SECTION 01 10 00.12-1477
TASK ORDER STATEMENT OF WORK

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
Modified Record Fire Range (MRF)	

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

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

1.1. SECTION ORGANIZATION

This Section is organized under 6 major “paragraphs”.

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

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

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

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

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

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

2.0 SCOPE

2.1. MODIFIED RECORD FIRE RANGE (MRF)

Provide Modified Record Fire Range (MRF)) as defined by standard Range criteria and the matrix below. This project type is to train and test soldiers on the skills necessary to identify, engage, and defeat stationary infantry targets for day/night qualification requirements with the M16 and M4 rifles. The command & control system and targetry will be Government Furnished and Government Installed (GFGI).

Project Definition Matrix: Incorporated in the RFP at the end of Paragraph 3.0

2.2. SITE:

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

Approximate area available 40.00 acres

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

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

The following are also GFGI items: [Not Supplied - FacilityAddREq : GFGI_ITEMS]

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. Reference applicable appendix for Preliminary FF&E Information including furniture dimensions sizes as shown in the Standard Design.

3.0 MODIFIED RECORD FIRE RANGE (MRF)

3.1. GENERAL REQUIREMENTS:

A. The controlling documents for this range project are the current approved DD1391 Military Construction Project Data and the CEHNC 1110-1-23 Modified Record Fire Range (MRF) Design Volume. The Design Volume can be found at www.hnd.usace.army.mil/rdg/intertemplate.aspx under the title (MRF) Modified Record Fire Range. The information in the Design Volume and this document is based on Training Circular (TC) 25-8 Training Ranges dated 2010, Facility Category Code (FCC) 17806 Facility Description

B. The designer/constructor of this range is strongly urged to coordinate closely with the customer's live-fire range training subject matter experts so that he can understand the training objectives of this type of facility. Even though the engineering and construction techniques in this type of range are not extremely complex, the objectives of the project are unique to live-fire training. The designer/constructor is required to have a live-fire range training subject matter expert on his team to ensure that all military training issues are understood.

C. The designer/constructor of this range must be aware of and comply with the Construction Compliance Inspection (CCI) and Target Interface Inspection (TII) appendix of the Design Volume.

D. Unexploded Ordnance (UXO): The potential for UXO always exists on military property and is a potentially serious problem on all range projects. Special restrictions on construction operations are specified in Paragraph 6 of this section

E. FACILITY SPECIFIC SUBMITTAL REQUIREMENTS

In addition to submittals specified in other parts of this RFP, submit the following:

1) DESIGN SUBMITTALS:

a) Line of Site profiles from 1) each firing position to their associated targets; 2) each firing position to the Lane Markers and Range Limit markers.

b) Emplacement details – both Civil and Electrical

c) Complete riser diagram indicating routing of data cables

d) Voltage drop calculations

2) CONSTRUCTION SUBMITTALS: Complete riser diagram indicating as-built routing of data cables

3.1.1. FACILITY DESCRIPTION

The Modified Record Fire range, FCC 17806, is used to train and test individual soldiers on the skills necessary to identify, engage, and defeat stationary infantry targets for day/night qualification requirements with the M16 and M4 series rifles.

3.1.2. FACILITY RELATIONSHIPS

A separate contractor will enter the project after construction is complete to install targetry and the targetry control system. They will be installing this equipment using the interface points established during this design-build contract. Therefore, deviation from standards depicted in the Design Volume is prohibited.

3.1.3. ACCESSIBILITY REQUIREMENTS

Training Ranges are restricted by occupancy classification to use *only* by able-bodied military personnel during the expected useful life of the building or facility and need not be accessible.

3.1.4. BUILDING AREAS

Refer to the Project Development Matrix for building sizes and requirements

3.1.5. ADAPT BUILD MODEL

Standard building footprints are contained in the Design Volume, no adapt-build models are available.

3.2. FUNCTIONAL AND OPERATIONAL REQUIREMENTS

3.2.1. FUNCTIONAL SPACES

The MRF is comprised of the Range Operations and Control Area (ROCA) and the down range area.

A. RANGE OPERATIONS AND CONTROL AREA – SMALL ARMS: The Range Operations and Control Area (ROCA) is the center for overall control and operation of the range, training exercises, administrative services, and support facilities. From the range operations and control area, downrange target and simulation equipment are operated and activities are monitored for scoring and performance data review. The data is collected and distributed to the participants for an after action review. The location of the buildings is critical for the command and control during training operations on the range; therefore, coordination with the installation user is mandatory for the placement of the ROCA buildings on the construction site. The ROCA is comprised of multiple vertical construction components, which are defined in the Project Specific Matrix. The command & control system and targetry equipment will be Government Furnished and Government Installed (GFGI).

