourth column for additional comments or reference.

The Recommended Repair Methods List shall be arranged in a columnar format and shall list all devices in the Equipment Data Compliance Booklet and state the guidance on recommended repair methods, either field repair, factory repair, or whole-item replacement.

The As-Built Equipment Data Booklet shall include the Equipment Compliance Booklet and all manufacturer supplied user manuals and information.

Provision of As-built Drawings: All Electronic drawings shall be submitted in native format to Microstation Version 8. Any drawings created in anything other than Microstation shall be converted into Microstation format and require two (2) complete sets of electronic files. One set in its original format and one set in Microstation format. The Contractor shall insure the drawings integrity is kept when converting drawings into Microstation format. Drawing integrity includes but not limited to line types, line weights, layering, and color. Electronic file names shall include sheet title information, sequence number, drawing number, sheet number, and revision number. All as-build drawings furnished by the Contractor shall be in

AutoCAD® Release 14 file structure for use by FT. Sam Houston. Two "C" size (18 x 24) sets of as-built drawings and 2 CD-ROMs shall be furnished. All drawings shall be delivered within 30 days after written acceptance of the system by the Government. All drawings shall be delivered within 30 days after written acceptance of the system by the Government.

Provide Equipment Installation Engineering Drawings: All drawings related to installation and assembly of the computers, field equipment panels, data transmission equipment, interfaces, and instrumentation shall be provided IAW the specifications and CDRLs.

If the Operation Manual and the Maintenance and Repair Manual are provided in a common volume, they shall be clearly differentiated and separately indexed.

SD-11 Closeout Submittals

Training

An outline for the HVAC Control System Training Course with a proposed time schedule. Approval of the planned training schedule shall be obtained from the Government at least 30 days prior to the start of the training.

Six copies of HVAC Control System Training Course material 30 days prior to the scheduled start of the training course. The Training Course material shall include the Operation Manual, Maintenance and Repair Manual, and paper copies of overheads used in the course.

Service Personnel

Six copies of a list of service organizations and personnel qualified to service the HVAC control system. The list shall include the service organization name, address, technical point of contact and telephone number, and contractual point of contact and telephone number.

Posted and Panel Instructions

Furnish posted and panel instructions in accordance with Part 3 paragraph BALANCING, COMMISSIONING, AND TESTING, subparagraph Posted and Panel Instructions.

1.4 DELIVERY AND STORAGE

Products shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants, within the storage-condition limits published by the equipment manufacturer. Dampers shall be stored so that seal integrity, blade alignment and frame alignment are maintained.

1.5 FACTORY TESTING

1.5.1 General

The Contractor shall assemble the factory test IGDDCS system as specified and perform test to demonstrate that the performance of the system satisfies the requirements of this specification. Model numbers of equipment tested shall be identical to those to be delivered to the site. Original copies of all data produced, including results of each test procedure during factory testing shall be delivered to the Government at the conclusion of testing, prior to Government approval of the test. The test results documentation shall be arranged so that all commands, responses, and data acquired are correlated in a manner which will allow for logical interpretation of the data.

1.5.2 Factory Test Setup

When item is used, the factory test setup shall include the following:

a. Command Entry Device with Keyboard.

b. Printer.

c. Disk Storage.

d. PLC Panel.

e. PLC Panel Test Set.

f. PLC Panel Portable Tester.

g. Not used.

h. Not used.

i. Communication links of each type and speed.

j. Software.

1.6 TRAINING

1.6.1 Training-Course Requirements

A training course shall be conducted for 3 operating staff members designated by the Contracting Officer in the maintenance and operation of the system, including specified hardware and software. The training period, for a total of 16 hours of normal working time, shall be conducted within 30 days after successful completion of the performance verification test. The training course shall be conducted at the project site. Audiovisual equipment and 6 sets of all other training materials and supplies shall be provided. A training day is defined as 8 hours of classroom instruction, including two 15-minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility.

1.6.2 Training-Course Content

For guidance in planning the required instruction, the Contractor shall assume that attendees will have a high school education or equivalent, and are familiar with HVAC systems. The training course shall cover all of the material contained in the Operating and Maintenance Instructions, the layout and location of each HVAC control panel, the layout of one of each type of unitary equipment and the locations of each, the location of each system-control device external to the panels, the location of the compressed-air station, preventive maintenance, troubleshooting, diagnostics, calibration, adjustment, commissioning, tuning, and repair procedures. Typical systems and similar systems may be treated as a group, with instruction on the physical layout of one such system. The results of the performance verification test and the calibration, adjustment and commissioning report shall be presented as benchmarks of HVAC control-system performance by which to measure operation and maintenance effectiveness.

1.7 MAINTENANCE AND SERVICE

1.7.1 General Requirements

Services, materials and equipment shall be provided as necessary to maintain the entire system in an operational state as specified for a period of 1 year after successful completion and acceptance of the Performance Verification Test. Impacts on facility operations shall be minimized.

1.7.2 Description of Work

The adjustment and repair of the system shall include the manufacturer's required adjustments of computer equipment, software updates, transmission equipment and instrumentation and control devices.

1.7.3 Personnel

Service personnel shall be qualified to accomplish work promptly and satisfactorily. The Government shall be advised in writing of the name of the designated service representative, and of any changes in personnel.

1.7.4 Scheduled Inspections

Two inspections shall be performed at 6-month intervals (or less if required by the manufacturer), and all work required shall be performed. Inspections shall be scheduled in June and December. These inspections shall include:

a. Visual checks and operational tests of all equipment.

b. Fan checks and filter changes for all control system equipment.

c. Clean all control system equipment including interior and exterior surfaces.

d. Check and calibrate each field device. Check and calibrate 50 percent of the total analog points during the first inspection. Check and calibrate the remaining 50 percent of the analog points during the second major inspection. Certify analog test instrumentation accuracy to be twice that of the device being calibrated. Randomly check at least 25 percent of all digital points for proper operation during the first inspection. Randomly check at least 25 percent of the remaining digital points during the second inspection.

e. Run all system software diagnostics and correct all diagnosed problems.

f. Resolve any previous outstanding problems.

1.7.5 Scheduled Work

This work shall be performed during regular working hours, Monday through Friday, excluding legal holidays.

1.7.6 Emergency Service

The Government will initiate service calls when the system is not functioning properly. Qualified personnel shall be available to provide service to the system. A telephone number where the service supervisor can be reached at all times shall be provided. Service personnel shall be at the site within 24 hours after receiving a request for service. The control system shall be restored to proper operating condition within 3 calendar days after receiving a request for service.

1.7.7 Operation

Scheduled adjustments and repairs shall include verification of the control system operation as demonstrated by the applicable tests of the performance verification test.

1.7.8 Records and Logs

Dated records and logs shall be kept of each task, with cumulative records for each major component, and for the complete system chronologically. A continuous log shall be maintained for all devices. The log shall contain all initial analog span and zero calibration values and all digital points. Complete logs shall be kept and shall be available for inspection onsite, demonstrating that planned and systematic adjustments and repairs have been accomplished for the control system.

1.7.9 Work Requests

Each service call request shall be recorded as received and shall include the serial number identifying the component involved, its location, date and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. A record of the work performed shall be submitted within 5 days after work is accomplished.

1.7.10 System Modifications

Recommendations for system modification shall be submitted in writing. No system modifications, including operating parameters and control settings, shall be made without prior approval of the Government. Any modifications made to the system shall be incorporated into the operations and maintenance manuals, and other documentation affected.

1.7.11 Software

Updates to the software shall be provided for system, operating and application software, and operation in the system shall be verified. Updates shall be incorporated into operations and maintenance manuals, and software documentation. There shall be at least one scheduled update near the end of the first year's warranty period, at which time the latest released version of the Contractor's software shall be installed and validated.

1.7.12 Graphics

All graphics shall be consistent, coordinated, and integrated with the existing post-wide UMCS Employing FSH Industrial Grade Direct Digital Control System (IGDDCS) graphics. All existing post-wide UMCS Employing FSH Industrial Grade Direct Digital Control System (IGDDCS) graphics shall be modified to include monitoring of additional points by existing post-wide UMCS Employing FSH Industrial Grade Direct Digital Control System (IGDDCS) workstations. New graphics shall be provided for systems where no existing graphics exist.

PART 2 PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

Units of the same type of equipment shall be products of a single manufacturer. Each major component of equipment shall have the manufacturer's name and address, and the model and serial number in a conspicuous place. Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products shall have been in a satisfactory commercial or industrial use for 2 years prior to use on this project. The 2 years' use shall include applications of equipment and materials under similar circumstances and of similar size. The 2 years' experience shall be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6,000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization. Items of the same type and purpose shall be identical, including equipment, assemblies, parts and components. Automatic temperature controls shall be direct digital controls that will provide the required sequence of operation. No pneumatics will be allowed except for valve or damper actuators.

2.1.1 Electrical and Electronic Devices

Electrical, electronic, and electro pneumatic devices not located within a DDC-PLC panel shall have a NEMA ICS 1 enclosure in accordance with NEMA 250 unless otherwise shown.

2.1.2 Standard Signals

Except for air distribution terminal unit control equipment, the output of all analog transmitters and the analog input and output of all DDC-PLC panels shall be 4-20mA, 2-10VDC or 0-10VDC signals.

2.1.3 Ambient Temperature Limits

IGDDCS panels shall have ambient condition ratings of 35 to 120 degrees F and 10 to 95 percent relative humidity, non-condensing. Devices installed outdoors shall operate within limit ratings of minus 35 to plus 150 degrees F. Instrumentation and control elements shall be rated for continuous operation under the ambient environmental temperature, pressure, humidity, and vibration conditions specified or normally encountered for the installed location.

2.2 WIRING

2.2.1 Multi-Conductor Cables

Multi-conductor cables shall be used to connect field devices such as valves and dampers to eth IGDDC panel. Field terminations for field devices shall be grouped together on the IGDDC field terminal blocks.

2.2.2 Terminal Blocks

Terminal blocks shall be single-tier insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, shall be suitable for rail mounting, and shall have end plates and partition plates for separation or shall have enclosed sides.

When necessary due to space limitations, double tier terminal blocks may be used in lieu of single tier terminals.

When necessary due to space limitations, 3-tier terminal blocks may be used only for 2-analog sensors. When used, the lower row of the 3-tier terminals will be bonded together and connected to ground. The lower row will serve as the shield grounding point. The sensor cable shield will only be grounded at this location. The cable shield SHALL NOT be grounded in the field.

Terminal blocks will be color coded as follows:

Orange = Discrete (Binary) Inputs
Blue = Discrete (Binary) Outputs
Grey = Analog Input
Yellow = Analog Output
Black = System Common (24VDC and 24VAC connected together)
White /Red = Not Wired and/or miscellaneous control

2.2.3   Control Wiring for 24-Volt Circuits

Control wiring for 24-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 300-volt service.

2.2.4   Wiring for 120-Volt Circuits

Wiring for 120-volt circuits shall be 18 AWG minimum, stranded copper and shall be rated for 600-volt service.

2.2.5   Instrumentation Cable

Instrumentation cable shall be 18 AWG, stranded copper, single- or multiple-twisted, minimum 2 inch lay of twist, 100 percent shielded pairs, and shall have a 300-volt insulation. Each pair shall have a 20 AWG tinned-copper drain wire and individual overall pair insulation. Cables shall have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

2.2.6   Transformers

Step down transformers shall be utilized where control equipment operates at lower than line circuit voltage. Transformers, other than transformers in bridge circuits, shall have primaries wound for the voltage available and secondaries wound for the correct control circuit voltage. Transformer shall be sized so that the connected load is 80 percent of the rated capacity or less. Transformers shall conform to UL 508 and NEMA ST 1.

2.3   ACTUATORS

2.3.1   General Requirements

Actuators shall be electronic of the bi-directional type, capable of delivering 150% of torque required. Actuator shall be provided with mounting and connecting hardware. Actuators shall be supplied with field selectable rotation direction collar design that allows for easy field adjustment of rotation angle and position indicator, manual override, electronic stall detection and output position feedback. All actuators shall be controlled with analog modulation using 0-10 VDC, 2-10VDC or 4-20 mA for control and feedback. Discrete, floating or pulse width modulation actuator control is not allowed.

When required, actuators shall fail to their spring return positions on signal or power failure. The actuator stroke shall be limited in the direction of power stroke by an adjustable stop. Actuators shall have a visible position indicator, readable from 20 feet. Actuators shall smoothly open or close the devices to which they are applied and shall have a full stroke response time of 60 seconds or less. Electric or electronic actuators operating in series shall have an auxiliary actuator driver. Electric actuators used in a sequencing application shall have zero and span adjustments.

2.3.2   Damper Actuators

Damper actuators shall be provided with mounting and connecting hardware. Actuators shall smoothly operate the devices to which they are applied. Actuators shall fully open and close the devices to which they are applied and shall have a full stroke response time of 60 seconds or less. The actuator stroke shall be limited by an adjustable stop in the direction of power stroke.

2.3.3   Valve Actuators

Valve actuators shall be selected to provide a minimum of 125 percent of the motive power necessary to operate the valve over its full range of operation.

2.4 AUTOMATIC CONTROL VALVES

Valves shall have stainless-steel stems and stuffing boxes with extended have globe style bodies. Valve bodies shall be designed for not less than 125 psig working pressure or 150 percent of the system operating pressure, whichever is greater. Valve leakage rating shall be 0.01 percent of rated Cv. Unless otherwise specified, bodies for valves 1-1/2 inches and smaller shall be brass or bronze, with threaded or union ends; bodies for 2 inch valves shall have threaded ends; and bodies for valves 2 inches to 3 inches shall be of brass, bronze or iron. Bodies for valves 2-1/2 inches and larger shall be provided with flanged-end connections. Valve Cv shall be within 100 to 125 percent of the Cv shown.

2.4.1 Butterfly-Valve Assembly

Butterfly valves shall be threaded lug type suitable for dead-end service and modulation to the fully-closed position, with carbon-steel bodies and noncorrosive discs, stainless steel shafts supported by bearings, and EPDM seats suitable for temperatures from minus 20 to plus 250 degrees F. Valves shall have a manual means of operation independent of the actuator. The rated Cv for butterfly valves shall be the valve Cv at 70% open (60 degrees open).

2.4.2 Two-Way Valves

Two-way modulating valves shall have equal-percentage characteristics.

2.4.3 Three-Way Valves

Three-way valves shall provide linear flow control with constant total flow throughout full plug travel.

2.4.4 Terminal-Unit-Coil Valves

Control valves with either flare-type or solder-type ends shall be provided for terminal-unit coils. Flare nuts shall be furnished for each flare-type end valve.

2.4.5 Valves for Chilled-Water Service

Internal valve trim shall be bronze except that valve stems may be type 316 stainless steel. Valve Cv shall be within 100 percent to 125 percent of the Cv shown. Valves 4 inches and larger shall be butterfly.

2.4.6 Valves for Hot-Water Service

For hot water service below 250 degrees F service, internal trim (including seats, seat rings, modulating plugs, and springs) of valves controlling water hotter than 210 degrees F shall be Type 316 stainless steel. Internal trim for valves controlling water 210 degrees F or less shall be brass or bronze. Nonmetallic parts of hot-water control valves shall be suitable for a minimum continuous operating temperature of 250 degrees F or 50 degrees F above the system design temperature, whichever is higher. Valves 4 inches and larger shall be butterfly valves.

2.5 DAMPERS

2.5.1 Damper Assembly

A single damper section shall have blades no longer than 48 inches and shall be no higher than 72 inches. Maximum damper blade width shall be 8 inches. Larger sizes shall be made from a combination of sections. Dampers shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. Blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section shall not be located directly in the air stream. Damper axles shall be 0.5 inch minimum, plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 0.04 inch water gauge at 1,000 feet per minute in the wide-open position. Frames shall not be less than 2 inches in width. Dampers shall be tested in accordance with AMCA 500-D.

2.5.2   Operating Links

Operating links external to dampers, such as crank arms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers, shall withstand a load equal to at least twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises shall be brass, bronze, or stainless steel. Adjustments of crank arms shall control the open and closed positions of dampers.

2.5.3   Damper Types

Dampers shall be parallel-blade type.

2.5.3.1   Outside Air, Return Air, and Relief Air Dampers

Outside air, return air and relief air dampers shall be provided where shown. Blades shall have interlocking edges and shall be provided with compressible seals at points of contact. The channel frames of the dampers shall be provided with jamb seals to minimize air leakage. Dampers shall not leak in excess of 20 cfm per square foot 4 inches water gauge static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 to plus 200 degrees F. Dampers shall be rated at not less than 2,000 feet per minute air velocity.

2.5.3.2   Mechanical and Electrical Space Ventilation Dampers

Mechanical and electrical spare ventilation dampers shall be as shown.   Dampers shall not leak in excess of 80 cfm square foot at 4 inches water gauge static pressure when closed. Dampers shall be rated at not less than 1,500 feet per minute air velocity.

2.5.4   Damper End Switches

Each end switch shall be a hermetically sealed switch with a trip lever and over-travel mechanism. The switch enclosure shall be suitable for mounting on the duct exterior and shall permit setting the position of the trip lever that actuates the switch. The trip lever shall be aligned with the damper blade.

2.6   SMOKE DETECTORS

Duct smoke detectors shall be provided in supply and return air ducts in accordance with NFPA 90A. Duct smoke detectors shall conform to the requirements of UL 268A. Duct smoke detectors shall have perforated sampling tubes extended into the air duct. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have manual reset. Detectors shall be rated for air velocities that include air flows between 500 and 4000 fpm. Detectors shall be powered from the HVAC control panel. Detectors shall have two sets of normally open alarm contacts and two sets of normally closed alarm contacts. Detectors shall be connected to the building fire alarm panel for alarm initiation.

A remote annunciation lamp and accessible remote reset switch shall be provided for duct detectors that are mounted 8 feet or more above the finished floor and for detectors that are not readily visible. Remote lamps and switches as well as the affected fan unit(s) shall be properly identified in etched rigid plastic placards.

2.7 INSTRUMENTATION

2.7.1 Measurements

Transmitters shall be calibrated to provide the following measurements, over the indicated ranges, for an output of 4-20mA, 2-10VDC or 0-10VDC:

a. Conditioned space temperature, from 50 to 85 degrees F.

b. Duct temperature, from 40 to 140 degrees F except that return-air temperature for economizer operation shall be minus 30 to plus 130 degrees F.

c. Not used.

d. Water source heat pump sink water temperature, from 50 to 100 degrees F.

e. Not used.

f. Not used.

g. Not used.

h. Outside-air temperature, from minus 30 to 130 degrees F.

i. Relative humidity, 0 to 100 percent for space and duct high-limit applications.

j. Not used

k. Pitot-tube air-flow measurement station and transmitter, from 0 to 0.1 inch water gauge for flow velocities of 700 to 1200 fpm, 0 to 0.25 inch water gauge for velocities of 700 to 1800 fpm, or 0 to 0.5 inch water gauge for velocities of 700 to 2500 fpm.

l. Electronic air-flow measurement station and transmitter, from 125 to 2500 fpm.

2.7.2 Temperature Instruments

2.7.2.1 Resistance Temperature Detectors (RTD)

Temperature sensors shall be 100 or 1000 ohm RTD of 2 or 3 wire design.
Each RTD shall be platinum with a tolerance of plus or minus 0.1 percent at 32 degrees F, and shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Each RTD shall be furnished with an RTD transmitter as specified, integrally mounted unless otherwise shown.

2.7.2.2 Continuous Averaging RTD

Continuous averaging RTDs shall have a tolerance of plus or minus 1.0 degree F at the reference temperature, and shall be of sufficient length to ensure that the resistance represents an average over the cross section in which it is installed. The sensing element shall have a bendable copper sheath. Each averaging RTD shall be furnished with an RTD transmitter to match the resistance range of the averaging RTD.

2.7.2.3 RTD Transmitter

The RTD transmitter shall match the resistance range of the RTD. The transmitter shall be a 2-wire, loop powered device. The transmitter shall produce a linear 4-20mA, 2-10VDC or 0-10VDCoutput corresponding to the required temperature measurement. The output error shall not exceed 0.1 percent of the calibrated measurement.

2.7.3 Relative Humidity Instruments

A relative-humidity instrument for indoor application shall have a measurement range from 0 to 100 percent relative-humidity and be rated for operation at ambient air temperatures within the range of 25 to 130 degrees F. It shall be capable of being exposed to a condensing air stream (100 percent RH) with no adverse effect to the sensor's calibration or other harm to the instrument. The instrument shall be of the wall-mounted or duct-mounted type, as required by the application, and shall be provided with any required accessories. Instruments used in duct high-limit applications shall have a bulk polymer resistive sensing element. Duct-mounted instruments shall be provided with a duct probe designed to protect the sensing element from dust accumulation and mechanical damage. The instrument (sensing element and transmitter) shall be a two-wire, loop-powered device and shall have an accuracy of plus or minus 3 percent of full scale within the range of 20 to 80 percent relative humidity. The instrument shall have a typical long-term stability of 1 percent or less drift per year. The transmitter shall convert the sensing element's output to a linear 4-20mA, 2-10VDC or 0-10VDC output signal in proportion to the measured relative-humidity value. The transmitter shall include offset and span adjustments.