B. DOWN RANGE AREA: The down range area consists of the firing positions, targetry lanes, and support equipment that provide the user the capability to meet current army training standards. In conjunction with this, each site-specific project may include necessary site amenities, such as site improvements, vehicle parking area, access roads, service trails, and exterior utilities. Paragraph 6 of this section or the RFP Appendices establishes which have been authorized for this range project. The command & control system and targetry equipment will be Government Furnished and Government Installed (GFGI).

1) **Line of Site (LOS)** validation must be accomplished during design between each firing position and all of its associated target locations, lane markers and limit markers. Document the LOS validation in the design submittal(s).

2) Signage as described in the Design Volume is required for this range. In addition, refer to installation specific requirements in Paragraph 6 of this section or Appendix H.

3) **Surface Danger Zone (SDZ)**. An SDZ for the layout depicted in Appendix J has been validated by the Installation safety office. Any changes made to the layout during design development that may affect the validated SDZ shall be approved by the Installation safety office.

3.3. SITE FUNCTIONAL REQUIREMENTS

The range's functional layout and adjacency requirements are as indicated on drawings contained in the Design Volume and, if applicable, as depicted in Appendix J. The extent to which the drawings represent required or preferred layouts and the allowable latitude for changes to them is as noted on the drawings. The layout of the Range Operations and Control Area is dependent on the user’s training objectives and the facilities’ terrain.

3.4. SITE AND LANDSCAPE REQUIREMENTS

Site design requirements are identified in the Design Volume. Special attention must be given to the Line-of-Sight (LOS) validation, the Surface Danger Zone (SDZ) verification and site drainage issues. Provide the LOS validation and SDZ verification in the design package.

3.5. ARCHITECTURAL REQUIREMENTS

A. Architectural design requirements are identified in the Design Volume.

B. Coordinate with the installation's Public Works office for the exterior and interior color finishes if not specified in the RFP Appendices.

3.5.1. FINISHES AND INTERIOR SPECIALTIES:

A. FINISHES: Coordinate with the installation's Public Works office for the exterior and interior color finishes if not specified in the RFP Appendices. See the Design Volume.

B. INTERIOR SPECIALTIES:

1) Signage as described in the Design Volume is required for this range. In addition, refer to installation specific requirements in Paragraph 6 of this section or Appendix H.

2) Fire Extinguishers, Cabinets & Mounting Brackets: Furnish a list of installed fire extinguisher cabinets and mounting brackets (including location, size and type) to the Contracting Office Representative. Provide a list of all required portable fire extinguishers, with descriptions (location, size, type, etc.) and total number per type. See also Section 01 33 16, Attachment D, "SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW", paragraph 1.14.

3.6. SEE PARAGRAPH 5.6 STRUCTURAL REQUIREMENTS – NOT USED

3.7. SEE PARAGRAPH 6.7 THERMAL PERFORMANCE – NOT USED

3.8. PLUMBING REQUIREMENTS

Water and Sewer service to a range project is a rare occurrence, the remoteness of most ranges from the Installation's existing infrastructure makes their use impractical. However, if water or sewer hookup is specified in the Project Definition Matrix, refer to Paragraph 6 and Appendix C for utility connection information.

3.9. COMMUNICATIONS AND SECURITY SYSTEMS

A. If telephone service is included in the Scope of this project, coordination with the local NEC is required to ensure Installation compatibility and acceptance.

B. Refer to Paragraph 6 of this section and Appendix C for utility connection information.

C. There shall be a clear delineation between the down range communications infrastructure and the facility telecommunication infrastructure. Each communication system enters the ROC Tower, but shall be terminated and housed in separate enclosures and backboards. The downrange communications infrastructure shall be installed in accordance with the Design Volume and the facility telecommunications infrastructure shall be installed in accordance with I3A.

3.10. ELECTRICAL REQUIREMENTS

A. GENERAL: Power and lighting shall be provided to the facilities and downrange area as specified below; all IEEE Standards (including Recommended Practice) where the scope is applicable to this design effort; all UL Standards where the UL scope is applicable to this design effort and where itemized in the combined interdisciplinary areas cited.

1) Provide the downrange power and data communications systems in accordance with CEHNC 1110-1-23 Modified Record Fire Range (MRF) Design Volume.

2) Perform a short circuit study as an integral part of selecting and sizing electrical distribution components (all equipment shall be fully rated; that is, do not use series-combination rated equipment).

3) For Ranges being provided power through Government owned utility systems, perform a coordination study to ensure that protective device settings are appropriate for the expected range of conditions (depending on the design and construction schedule, it is acceptable to design adequate protective devices with adjustable features, followed by a coordination study required during construction to specify the correct settings.)

4) Refer to Paragraph 6 of this Section and Appendix C for utility connection information.

5) The Design Volume contains design submittal and construction submittal requirements that are in addition to those identified by Section 01 33 16 Design After Award and Section 01 78 02.00 10 Closeout Submittals. Project submittal register shall specifically include all submittals required by the Design Volume

B. <u>POWER</u>: Circuit breakers, disconnect switches, and other devices that meet the OSHA definition of energy-isolating device must be lockable.

1) Allowable Facility Voltage Drop: For transformer located exterior to the facility, limit the combined voltage drop for service conductors, feeders, and branch circuits to 5 percent. Individual voltage drop on branch circuits should not exceed 3 percent.

2) Allowable Downrange Voltage Drop: Voltage available to each target shall be no less than 95 percent of the target's rated operating voltage.

3) Medium voltage (MV) surge arrestors shall be provided on all riser poles, within each MV sectionalizer enclosures, within each pad mounted transformer, and wherever the medium voltage rises above grade.

C. <u>LIGHTING</u>: Night Operations Lighting, where separate switching standard and red lighting is required, identify each switch with a label and provide the standard lighting switch with a locking tab that will permit the standard lighting to be locked "off" during night operations.

3.11. HEATING VENTILATING AND AIR CONDITIONING (HVAC) REQUIREMENTS

Heating, Ventilating and Air Conditioning (HVAC) requirements are identified in the Design Volume. HVAC requirements are addressed on a building-by-building basis.

3.12. ENERGY CONSERVATION REQUIREMENTS

Refer to paragraph 5.9 for energy conservation requirements.

3.13. FIRE PROTECTION REQUIREMENTS

Fire detection and alarm systems are seldom used in Army training ranges due to the low volume of personnel in any facility at any given time. If the project dictates a fire detection and/or a response system, coordinate directly with the Installation's Fire Department for specific requirements. Refer to Paragraph 6 of this section for installation requirements.

3.14. SEE PARAGRAPHS 5.12 AND 6.14 SUSTAINABLE DESIGN – NOT USED

3.15. SEE PARAGRAPH 6.15 ENVIRONMENTAL – NOT USED

3.16. SEE PARAGRAPH 6.16 PERMITS – NOT USED

3.17. SEE PARAGRAPH 6.17 DEMOLITION – NOT USED`

3.18. SEE PARAGRAPH 6.18 ADDITIONAL FACILITIES – NOT USED

3.19. EQUIPMENT AND FURNITURE REQUIREMENTS

3.19.1. FURNISHINGS

Furnishings, other than installed equipment, are Government-furnished and Government-installed (GFGI) unless otherwise specified in this document.

3.19.2. EQUIPMENT

Targetry and Targetry Control Equipment GFGI unless otherwise specified in this document.

3.20. FACILITY SPECIFIC REFERENCES

A. CEHNC 1110-1-23 Modified Record Fire Range (MRF) Design Volume - www.hnd.usace.army.mil/rdg/intertemplate.aspx under the title (MRF) Modified Record Fire Range

B. Training Circular (TC) 25-8 Training Ranges dated 2010, Facility Category Code (FCC) 17806 Facility Description

MODIFIED RECORD FIRE RANGE (MRF)
PROJECT DEFINITION MATRIX

An "X" indicates selections

General Project Information	
X	No Known Environmental Issues on the Project Site
	Environmental Issues Potentially on Project Site – addressed in more detail in Paragraph 6 and appendices.
X	No Known Evidence of Unexploded Ordnance (UXO) on the Project Site
	Unexploded Ordnance (UXO) Potentially on Project Site – UXO awareness instruction required for all site employees
X	ADA and ABA Accessibility Guidelines do not apply to this project
	Constructive Anti-Terrorism/Force Protection (ATFP) measures are required for this project – addressed in more detail in Paragraph 6 if different from UFC 4-010-01