2.7.4 Pitot Tube Airflow Measurement Stations and Transmitters

2.7.4.1 Stations

Each station shall contain an array of velocity sensing elements and straightening vanes inside a flanged sheet metal casing. The velocity sensing elements shall be of the multiple pitot tube type with averaging manifolds. The sensing elements shall be distributed across the duct cross section in the quantity and pattern specified by the published installation instructions of the station manufacturer. The resistance to air flow through the airflow measurement station shall not exceed 0.08 inch water gauge at an airflow of 2,000 fpm. Station construction shall be suitable for operation at airflows of up to 5,000 fpm over a temperature range of 40 to 120 degrees F, and accuracy shall be plus or minus 3 percent over a range of 500 to 2,500 fpm. This device will not be used if the required velocity measurement is below 700 fpm or for outside airflow measurements.

2.7.4.2 Transmitters

Each transmitter shall produce a linear 4-20mA, 2-10VDC or 0-10VDCoutput corresponding to the required velocity pressure measurement. Each transmitter shall have a low range differential pressure sensing element. The transmitter shall be a 2-wire, loop powered device. Sensing element accuracy shall be plus or minus 1 percent of full scale, and overall transmitter accuracy shall be plus or minus 0.25 percent of the calibrated measurement.

2.7.5 Differential Pressure Instruments

The instrument shall be a pressure transmitter with an integral sensing element. The instrument over pressure rating shall be 300 percent of the operating pressure. The sensor/transmitter assembly accuracy shall be plus or minus 2 percent of full scale. The transmitter shall be a two-wire, loop-powered device. The transmitter shall produce a linear 4-20mA, 2-10VDC or 0-10VDC output corresponding to the required pressure measurement.

2.7.6 Thermowells

Thermowells shall be Series 300 stainless steel with threaded brass plug and chain, 2 inch lagging neck and extension type well. Inside diameter and insertion length shall be as required for the application.

2.7.7 Sunshields

Sunshields for outside air temperature sensing elements shall prevent the sun from directly striking the temperature sensing elements. The sunshields shall be provided with adequate ventilation so that the sensing element responds to the ambient temperature of the surroundings. The top of each sunshield shall have a galvanized metal rain shield projecting over the face of the sunshield. The sunshields shall be painted white.

2.8 THERMOSTATS AND MULTIFUNCTION DEVICES

2.8.1 General

Thermostat ranges shall be selected so that the setpoint is adjustable between plus or minus 10 degrees F of the setpoint shown. Thermostats shall be electronic or electric. Multifunction devices are products that combine the functions of sensor and user input or output devices into a single product

2.8.2 Nonmodulating Room Thermostats

Contacts shall be single-pole double-throw (SPDT), hermetically sealed, and wired to identified terminals. Maximum differential shall be 5 degrees F. Room thermostats shall be enclosed with separate locking covers (guards).

2.8.3 Microprocessor Based Room Thermostats

Microprocessor based thermostats shall have built-in keypads for scheduling of day and night temperature settings. Access to the scheduling mode shall be by a password control code. When out of the scheduling mode, thermostats shall have continuous display of time, with AM and PM indicator, continuous display of day of week, and either continuous display of room temperature with display of temperature setpoint on demand, or continuous display of temperature setpoint with display of room temperature on demand. In the programmable mode, the display shall be used for interrogating time program ON-OFF setpoints for all 7 days of the week. The time program shall allow two separate temperature setback intervals per day. The thermostats shall have a means for temporary and manual override of the program schedule, with automatic program restoration on the following day. Thermostats shall have a replaceable battery to maintain the timing and maintain the schedule in memory for 1 year in the event of a power outage. Maximum differential shall be 2 degrees F. When used for heat pump applications, the thermostat shall have an emergency heat switch.

2.8.4 IGDDC Controller Space Sensor & User Interface

Each zone controlled by an IGDDC controller shall have a Space Sensor & User Interface device located within the controlled space as indicated. Each Space Sensor & User Interface device (indicate by the symbol "T" on the drawings) shall have a space temperature sensor and a user interface set point adjust mechanism. The set point adjust shall be increase/decrease buttons. The device shall also have an LCD display indicating current space temperature and shall change to display current setpoint when user makes an input to the setpoint adjust mechanism. Where indicated, the device shall be enclosed with separate locking cover (guard). The device shall provide a 2-10VDC signal to the IGDDC to indicate temperature and setpoint. The signal shall be scaled 20-100 DegF.

2.8.5 Nonmodulating Capillary Thermostats and Aquastats

Each thermostat shall have a capillary length of at least 5 feet, shall have adjustable direct-reading scales for both setpoint and differential, and shall have a differential adjustable from 6 to 16 degrees F. Aquastats shall be of the strap on type, with 10 degrees F fixed differential.

2.8.6 Freezestats

Freezestats shall be manual reset, low temperature safety thermostats, with NO and NC contacts and a 20 foot element which shall respond to the coldest 18 inch segment.

2.9 PRESSURE SWITCHES AND SOLENOID VALVES

2.9.1 Pressure Switches

Each switch shall have an adjustable setpoint with visible setpoint scale. Range shall be as shown. Differential adjustment shall span 20 to 40 percent of the range of the device.

2.9.2 Differential-Pressure Switches

Each switch shall be an adjustable diaphragm-operated device with two SPDT contacts, with taps for sensing lines to be connected to duct pressure fittings designed to sense air pressure. These fittings shall be of the angled-tip type with tips pointing into the air stream. The setpoint shall not be in the upper or lower quarters of the range and the range shall not be more than three times the setpoint. Differential shall be a maximum of 0.15 inch water gauge at the low end of the range and 0.35 inch water gauge at the high end of the range.

2.10 INDICATING DEVICES

2.10.1 Thermometers

2.10.1.1 Piping System Thermometers

Piping system thermometers shall have brass, malleable iron or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9-inch scale. Thermometers for piping systems shall have rigid stems with straight, angular, or inclined pattern.

2.10.1.2 Piping System Thermometer Stems

Thermometer stems shall have expansion heads as required to prevent breakage at extreme temperatures. On rigid-stem thermometers, the space between bulb and stem shall be filled with a heat-transfer medium.

2.10.1.3 Nonaveraging Air-Duct Thermometers

Air-duct thermometers shall have perforated stem guards and 45-degree adjustable duct flanges with locking mechanism.

2.10.1.4 Averaging Air-Duct Thermometers

Averaging thermometers shall have a 3-1/2 inch (nominal) dial, with black legend on white background, and pointer traveling through a 270-degree arc.

2.10.1.5 Accuracy

Thermometers shall have an accuracy of plus or minus 1 percent of scale range. Thermometers shall have a range suitable for the application.

2.10.2 Pressure Gauges

Gauges shall be 2 inch (nominal) size, back connected, suitable for field or panel mounting as required, shall have black legend on white background, and shall have a pointer traveling through a 270-degree arc. Accuracy shall be plus or minus 3 percent of scale range. Gauges shall meet requirements of ASME B40.100.

2.10.2.1 Hydronic-System Gauges

Gauges for hydronic-system applications shall have ranges and graduations as shown.

2.10.3 Low Differential Pressure Gauges

Gauges for low differential pressure measurements shall be a minimum of 3.5 inch (nominal) size with two sets of pressure taps, and shall have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gauges shall have ranges and graduations as shown. Accuracy shall be plus or minus 2 percent of scale range.

2.11 CONTROL DEVICES AND ACCESSORIES

2.11.1 Relays

Control relay contacts shall have utilization category and ratings selected for the application, with a minimum of two sets of contacts (two normally open, two normally closed) enclosed in a dustproof enclosure. Relays shall be rated for a minimum life of one million operations. Operating time shall be 20 milliseconds or less. Relays shall be equipped with coil transient suppression devices to limit transients to 150 percent of rated coil voltage. Time delay relays shall be 2PDT with 8-pin connectors, dust cover, and a matching rail-mounted socket. Adjustable timing range shall be 0 to 5 minutes. Power consumption shall not be greater than 3 watts.

2.11.2 Occupancy Sensors

Occupancy sensors shall have occupancy-sensing sensitivity adjustment and an adjustable off-delay timer with a range encompassing 30 seconds to 15 minutes. Occupancy sensors shall be rated for operation in ambient air temperatures ranging from 50 degrees F to 104 degrees F or temperatures normally encountered in the installed location. Sensors integral to wall mount on-off light switches shall have an auto-off switch. Wall switch sensors shall be decorator style and shall fit behind a standard decorator type wall plate. All occupancy sensors, power packs, and slave packs shall be UL listed.

In addition to any outputs required for lighting control, the occupancy sensor shall provide a contact output rated at 1A at 24 Vac or a SNVT output.

2.11.2.1 Passive Infrared (PIR) Occupancy Sensors

PIR occupancy sensors shall have a multi-level, multi-segmented viewing lens and a conical field of view with a viewing angle of 180 degrees and a detection of at least 6 meters (20 feet) unless otherwise shown or specified. PIR Sensors shall provide field-adjustable background light-level adjustment with an adjustment range suitable to the light level in the sensed area, room or space. PIR sensors shall be immune to false triggering from RFI and EMI.

2.11.3 Current Sensing Relays

Current sensing relays shall provide a normally-open contact rated at a minimum of 50 volts peak and 1/2 ampere or 25 VA, noninductive. There shall be a single hole for passage of current carrying conductors.

The devices shall be sized for operation at 50 percent rated current based on the connected load. Voltage isolation shall be a minimum of 600 volts.

2.11.4   Watt-hour Meters

Watt-hour meters shall be in accordance with ANSI C12.1 and shall have pulse initiators for remote monitoring of watt-hour consumption. Pulse initiators shall consist of contacts (one normally open, one normally closed) with a current rating not to exceed 2 amperes and voltage not to exceed 500 V, with combinations of VA not to exceed 100 VA, and a life rating of one billion operations. Pulse initiator contacts shall be connected to a terminal strip external to the meter enclosure. Meter sockets shall be in accordance with ANSI C12.15.

2.11.5   Watt-hour Transducers

Watt-hour transducers shall have an accuracy of plus or minus 0.25 percent of full scale for kW and kWh outputs from full lag to full lead power factor. Input ranges for kW and kWh transducers shall be selectable without requiring the changing of current or potential transformers. The output shall be 4 to 20 mAdc.

2.11.6   Power-Line Conditioners

Power line conditioners shall be furnished for each IGDDCS panel. The Power line conditioners shall provide both voltage regulation and noise rejection. The Power line conditioner shall be of the ferro-resonant design, with no moving parts and no tap switching, while electrically isolating the secondary from the power-line side.

The power line conditioners shall be sized for 125 percent of the actual connected kVA load. Characteristics of the PLC shall be as follows:

a. At 85 percent load, the output voltage shall not deviate by more than plus or minus 1 percent of nominal when the input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.

b. During load changes of zero to full load, the output voltage shall not deviate by more than plus or minus 3 percent of nominal voltage. Full correction of load switching disturbances shall be accomplished within 5 cycles, and 95 percent correction shall be accomplished within 2 cycles of the onset of the disturbance.

c. Total harmonic distortion shall not exceed 3-1/2 percent at full load.

2.12   FIELD EQUIPMENT PANEL HARDWARE

2.12.1   General

All Field Equipment Panels shall be based upon Programmable Logic Controllers (PLCs). PLCs shall be commercially available, off-the-shelf offerings of multiple vendors. Acceptable PLC offerings shall have a family of PLC processors to cover the requirements from very large applications (eg, Central Plant, major equipment room, etc.) to very small applications.

The PLCs shall be compatible with the IEC 61131-3 programming standard. All functions, constraints, database information, operator developed programs and any other data shall be downloadable from a central work station/tester through the primary network to Field Equipment Panels. The PLC family must be such that the top end PLCs share features with the low end PLCs. Similar features shall include common language features, similar programming look/feel, common coprocessor language, coprocessor programming support, communications protocols, common operator interface and common I/O circuits.

2.12.2   Operator Interfaces

Control panels shall be provided with operator interfaces mounted on front of control panel. Each building shall have a central control panel that will have as a minimum a 10.5" Ethernet Capable Color touchscreen. This screen will have a program that allows monitoring and control of all EMCS devices located in the building. All AHU panels shall have as a minimum a 5" Ethernet Capable Monochrome touchscreen. The AHU interface will have a program that will allow monitoring and control of the local AHU and all associated zones. Small devices such as Water Source Heat Pumps and VAV boxes do not require individual operator interfaces.

2.12.3   Large Memory Modular Controller Hardware

Large memory modular controllers shall be used in applications with high I/O counts and/or large buildings where the HVAC system is spread over a large area. Large memory modular controllers shall consist of a local or remote backplane upon which shall be mounted the processor, power supply, and I/O cards. All communication between the PLC and local I/O cards takes place over a communication bus integral to the backplane. Remote backplanes will talk to the PLC over a remote I/O network.

2.12.4   Small Memory Controller Hardware

Small memory controller hardware shall be used on applications with small I/O counts that are clustered in a local area. Examples are individual AHU control and VAV boxes. I/O shall be "brick" type with capability to expand via a remote network. I/O supplied at device shall be enough to do designed control plus 25% spares.

2.12.5   Modular Controller I/O Types

Modular I/O cards shall support the following I/O types:

Discrete:
- 110 VAC Inputs
- 24 VDC Inputs
- 24 VAC Inputs
- 110 VAC Triac Outputs
- 24 VDC Outputs
- 24 VAC Outputs
- Relayed Outputs

Analog:
- 100 Ohm Platinum RTD Inputs
- 0-10 VDC Input
- 2-10 VDC Input
- 4-20 mA Input
- 0-10 VDC Output
- 2-10VDC Output
- 4-20 mA Output

Analog I/O shall have 12 bit resolution as a minimum. Large memory modular controller shall have a real time clock and calendar integral to the controller. The large memory modular controller shall support the use of floating point math and PID control.

2.12.6   Modular Controller Programming Software

Large and Small controller programming software must be capable of programming all controllers. A separate programming package for Large and Small controllers is not allowed. Programming software shall allow for discrete I/O to be disabled and forced to a ON or OFF state. Programming software must be able to display and write to analog registers in integer, long integer, floating point and ASCII formats. Programming software must allow for on-line programming and documentation of logic elements. Software shall allow printing of logic, comments, logic elements used and element use cross reference. Large memory modular controllers shall fully support IEC 1131.3 programming software. This shall include as a minimum the following modules of IEC 61131-3:

Ladder Diagram
Function Block Diagram
Structured Text
Instruction List
Sequential Function Charts

2.12.7   Modular Controller Communications

Modular PLC controller shall have a minimum of two communication ports integral to the processor. These ports shall facilitate a serial link between the PLC and other parts of the building HVAC control system. At least one of the ports shall be capable of supporting the Modbus serial and/or Modbus/TCP Ethernet protocol.

2.12.8   Modular Controller I/O Expandability

The controller shall be expandable from its basic configuration to handle additional I/O points. This may be accomplished by adding additional backplanes. The controller shall also support I/O expansion by use of remote I/O drops.

2.12.9   Connection to Base EMCS

The PLC shall directly connect to an Ethernet TCP/IP network. This shall allow the PLC to be connected to a postwide VLAN. The controller connection to the Base EMCS will support Ethernet/IP or Modbus/TCP protocol. No bridges will be allowed to connect the PLC to the VLAN.

2.12.10   Control Panel Items

All control panels shall contain the following:

- Isolation circuit breaker to kill all panel and field devices
- Duplex receptacle
- TSS (Transient Surge Suppression) - may be incorporated into UPS device
- Uninterruptible Power Supply (UPS) for Main Panel Only
- Individual fusing on all discrete outputs and/or interposing relays
- Fuse holders that allow individual disconnect of all discrete outputs
- Wiring management system (conduit, wire trays, etc.)
- PLC and terminal blocks DIN rail mounted

2.12.11   Control Panel Terminals

All discrete and analog I/O shall be wired from PLC to terminal blocks located in the panel. Field I/O shall be landed on these terminal blocks during installation.

2.12.12   Control Panel Wiring

Discrete wire color in the control panel shall follow these guidelines:

-Black	=	110 VAC Hot
-White	=	110 VAC Neutral
-Red	=	110 VAC Control

-Dark Blue	=	24 VDC+
-Gray/Brown	=	24 VDC-
-Light Blue	=	24 VDC Control
-Orange	=	24 VAC Hot
-Yellow	=	24 VAC Neutral

All analog wiring (in panel and field) shall be shielded, twisted pair. All analog I/O shall have shields grounded at the terminal blocks of the control panel. When available in field devices, analog control signals shall be 4-20 mA. If 4-20 mA is not available, then use 0-10 VDC.

2.12.13 Modular Controller Programming

Modular controller programming shall follow current logic and alarming guidelines as supplied by the contracting officer. The purpose of these guidelines is to provide a uniform method of programming and alarming among vendors and contractors. These guidelines are periodically reviewed and updated as new HVAC hardware and methods are implemented.

2.13 I/O FUNCTIONS

2.13.1 General

Field Equipment Panel I/O functions shall be defined as functionally part of the PLC, and communicate over a dedicated communication circuit. When remotely located, I/O functions shall be subject to the same requirements as for the PLC. The controller CPU and Input/Output system shall both be of a modular design using plug-in assemblies. The PLC offering shall have at least two different sized mounting racks available for each type of FIELD EQUIPMENT PANEL. In order to minimize spare parts stocking requirements, the controller family shall have a high degree of interchangeability. The system design shall accommodate the replacement of I/O modules without having to disconnect field wiring.

2.13.1.1 The Analog Input (AI) Function

The AI function shall monitor each analog input, perform A to D conversion, and hold the digital value in a buffer for interrogation. The A to D conversion shall have a minimum resolution of 12 bits. All Analog Inputs shall be individually calibrated for zero and full scale. Conversion to engineering units will be accomplished by PLC logic. The AI shall incorporate common mode noise rejection of 50 dB from 0 to 100 Hz for differential inputs, and normal mode noise rejection of 20 dB at 60 Hz from a source impedance of 10,000 ohms. Input signals shall be within the range of 4-20 mA or 0-10 VDC.

2.13.1.2 The Analog Output (AO) Function

The AO function shall accept digital data, perform D to A conversion, and output a signal within the range of 4-20 mA or 0-10VDC. D to A conversion shall have a minimum resolution of 12 bits. All Analog Outputs shall be individually calibrated for zero and full scale. Short circuit protection on voltage outputs and open circuit protection on current outputs shall be provided.

2.13.1.3 The Digital Input (DI) Function

The DI function shall accept on off, open close, or other change of state (two state data) indications. Isolation and protection against an applied steady state voltage up to 180 VAC peak shall be provided.

2.13.1.4 The Digital Output (DO) Function

The DO function shall provide contact closures for momentary and maintained operation of output devices. Closures shall have a minimum duration of 0.1 second. DO relays shall have a breakdown voltage between contacts and coil of at least 500 volt peak. Electromagnetic interference suppression shall be furnished on all output lines to limit transients to non-damaging levels. Protection against an applied steady state voltage up to 180 VAC peak shall be provided. Minimum contact rating shall be 1 ampere at 24 VAC. HOA switches shall be provided for manual override of each digital output. Feedback shall be provided to the system as to the status of the override switch.

2.13.1.5   The Pulse Accumulator (PA) Function

The PA function shall have the same characteristic as the DI, except that a buffer shall be provided to totalize pulses and allow for interrogation by the system. The PA shall accept rates up to 20 pulses per second. The accumulator points shall totalize pulses received from dry contacts. A sensing voltage shall be supplied from the Field Equipment Panel. Accumulator points shall accept Form C contacts (both the "Y" and "Z" contacts kilowatt-hour meter KYZ contacts shall be monitored) and Form "A" or "B" contact inputs. Each PA shall totalize a count of up to 65,536, and shall be able to be read at any time without loss of input data. When each PA reaches its maximum value, it shall automatically reset to zero, and begin counting pulses again. The totalized value shall be reset to zero upon operator's command.

2.13.1.6   The Binary Coded Decimal (BCD) Function

The BCD function shall have the same characteristic as the DI, except that, in addition, the Basic Process Controller shall provide a buffer to totalize inputs and allow for interrogation. The BCD function shall have 16-channel optically isolated buffered inputs to read four digit numbers. The BCD function shall accumulate inputs at rates up to 20 inputs per second.

2.13.1.7   Failure Mode

Upon failure of the I/O function, including data transmission failure, logic power supply failure, FIELD EQUIPMENT PANEL processor malfunction, software failure, interposing relay power failure, or any other failure which prevents stand alone operation of any FIELD EQUIPMENT PANEL normally capable of stand alone operation, connected outputs shall be forced to the failure mode shown.

2.13.2   Central Workstation/Tester

When specified, a central workstation/tester shall be provided and shall be able to communicate with any network control panel via the primary network. The central workstation/tester shall consist of a central computer with a nominal 14 inch VGA color display, capable of displaying up to 256 colors at a minimum resolution of 640 X 480 pixels, 64 bit data bus and 32 bit architecture microprocessor operating at a minimum of 100 MHz. The central workstation/tester shall have, as a minimum, a 2100 MB hard drive, 32 megabytes of memory, integral pointing device, serial and parallel ports, color VGA video port for an external color monitor, 3.5 inch floppy disk drive, modem, PCMCIA Type 3 slot, rechargeable battery, battery charger and 120 VAC power supply and network adapter (Ethernet IEEE 802.3). A printer shall be provided for the central workstation/tester. The central workstation/tester shall:

a.   Run Field Equipment Panel diagnostics.
b.   Load all Field Equipment Panel memory resident programs and information, including parameters and constraints.
c.   Display any AI, DI, or PA input in engineering units.
d.   Control any AO or DO.
e.   Provide an operator interface, contingent on password level, allowing the operator to use full English language words and acronyms, or an object oriented graphical user interface.
f.   Display database parameters.
g.   Modify database parameters.
h.   Accept Field Equipment Panel software from a 3.5 inch floppy disk and information via an EIA 232 E port at the Central Station computers provided, for subsequent loading into a specific Field Equipment Panel. Provide all necessary software and hardware required to support this function.
i.   Disable/enable each Field Equipment Panel.
j.   Perform all workstation functions as specified.

2.13.3 Printer

A printer shall be provided for use with the central workstation/tester. The printer shall have a minimum 96 character standard ASCII character set. It shall have adjustable sprockets for paper width up to 241 mm (9.5 inches) and a friction feed for paper width up to 216 mm (8.5 inches), and shall print at least 80 columns per line. The printer shall have a minimum speed of 150 characters per second in utility mode (draft quality) and 32 characters per second in near letter quality mode. Print mode shall be switch or software selectable. The minimum character spacing shall be 10 characters per inch and 3 to 8 lines per inch. The printer shall utilize standard form size, sprocket fed fanfold paper. The unit shall have programmable control of top of form and variable line skip capability.

2.13.4 Wire and Labeling

2.13.4.1 Wire and Cable

Wire and cable jacket material shall be flame retardant PVC, or floropolymer as required for the application per NFPA 70. Multi-conductor cable shall have an outer jacket. Wire and cable not indicated as GFE shall be provided.

2.13.4.2 Control Wiring

a. Digital Functions: Control wiring for digital functions shall be 18 AWG minimum with 600 volt insulation.

b. Analog Functions: Control wiring for analog functions shall be 18 AWG minimum with 600 volt insulation, twisted and each pair shielded, 2, 3, or 4 wire to match analog function hardware.

2.13.4.3 Sensor Wiring

Sensor wiring shall be 20 AWG minimum twisted and shielded, 2, 3, or 4 wire to match analog function hardware.

2.13.4.4 Terminal Blocks

Terminal blocks shall be insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, suitable for rail mounting, and shall have end plates and partition plates for separation or shall have enclosed sides.

2.13.4.5 Transformer

Step-down transformer shall be utilized where control equipment operates at lower than line circuit voltage. Transformer, other than transformers in bridge circuits, shall have primaries wound for the voltage available and secondaries wound for the correct control circuit voltage. Transformer shall be sized so that the connected load is 80 % of the rated capacity or less.

2.13.4.6 Non-conducting Wiring Duct

Non-conducting wiring duct in control panels shall have slotted sides, snap-on duct covers, fittings for connecting ducts, mounting clips for securing ducts, and wire-retaining clips.

2.14 FIELD EQUIPMENT PANEL SOFTWARE

Field Equipment Panel software shall consist of inherent, PLC application software, and Field Equipment Panel resident application programs.

2.14.1   Inherent Software

The Contractor shall provide inherent software for all Field Equipment Panel to perform the following functions.

2.14.1.1   Operating System

Each Field Equipment Panel shall contain an operating system that controls and schedules that Field Equipment Panel's activities in real time. The Field Equipment Panel shall maintain a point database in its memory that includes all parameters, constraints, and the latest value or status of all points connected to that Field Equipment Panel. The execution of Field Equipment Panel application programs shall utilize the data in memory resident files. The operating system shall include a real time clock function that maintains the seconds, minutes, hours, date and month, including day of the week. Each Field Equipment Panel with a real time clock shall be automatically synchronized with the system's real time clock at least once per day to plus or minus 10 seconds. The time synchronization shall be accomplished without operator intervention and without requiring system shutdown. The operating system shall allow both local and remote (from the primary network) loading of software and data files from the Portable Tester/Workstation or central station HMI. It shall also support data entry and diagnostics.

2.14.1.2   Startup

The Field Equipment Panel shall have startup software that causes automatic commencement of operation without human intervention, including startup of all connected I/O functions. A Field Equipment Panel restart program based on detection of power failure at the Field Equipment Panel shall be included in the Field Equipment Panel software. Upon restoration of power to the Field Equipment Panel, the program shall restart equipment and restore loads to the state at time of power failure, or to the state as commanded by time programs or other overriding programs. The restart program shall include start time delays between successive commands to prevent demand surges or overload trips. The startup software shall initiate operation of self-test diagnostic routines. Upon failure of the Field Equipment Panel, if the database and application software are no longer resident or if the clock cannot be read, the Field Equipment Panel shall not restart and systems shall remain in the failure mode indicated until the necessary repairs are made. If the database and application programs are resident, the Field Equipment Panel shall resume operation after an adjustable time delay of from 0 to 600 seconds. The startup sequence for each Field Equipment Panel shall include a unique time delay setting for each control output when system operation is initiated.

2.14.1.3   Operating Mode

Each Field Equipment Panel shall control and monitor functions as specified, independent of communications with the Primary Network. This software shall perform all Field Equipment Panel functions and Field Equipment Panel resident application programs as specified using data obtained from I/O functions and based upon the Field Equipment Panel real time clock function. When communications circuits between the Field Equipment Panel and the Primary Network are operable, the Field Equipment Panel shall obtain real time clock updates and any required global data values transmitted from the Primary Network. The Field Equipment Panel software shall execute commands after performing constraints checks in the Field Equipment Panel. Status and analog values, including alarms and other data shall be transmitted to the Central Station/tester via the Primary Network when communications circuits are operable. If communications are not available, each Field Equipment Panel shall function in stand-alone mode and operational data, including the latest status and value of each point and results of calculations, normally transmitted to the Master HMI shall be stored for later transmission to the central station/tester. Storage for the latest 1024 values shall be provided at each PLC. Each Field Equipment Panel shall accept software downloaded from a Central Station/tester.

2.14.1.4   Failure Mode

Upon failure for any reason, each Field Equipment Panel shall perform an orderly shutdown and force all Field Equipment Panel outputs to a predetermined (failure mode) state, consistent with the failure modes shown and the associated control device.

2.14.2   Resident Application Programs

The Contractor shall provide all software necessary to accomplish the following functions, as appropriate, fully implemented and operational, within each PLC. The Contractor shall adhere to IEC 1131-3 compliant programming environment.

2.14.2.1   General Functions

a. List of General Functi

(1) Scanning of inputs.

(2) Control of outputs.

(3) Reporting of analog changes outside a selectable differential.

(4) Reporting of unauthorized digital status.

(5) Reporting of alarms automatically to Central Station.

(6) Reporting of I/O status to Central Station upon request.

(7) Maintenance of real time, updated by the Central Station at least once a day.

(8) Communication with Central Station/tester via primary network, secondary network, and serial ports.

(9) Execution of Field Equipment Panel resident application programs.

(10) Averaging or filtering of all AIs.

(11) Constraints checks (prior to command issuance).

(12) Diagnostics.

(13) Reset of PA by operator based on time and value.

(14) PI Control: This function shall provide proportional control and proportional plus integral control.

(15) Two Position Control: This function shall provide control for a two state device by comparing a set point against a process variable and an established deadband.

(16) Floating Point Control: This function shall exercise control when an error signal exceeds a selected deadband, and shall maintain control until the error is within the deadband limits.

(17) Signal Selection: This function shall allow the selection of the highest or lowest analog value from a group of analog values as the basis of control. The function shall include the ability to cascade analog values so that large numbers of inputs can be reduced to one or two outputs.

(18) Signal Averaging: This function shall allow the mathematical calculation of the average analog value from a group of analog values as the basis of control. The function shall include the ability to "weight" the individual analog values so that the function output can be biased as necessary to achieve proper control.

(19) Reset Function: This function shall develop an AO based on up to two AIs and one operator specified reset schedule.

(20) Ventilation Delay Mode shall occur one hour prior to the start of the Occupied Mode.

(21) Unoccupied Mode shall take place between the Occupied Mode and the Ventilation Delay Mode.

b. Analog Monitoring

The system shall measure and transmit all analog values including calculated analog points. An analog change in value is defined as a change 1% of scale. The record transmitted for each analog value shall include a readily identifiable flag which indicates the abnormal status of the value when it deviates from operator selectable upper and lower analog limits. Analog values shall be expressed in proper engineering units with sign. Engineering units conversions shall be provided for each measurement. Each engineering units conversion set shall include range, span, and conversion equation. A vocabulary of engineering unit descriptors shall be provided, using at least three alphanumeric characters to identify information in the system.

c. Logic (Virtual) Points

Logic (virtual) points shall be software points entered in the point database which are not directly associated with a physical I/O function. Logic (virtual) points shall be analog or digital points created by calculation from any combination of digital and analog points, or other data having all the properties of real points, including alarms, without the associated hardware. Logic (virtual) points shall be defined or calculated and entered into the database by the Contractor. The calculated analog point shall have point identification in the same format as any other analog point. The calculated point shall be used in any program where the real value is not obtainable directly. Constants used in calculations shall be changeable on-line by the operator. Calculated point values shall be current for use by the system within 10 seconds of the time of any input changes.

d. State Variables

Analog variables, real or virtual, which represent more than two (up to 8) specific states, each state shall have an assignable name for each state.

e. Alarm Processing

Each Field Equipment Panel shall have alarm processing software for AI, DI, and PA alarms for all real and virtual points connected to that Field Equipment Panel.

f. Digital Alarms Definition

Digital alarms are those abnormal conditions indicated by DIs as specified and shown.

g. Analog Alarms Definition

Analog alarms are those conditions higher or lower than a defined value, as measured by an AI. Analog readings shall be compared to predefined high and low limits, and alarmed each time a value enters or returns from a limit condition. Unique high and low limits shall be assigned to each analog point in the system. Each analog alarm limit shall have an associated unique limit differential specifying the amount by which a variable must return into the proper operating range before being enunciated as a return-to-normal-state. All limits and differentials shall be entered online by the operator in units of the measured variable, without interruption or loss of monitoring of the point concerned. The program =shall automatically change the high or low limits or both, of any analog point, based on sensed values, schedules, or mode of operation, allowing for a time interval before the alarm limit becomes effective.

h. Not Used

i. Constraints

All control devices connected to the system shall have the Field Equipment Panel memory resident constraints checked before each command is issued to insure that no equipment damage will result from improper operation. Each command shall be executed by the Field Equipment Panel only after all constraints checks have been passed. Each command point shall have unique constraints assigned. High and low "reasonableness" values or one differential "rate-of-change" value shall be assigned to each AI.

Values outside the reasonableness limits shall be rejected and an alarm message sent to the Central Station. Status changes and analog point values shall be reported to the workstation upon operator request, such as for reports, alphanumeric displays, graphic displays, and application programs. Each individual point shall be capable of being selectively disabled by the operator from the workstation. Disabling a point shall prohibit alarming of that point. Each control point in the database shall have Field Equipment Panel resident constraints defined and entered by the Contractor, including as applicable:

(1) Maximum starts (cycles) per hour.

(2) Minimum off time.

(3) Minimum on time.

(4) High limit (value in engineering units).

(5) Low limit (value in engineering units).

j. Diagnostics

Each Field Equipment Panel shall have self-test diagnostic routines implemented in firmware. The tests shall include routines that exercise memory. Diagnostic software shall be usable in conjunction with the portable tester/workstation. The software shall display messages in English to inform the tester's operator of diagnosed problems.

2.14.2.2 Control Sequences and Control Loops

The Contractor shall provide resident applications programs developed in accordance with IEC 61131-3 to achieve the sequences of operation, parameters, constraints, and interlocks shown. Application software shall be resident in the Field Equipment Panel in addition to any other required software.

Specific functions to be implemented are defined in individual system control sequences and database tables shown in the drawings, and shall include, as applicable, the following:

a. Economizer Program

The software shall reduce the HVAC system cooling requirements when the OA dry bulb temperature is less than the return air temperature and the system is in cooling mode. When the OA dry bulb temperature is above the return air temperature or changeover setpoint, the OA dampers, return air dampers, and relief air dampers shall be positioned to provide minimum required OA. When the OA dry bulb temperature is below a changeover setpoint temperature (Return air temperature minus deadband) and the air handler is in cooling mode, the OA dampers, return air dampers, and exhaust air dampers shall be modulated by the PID algorithm to maintain the required mixed air temperature. A deadband shall be incorporated to prevent cycling of the economizer.

(1) Program Input

(a) Changeover conditions.
(b) OA dry bulb temperature.
(c) Return air dry bulb temperature.
(d) Mixed air dry bulb temperature.
(e) Maximum allowable OA air dry bulb temperature.
(f) Equipment constraints.

(2) Program Output: Damper actuator/cooling control signal.

b. Ventilation-Recirculation Program

The software shall provide the ability to reduce the HVAC system thermal load during both warm-up and cool-down cycles prior to occupancy of the building and during day/night setback operations.

(1) Ventilation mode: In this mode, the system shall use 100% outside air to cool (heat) the space prior to building occupancy and during day/night setback operations. When the outside air temperature is lower (higher) than the space temperature, the outside air damper and exhaust air damper shall open to their maximum positions and the return air damper shall close to its minimum position. The outside air damper and the exhaust (relief) air damper shall be closed at all other times during unoccupied periods.

(2) Recirculation mode: In this mode, the system shall cool (heat) the space prior to building occupancy and during day/night setback operations. When the outside air temperature is higher (lower) than the space temperature, the outside air damper and the exhaust air damper shall close to their minimum positions and the return air damper shall open to its maximum position. The outside air damper and the exhaust air damper shall be closed at all other times during unoccupied periods.

(3) Not Used.

(4) Program Inputs

(a) Day of week.
(b) Time of day.
(c) Outside air temperature.
(d) Equipment status.

(e) Cooling or heating mode operation.
(f) Cooling or heating occupancy schedule (fixed or calculated).
(g) Space temperature.
(h) Equipment constraints.

(5) Program Output

(a) Damper actuator control signal.
(b) Heating valve actuator control signal.
(c) Cooling valve actuator control signal.

c. Day-Night Setback Program

The Day-Night Setback program shall limit the drop of space temperature during unoccupied hours. Whenever the space temperature below the operator assigned temperature limit, the system shall be turned on until the temperature is within the assigned temperature limit. The outside air damper and the exhaust air damper shall remain closed.

(1) Program Inputs:

(a) Day of week.
(b) Time of day.
(c) Cooling or heating mode of operation.
(d) Cooling and heating occupancy schedules.
(e) Equipment status.
(f) Space temperature (or specified fluid temperature).
(g) Minimum space temperature (or specified fluid temperature) during unoccupied periods.
(h) Maximum space temperature (or specified fluid temperature) during unoccupied periods.
(i) Equipment constraints.

(2) Program Outputs: Start/stop signal.

(3) Command Priority: The Night Setback program shall override all command priorities except operator initiated. Night Setback shall function at all times that the system is determined to be in Unoccupied Mode.

d. Operator Initiated Start/Stop

The resident application shall perform a start stop command when it is requested from an authorized logon at an HMI. This shall have the highest (Level 1) priority.

2.14.2.3 Language Support

The software development environment shall Sequential Function Chart programming according to IEC 1131-3.

2.14.2.4 Program Inputs and Outputs

The Contractor shall use program inputs listed for each application program to calculate the required program outputs. All program inputs shall be provided and entered by the contractor. Program outputs shall be real analog or digital outputs or logic (virtual) points as required to provide the specified functions. The Contractor shall select the appropriate input and output signals to satisfy the requirements for control of all systems as shown.

2.14.3   PLC Interface Software

2.14.3.1   Database Definition

Data throughout the network will be available to all Operator Stations. The PLC shall provide a data management function relative to a system-wide data base. Windows-based standards will be utilized to provide data transfers in a client-server architecture. The contractor shall initially configure the database at the PLC level. A standard forms approach will be applied using an off-the-shelf program such as Microsoft Excel. The same form will then be used by the process software to configure the system data base at that level. The definition shall include all physical parameters associated with each point. Each point shall be defined and entered into the database by the Contractor, including as applicable:

a. Name.
b. Device or sensor type (i.e., sensor, control relay, motors).
c. Point identification number.
d. Unit.
e. Building number.
f. Area.
g. Installation.
h. Field Equipment Panel number and channel address.
i. Sensor range.
j. Controller range.
k. Sensor span.
l. Controller span.
m. Engineering units conversion (scale factor).
n. Setpoint (analog).
o. High reasonableness value (analog).
p. Low reasonableness value (analog).
q. High alarm limit (differential return to normal).
r. Low alarm limit differential (return to normal).
s. High alarm limit (analog).
t. Low alarm limit (analog).
u. Alarm disable time period upon startup or change of setpoint.
v. Analog change differential (for reporting).
w. Alarm class and associated primary message test.
x. High accumulator limit (pulse).
y. Status description.
z. Run time target.
aa. Failure mode as specified and shown.
bb. Constraints as specified.

2.14.3.2   Command Priorities

A scheme of priority levels shall be provided to prevent interaction of a command of low priority with a command of higher priority. The system shall require the latest highest priority command addressed to a single point to be stored for a period of time longer than the longest time constraint in the on and off states, insuring that the correct command shall be issued when the time constraint is no longer in effect or report the rejected command. The default priorities of the various modes associated with resident application software shall be from the highest to lowest as follows:

PRIORITY 1 - Operator initiated
PRIORITY 2 - Day Night Setback
PRIORITY 3 - Special Events
PRIORITY 4 - Holiday Schedule
PRIORITY 5 - Scheduled Start-Stop

2.15 CENTRAL OPERATOR WORKSTATION HUMAN MACHINE INTERFACE (HMI)

2.15.1 Hardware

Not Used.

2.15.2 Software

Using the Government provided Human Machine Interface (HMI) graphical interface software templates, the Contractor shall provide all software necessary to accomplish the following functions, as appropriate, fully implemented and operational, within the Central Operator Workstations. The Contractor shall adhere to the non-disclosure requirements of the current postwide UMCS Systems Integration contract.

2.15.2.1 Scheduled, Holiday, and Special Events Start Stop Program

The Scheduled, Holiday, and Special Events Start Stop Program shall start and stop equipment based on a Daily Default Schedule, a Holiday Schedule, and a Special Events Schedule. To eliminate power surges, an operator adjustable time delay shall be provided between consecutive start commands. This program shall be coordinated with the Daily Default Schedule, the Holiday Schedule, and a Special Events Schedule. Each shall have inputs, outputs, and a graphic display as described. All shall have a System Database to save scheduled information.

a. Scheduled Start Stop (Daily Default) Schedule

The Daily Default Start-Stop Schedule function shall allow for assignment of specific HVAC systems to unique start-stop schedules. The system shall default to these schedules whenever they do not conflict with either a Holiday Schedule or Special Event Schedule. It shall interface with the temperature control programs to determine whether each of the subordinate HVAC systems should be in Ventilation Delay, Occupied or Unoccupied Mode. The values for program inputs 1, 2, and 3 (enabling of the specified day, start time, and duration) shall initially be entered at the Operator Stations and shall then be transferred to the Basic Process PLC for each HVAC system independently. The Basic Process PLC shall use these values to determine the current mode of a specific HVAC system. It shall then send a command, via the Secondary Network, to the subordinate Application Specific PLC or Micro PLC informing the specific HVAC system to enter into an Occupied Mode, Ventilation-Delay Mode, or Unoccupied Mode based upon the current time of day.

(1) Program Inputs:

(a) Enable/Disable Default Schedule
(b) Cooling and heating start schedules
(c) Cooling and Heating Duration
(d) Current Day of week
(e) Time of day
(f) Cooling or heating mode of operation
(h) Equipment status
(i) Equipment constraints
(j) Consecutive start time delay
(k) Current Month
(l) Current date of month

(2) Program Outputs:

(a) Start/stop signal.
(b) Calculated Stop time based upon the Start time and its duration.

(3) Constraints

Changes to the Start Time, Duration or Enable while a HVAC system is in Occupied Mode shall not effect the system until after it has exited the Occupied Mode.

(4) Graphical Interface

The operator shall configure the following schedule parameters used to interact with the application programs through the Central Station HMI.

(a) Enable or Disable the Occupied Mode for a specific day of the week.
(b) Time the Occupied Mode shall start for each specific day of the week.
(c) Duration in hours for the Occupied Mode for each specific day of the week.

b. Holiday Schedule

The Holiday Schedule function shall override equipment start stop times on days that are defined as holidays. The Holiday Schedule shall have a capacity for at least fifteen (15) base wide holidays. The Base Wide Holiday Schedule or shall be accessed through the Start/Stop Schedule of individual HVAC system graphics. Further, each holiday shall be individually enabled or disabled for each specific HVAC system, thereby allowing a complete configuration of each HVAC system as needed based upon the holiday schedule of the occupants. The Basic Process PLC shall determine when a holiday month and date matches the current month and date. If this occurs, the selected holiday schedule shall override the existing daily schedule. The Basic Process PLC shall then determine the current mode a specific HVAC system should be in. It shall then send a command, via the Secondary Network, to the subordinate PLC informing the specific HVAC system to enter into an Occupied Mode, Ventilation-Delay Mode, or Unoccupied Mode based upon the current time of day.

(1) Configurable Inputs For Each Specific Holiday

(a) Enable/Disable
(b) Date
(c) Start
(d) Duration

(2) Constraints

(a) The base wide Holidays must be entered in chronological order for the program to execute properly.
(b) If changes to the base wide holiday schedule are not made by January 15 of a new year, the system shall inform the operator to set the holiday schedule for the new year.

c. Special Events

The Special Events program shall allow for unique start-stop schedules for special occurrences throughout the year. Up to fifteen (15) special events shall be entered for a specific HVAC system via its special events graphical interface. These special events shall only affect their associated HVAC system. The operator interface shall allow the configuration of special event start times and durations for each individual HVAC system. Additionally, a comment shall be enterable allowing the operator to enter a description of the special event.

(1) Program Inputs

(a) Date
(b) Month
(c) Year
(d) Start Time
(e) Duration
(f) Comment

(2) Configurable Values

All program inputs shall be configurable via the special events graphic.

(3) Constraints

The system shall automatically sort the special events in chronological order whenever a new event is added or an existing event is edited or deleted. Any special events that have already occurred shall automatically be removed from the special events list. Once these special events have been configured, the next scheduled special event is transferred to the Basic Process PLC. When the Basic Process PLC determines that this special event month and date matches the current month and date, the special event start time and duration shall override scheduled Start stop and Holiday Schedules.

(4) Graphic Interface

Graphics: All graphics shall be consistent, coordinated, and integrated with the existing post-wide UMCS Employing FSH Industrial Grade Direct Digital Control System (IGDDCS) graphics. All existing post-wide UMCS Employing FSH Industrial Grade Direct Digital Control System (IGDDCS) graphics shall be modified to include monitoring of additional points by existing post-wide UMCS Employing FSH Industrial Grade Direct Digital Control System (IGDDCS) workstations. New graphics shall be provided for systems where no existing graphics exist.

The operator shall configure the following schedule parameters used to interact with the application programs through the portable work station or the central station HMI.

(a) Add a new special event and configure its start time and duration. Also a description may be entered that is associated with the new special event.

(b) Edit the configuration parameters of an existing special event (i.e. start time, duration, description).

(c) Delete an existing special event.

(d) View the special events list in chronological order. This includes an operator entered start time, duration, and description. Also, the calculated stop time may be seen.

d. Graphic Display Windows

Scheduled, Holiday, and Special Events Start Stop program shall have the following graphic display windows associated with it:

(1) DEFAULT START/STOP
(2) SCHEDULED START/STOP HELP

(3) SPECIAL EVENTS
(4) BASE WIDE HOLIDAY SCHEDULE

2.16 LAN EQUIPMENT

All local PLCs shall be networked together with necessary cables and accessories as specified. All LAN equipment shall fully comply with IEEE Std 802.3 (10 BASE 2 or 10 BASE T) Ethernet networks.

2.16.1 Coaxial Cables and Connectors

Cable shall be type RG-58/U coaxial cable specifically designed for Ethernet applications or RG-62 coaxial cable specifically designed for ARCNET application compatible with the LAN and shall have a tinned copper conductor with polyethylene insulation, tinned copper braid shield, PVC jacket and minimum shield coverage of 95%. Connections to the LAN shall be made using BNC Female-Male-Female T-connectors utilizing a radiation suppressing sleeve supporting the sheath. LAN terminations shall be made using 50 or 93 ohm resistors as required by the LAN.

2.16.2 10 BASE T Cable and Accessories

a. Cable shall meet the requirements of EIA TSB36 for Category 3 cable. Cable shall be label verified. Cable jacket shall be factory marked at regular intervals indicating the verifying organization and its performance level. Conductors shall be solid untinned copper 24 AWG. Cable shall be rated for plenum application per NFPA 70.

b. Outlets shall be 8-position modular jacks that meet the requirements of EIA TSB40-A for Category 3 connecting hardware. Outlet wire terminations shall be insulation displacement type. Jack pin/pair configuration shall be T568A per EIA 568. Outlets shall be unkeyed. Faceplates shall be provided and shall be ivory in color, impact resistant plastic, single gang. Mounting plates shall be provided for system furniture and shall match the furniture system in color.

c. Patch panels shall consist of 8-position jacks arranged in rows or columns on wall mounted frames. Cable terminations shall be insulation displacement type. Patch panel components shall meet or exceed the requirements of EIA TSB40-A for Category 3 connecting hardware. Jack pin/pair configuration shall be T568A per EIA 568. Jacks shall be unkeyed.

d. Patch cords shall be cable assemblies consisting of flexible, twisted pair stranded wire with 8-position plugs at each end. Patch cords shall meet the requirements of EIA TSB36 and TSB40-A for Category. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating the verifying organization and performance level. Patch cords shall be wired straight through such that pin numbers are identical at each end and shall be paired to match T568A patch panel jack wiring per EIA 568. Patch cords shall be unkeyed. Patch cords shall be factory assembled.

2.16.3 Network Interface Card

Network interface cards shall be provided for LAN management functions and for serving devices as shown on the drawings. The network interface card shall use a 16 bit interface to the data bus. It shall be supplied with an on-board BNC RJ45 connector and transceiver for direct connection to the LAN. It shall also have an auxiliary unit input port for performing diagnostics. On-board buffer memory of at least 16K bytes shall be included to prevent loss of data packets.

2.16.4 Bridges

Bridges shall provide communication between local area networks segments as shown. Bridges shall support protocols utilized in the local area networks. The bridge shall include interface equipment to support data rates shown, but no less than 14,400 bps. Bridges with multiple communication lines shall be modular, expandable to a minimum of 16 ports. Each port shall have LED indicators for monitoring network status. The bridge shall be self-configuring and protocol transparent.

2.16.5 Hubs

Network hubs shall provide communication between network devices using 10 BASE T cables. Network hubs shall support protocol utilized in the LAN. Network hubs shall be modular and expandable from a minimum of 16 ports up to 48 ports. Each port shall have LED indicator for network monitoring status. Network hubs shall permit online network changes without disturbing network devices. Malfunctioning network devices shall be automatically removed from service without shutting down the network.

2.16.6 Communications Network Interface

The Central Station shall include modems, data connecting units, and other line terminations as required for each communications circuit connected to the communication network shown.

2.16.7 Uninterruptible Power Supply (UPS)

A self contained UPS suitable for installation and operation at the Central Station, shall be provided sized to provide a minimum of 30 minutes of operation of the Central Station Equipment. Equipment connected to the UPS shall not be affected in any manner by a power outage of a duration less than the rated capacity of the UPS. UPS shall be complete with all necessary power supplies, transformers, batteries, and accessories and shall include visual indication of normal power operation, UPS operation, abnormal operation and visual and audible indication of low battery power.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION CRITERIA

3.1.1 HVAC Control System

The HVAC control system shall be completely installed and ready for operation. Dielectric isolation shall be provided where dissimilar metals are used for connection and support. Penetrations through and mounting holes in the building exterior shall be made watertight. The HVAC control system installation shall provide clearance for control system maintenance by maintaining access space between coils, access space to mixed-air plenums, and other access space required to calibrate, remove, repair, or replace control system devices. The control system installation shall not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.1.2 Software Installation

Software shall be loaded for an operational system, including databases for all points, operational parameters, and system, command, and application software. The Contractor shall provide original and backup copies of source, excluding the general purpose operating systems and utility programs furnished by computer manufacturers and the non-job-specific proprietary code furnished by the system manufacturer, and object modules for all software on each type of media utilized, within 30 days of formal Government acceptance. In addition, a copy of individual floppy disks of all software for each DDC-PLC panel shall be provided.

3.1.3 Device-Mounting Criteria

Devices mounted in or on piping or ductwork, on building surfaces, in mechanical/electrical spaces, or in occupied space ceilings shall be installed in accordance with manufacturer's recommendations and as shown. Control devices to be installed in piping and ductwork shall be provided with all required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements shall not be used except as specified.

3.1.4 Wiring Criteria

Wiring external to control panels, including low-voltage wiring, shall be installed in metallic raceways. Wiring shall be installed without splices between control devices and DDC-PLC panels. Instrumentation grounding shall be installed as necessary to prevent ground loops, noise, and surges from adversely affecting operation of the system. Ground rods installed by the contractor shall be tested as specified in IEEE Std 142. Cables and conductor wires shall be tagged at both ends, with the identifier shown on the shop drawings, in accordance with the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Other electrical work shall be as specified in Section 16415 ELECTRICAL WORK, INTERIOR and as shown.

3.2 CONTROL-SYSTEM INSTALLATION

3.2.1 Damper Actuators

Actuators shall not be mounted in the air stream. Multiple actuators operating a common damper shall be connected to a common drive shaft. Actuators shall be installed so that their action shall seal the damper to the extent required to maintain leakage at or below the specified rate and shall move the blades smoothly.

3.2.2 Room-Instrument Mounting

Room instruments shall be mounted so that their sensing elements are 5 feet above the finished floor unless otherwise shown. Temperature setpoint device shall be recess mounted.

3.2.3 Freezestats

For each 20 square feet of coil-face area, or fraction thereof, a freezestat shall be provided to sense the temperature at the location shown. Manual reset freezestats shall be installed in approved, accessible locations where they can be reset easily. The freezestat sensing element shall be installed in a serpentine pattern.

3.2.4 Averaging-Temperature Sensing Elements

Sensing elements shall have a total element minimum length equal to 1 linear foot per square foot of duct cross-sectional area.

3.2.5 Duct Static-Pressure Sensing Elements and Transmitters

The duct static-pressure sensing element and transmitter sensing point shall be located at 75% to 100% of the distance between the first and last air terminal units.

3.2.6 Indication Devices Installed in Piping and Liquid Systems

Gauges in piping systems subject to pulsation shall have snubbers. Gauges for steam service shall have pigtail fittings with cock. Thermometers and temperature sensing elements installed in liquid systems shall be installed in thermowells.

3.3 CONTROL SEQUENCES OF OPERATION

3.3.1 General Requirements - HVAC Systems

These requirements shall apply to all primary HVAC systems unless modified herein. The sequences describe the actions of the control system for one direction of change in the HVAC process analog variable, such as temperature, humidity or pressure. The reverse sequence shall occur when the direction of change is reversed. Sequence of Control shall be as described on the control drawings.

3.4 COMMISSIONING PROCEDURES

3.4.1 Evaluations

The Contractor shall make the observations, adjustments, calibrations, measurements, and tests of the control systems, set the time schedule, and make any necessary control-system corrections to ensure that the systems function as described in the sequence of operation.

3.4.1.1 Item Check

Signal levels shall be recorded for the extreme positions of each controlled device. An item-by-item check of the sequence of operation requirement shall be performed using Steps 1 through 4 in the specified control system commissioning procedures. Steps 1, 2, and 3 shall be performed with the HVAC system shut down; Step 4 shall be performed after the HVAC systems have been started. External input signals to the DDC-PLC panel (such as starter auxiliary contacts, and external systems) may be simulated in steps 1, 2, and 3. With each operational-mode signal change, DDC-PLC panel output relay contacts shall be observed to ensure that they function.

3.4.1.2 Weather-Dependent Test Procedures

Weather-dependent test procedures that cannot be performed by simulation shall be performed in the appropriate climatic season. When simulation is used, the actual results shall be verified in the appropriate season.

3.4.1.3 Two-Point Accuracy Check

A two-point accuracy check of the calibration of each HVAC control system sensing element and transmitter shall be performed by comparing the DDC-PLC panel readout to the actual value of the variable measured at the sensing element and transmitter or airflow measurement station location. Digital indicating test instruments shall be used, such as digital thermometers, motor-driven psychrometers, and tachometers. The test instruments shall be at least twice as accurate as the specified sensing element-to-DDC-PLC panel readout accuracy. The calibration of the test instruments shall be traceable to National Institute Of Standards And Technology standards. The first check point shall be with the HVAC system in the shutdown condition, and the second check point shall be with the HVAC system in an operational condition. Calibration checks shall verify that the sensing element-to-DDC-PLC panel readout accuracies at two points are within the specified product accuracy tolerances. If not, the device shall be recalibrated or replaced and the calibration check repeated.

3.4.1.4 Insertion and Immersion Temperatures

Insertion temperature and immersion temperature sensing elements and transmitter-to-DDC-PLC panel readout calibration accuracy shall be checked at one physical location along the axis of the sensing element.

3.4.1.5 Averaging Temperature

Averaging-temperature sensing element and transmitter-to-DDC-PLC panel readout calibration accuracy shall be checked every 2 feet along the axis of the sensing element in the proximity of the sensing element, for a maximum of 10 readings. These readings shall then be averaged.

3.4.2 Unit Heater and Cabinet Unit Heater

The "OFF/AUTO" switch shall be placed in the "OFF" position. Each space-thermostat temperature setting shall be turned up so that it makes contact and turns on the unit heater fans. The unit heater fans shall not start. The "OFF/AUTO" switch shall be placed in the "AUTO" position. It shall be ensured that the unit-heater fans start. Each space thermostat temperature setting shall be turned down, and the unit-heater fans shall stop. The thermostats shall be set at their temperature setpoints. The results of testing of one of each type of unit shall be logged.

3.4.3 All-Air Small Packaged Unitary

The schedules shall be manually entered for day temperature and night temperature setpoints as shown. The fan "AUTO/ON" switch shall be set to "ON." The time shall be manually entered as "DAY." The heating-cooling switch shall be raised to "HEATING" and it shall be ensured that cooling is off. The temperature setpoint shall be raised and it shall be ensured that heating starts. The heating/cooling switch shall be set to "COOLING" and it shall be ensured that heat is off. The temperature setpoint shall be lowered and it shall be ensured that cooling starts. The fan "AUTO/ON" switch shall be set to "AUTO" and the foregoing procedure repeated. The fan shall start and stop automatically with the starting and stopping of heating and cooling. The time shall be manually entered as "NIGHT." The foregoing procedures shall be repeated. When the system is verified as operational, the correct "DAY" and "NIGHT" temperature settings shall be restored and the correct time restored. The power to the thermostat shall be shut off and it shall be verified that the thermostat clock keeps time. The results of testing of one of each type of unit shall be logged.

3.5 BALANCING, COMMISSIONING, AND TESTING

3.5.1 Coordination with HVAC System Balancing

Commissioning of the control system, except for tuning of controllers, shall be performed prior to or simultaneous with HVAC system balancing. The contractor shall tune the HVAC control system after all air-system and hydronic-system balancing has been completed, minimum damper positions set and a report has been issued.

3.5.2 Control System Calibration, Adjustments, and Commissioning

Control system commissioning shall be performed for each HVAC system, using test plans and procedures previously approved by the Government. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform commissioning and testing of the HVAC control system. All instrumentation and controls shall be calibrated and the specified accuracy shall be verified using test equipment with calibration traceable to NIST standards. Wiring shall be tested for continuity and for ground, open, and short circuits. Tubing systems shall be tested for leaks. Mechanical control devices shall be adjusted to operate as specified. HVAC control panels shall be pretested off-site as a functioning assembly ready for field connections, calibration, adjustment, and commissioning of the operational HVAC control system. Control parameters and logic (virtual) points including control loop setpoints, gain constants, and integral constraints, shall be adjusted before the system is placed on line. Communications requirements shall be as indicated. Written notification of any planned commissioning or testing of the HVAC Control systems shall be given to the Government at least 14 calendar days in advance.

3.5.3 Performance Verification Test

The Contractor shall demonstrate compliance of the HVAC control system with the contract documents. Using test plans and procedures previously approved by the Government, the Contractor shall demonstrate all physical and functional requirements of the project. The performance verification test procedures shall show, step-by-step, the actions and results demonstrating that the control systems perform in accordance with the sequences of operation. The performance verification test shall not be started until after receipt by the Contractor of written permission by the Government, based on Government approval of the Commissioning Report and completion of balancing. The tests shall not be conducted during scheduled seasonal off-periods of base heating and cooling systems.

3.5.4 Endurance Test

The endurance test shall be used to demonstrate the specified overall system reliability requirement of the completed system. The endurance test shall not be started until the Government notifies the Contractor in writing that the performance verification test is satisfactorily completed. The Government may terminate the testing at any time when the system fails to perform as specified. Upon termination of testing by the Government or by the Contractor, the Contractor shall commence an assessment period as described for Phase II. Upon successful completion of the endurance test, the Contractor shall deliver test reports and other documentation as specified to the Government prior to acceptance of the system.

a. Phase I (Testing)

The test shall be conducted 24 hours per day, 7 days per week, for 15 consecutive calendar days, including holidays, and the system shall operate as specified. The Contractor shall make no repairs during this phase of testing unless authorized by the Government in writing.

b. Phase II (Assessment)

After the conclusion of Phase I, the Contractor shall identify failures, determine causes of failures, repair failures, and deliver a written report to the Government. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the jobsite to present the results and recommendations to the Government. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by performing appropriate portions of the performance verification test. Based on the Contractor's report and test review meeting, the Government may require that the Phase I test be totally or partially rerun. After the conclusion of any retesting which the Government may require, the Phase II assessment shall be repeated as if Phase I had just been completed.

3.5.5 Posted and Panel Instructions

Posted and Panel Instructions, showing the final installed conditions, shall be provided for each system. The posted instructions shall consist of laminated half-size drawings and shall include the control system schematic, equipment schedule, sequence of operation, wiring diagram, communication network diagram, and valve and damper schedules. The posted instructions shall be permanently affixed, by mechanical means, to a wall near the control panel. Panel instructions shall consist of laminated letter-size sheets and shall include a Routine Maintenance Checklist and as-built configuration check sheets. Panel instructions and one copy of the Operation and Maintenance Manuals, previously described herein, shall be placed inside each control panel or permanently affixed, by mechanical means, to a wall near the panel.

3.6 OPERATION AND MAINTENANCE DATA

Furnish the Operation Manual and Maintenance and Repair Manual in accordance with Part 1 paragraph SUBMITTALS.

-- End of Section --

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Appendix FF

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SECTION 01 57 23

TEMPORARY STORM WATER POLLUTION CONTROL

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

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 832-R-92-005	(1992) Storm Water Management for Construction Activities Developing Pollution Preventions and Plans and Best Management Practices

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 122.26	Storm Water Discharges (Applicable to State NPDES Programs, see section 123.25)

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, Section 01 57 24.01 44 STORM WATER POLLUTION PREVENTION PLAN, and the requirements of the National Pollution Discharge Elimination System (NPDES) permit or applicable state Pollution Discharge Elimination System.

1.3 EROSION AND SEDIMENT CONTROLS

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, etc. 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.

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 Burnoff

Burnoff of the ground cover is not permitted.

1.3.1.3 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. Storm Water Notice of Intent for Construction Activities

e. Submit a Storm Water Notice of Intent for NPDES coverage under the general permit for construction activities and a Storm Water Pollution Prevention Plan (SWPPP) for the project to the Contracting Officer prior to the commencement of work. The SWPPP shall meet the requirements of the EPA or State of Texas, whichever is applicable, general permit for storm water discharges from construction sites. Submit the SWPPP along with any required Notice of Intents, Notice of Termination, and appropriate permit fees, via the Contracting Officer, to the appropriate FederalState Texas Commission of Environmental Quality (TCEQ) agency for approval, while meeting the required waiting periods for document submission and land disturbance commencement. 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 EPA or State of Texas, whichever is applicable, general permit for storm water discharge.

(4) Select applicable best management practices from EPA 832-R-92-005.

(5) Include a completed copy of the Registration Statement, BMP Inspection Report Template and Notice of Termination except for the effective date.

(6) Storm Water Pollution Prevention Measures and Notice of Intent 40 CFR 122.26, EPA 832-R-92-005. Provide a "Storm Water Pollution Prevention Plan" (SWPPP) for the project. The SWPPP will meet the requirements of the EPA or State of Texas, whichever is applicable, general permit for storm water discharges from construction sites. Submit the SWPPP along with any required Notice of Intents, Notice of Termination, and appropriate permit fees, via the Contracting Officer, to the appropriate FederalState agency TCEQ for approval,prior to the start of construction while adhering to the ermit required waiting periods. A copy of the approved SWPPP will be kept at the construction on-site office, and continually updated as regulations require to reflect current site conditions.

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 . Final removal of silt fence barriers shall be after establishment of final stabilization. Obtain approval from the Contracting Officer prior to final removal of silt fence barriers.

1.3.3.2 Diversion Dikes

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 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 reestablish a suitable stand of grass.

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
Storm Water Notice of Intent

Pollution prevention plan and Notice of intent for NPDES coverage under the general permit for construction activities

SD-06 Test Reports

Storm Water Inspection Reports for General Permit
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 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.

3.2.1 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-third 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 receive erosion control .

3.2.2 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.

3.3 INSPECTIONS

3.3.1 General

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.

3.3.2 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 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.

3.3.3 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, and all other requirements specified in the applicable Construction Storm Water General Permit. 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.

3.3.4 Storm Water Pollution Prevention Plan (SWPPP) Revisions

In compliance with TPDES General Permit TXR 150000 and Section 01 57 24.01 44 STORM WATER POLLUTION PREVENTION PLAN, the Contractor is responsible to revise Storm Water Pollution Prevention Plan including the erosion control drawings. The current locations of storm control structures and types shall be depicted on the drawing portion of the on-site SWPPP for regulatory inspection and SWPPP revision record.

-- End of Section --