Downrange Area	
A. Lanes	
X	Standard - 16 Lanes, 20 m wide lanes, 9 Target Emplacements Per lane
	Non-Standard: Lanes Lane width Target Emplacements each lane
B. Firing Positions	
X	Foxholes: 0 Drop –in 16 Walk-in
X	Prone: 16
	None
C. Markers	
X	Limit Markers: Configured for Night Fire? Yes

Downrange Area	
X	Lane Markers
X	Firing Point Markers
	Intermediate Lane Markers
D. Emplacements	
	Below Ground Target Emplacements
	Above Ground Target Emplacements
X	Combination as Dictated by Terrain
X	Zero Target Boots: 16 Sets
	Night Fire Line:
E. Emplacement Material	
X	Standard Concrete Target Emplacements
	Other:
F. Target Power and Control	
X	Hardwired Electricity and Data
	Hardwired Electricity and RF/WiFi Data (provided under separate contract)
	Battery and RF/WiFi Data (power and data provided under separate contract)
	Other:

Range Operations and Control Area (ROCA)	
1	Range Control Tower – Small Arms (Range Operation Center (ROC) – Tower) Standard size: 289 SQ FT, 17’ x 17’ enclosed
	Height to Control Room Floor: 10 feet
	Observation Level

Range Operations and Control Area (ROCA)	
A. Construction	
	D/B Contractors Discretion
	Concrete Masonry Unit (CMU)
X	Metal
	Other:
B. Building Infrastructure and Features	
X	Electrical Service
X	Day and night operations lighting
X	Lightning protection
X	Public Address (PA) System
X	Hardwired Command & Control Data Service-Downrange Data
X	Telephone service: copper, see App J for connection point
X	Fire Extinguisher Cabinets or Brackets
	Fire Detection & Alarm (connected to Installation Emergency Services)
C. HVAC: Power Source: See App J for infrastructure connection point	
X	Both heat and air conditioning
	Heat only
	Freeze protection only
	Ventilation only
D. Other	
	All structural steel, stairs, railings, grates, etc shall be galvanized steel. HVAC units shall be provided with galvanized security bars. Refer to Notes 6.19.5 and 6.19.6. No fire alarm of mass notification is required.
1	Operations Storage Building Standard Size: 20 ft x 40 ft – 800 SQ FT

Range Operations and Control Area (ROCA)	
A. Construction	
	D/B Contractors Discretion
	Concrete Masonry Unit (CMU)
X	Metal
	Other:
B. Building Infrastructure and Features	
X	Electrical Service
X	Day and night operations lighting
X	Lightning protection
X	Data Service - Internet
X	Telephone service: copper
X	Fire Extinguisher Cabinets or Brackets
	Fire Detection & Alarm (connected to Installation Emergency Services)
C. HVAC Power Source: 120/240	
X	Both heat and air conditioning
	Heat only
	Freeze protection only
	Ventilation only
D. Other	
	HVAC units shall be provided with galvanized security bars.
1	Classroom Facility (General Instruction Building) Standard Size: 20 ft x 40 ft – 800 SQ FT
A. Construction	
	D/B Contractors Discretion

Range Operations and Control Area (ROCA)	
	Concrete Masonry Unit (CMU)
X	Metal
	Other:
B. Building Infrastructure and Features	
X	Electrical Service
X	Day and night operations lighting
X	Lightning protection
X	Data Connection with ROC
X	Data Service - Internet
X	Telephone service: copper
X	Fire Extinguisher Cabinets or Brackets
	Fire Detection & Alarm (connected to Installation Emergency Services)
C. HVAC: Power Source: 120/240	
X	Both heat and air conditioning
	Heat only
	Freeze protection only
	Ventilation only
D. Other	
	HVAC units shall be provided with galvanized security bars.
1	Covered Mess Standard Size: 20’ x 40’
A. Construction	
	D/B Contractors Discretion
X	Metal
	Other:

Range Operations and Control Area (ROCA)	
B. Building Infrastructure and Features	
X	Electrical Service
X	Day and night operations lighting
X	Lightning protection
C. Other	
1	Ammunition Breakdown Building Standard Size: 185 SQ FT, 10’ x 12’ enclosed
A. Construction	
	D/B Contractors Discretion
	Concrete Masonry Unit (CMU)
X	Metal
	Other:
B. Building Infrastructure and Features	
X	Electrical Service
X	Day and night operations lighting
X	Lightning protection
X	Fire Extinguisher Cabinets or Brackets
	Fire Detection & Alarm (connected to Installation Emergency Services)
C. HVAC: Power Source: 120/240	
	Both heat and air conditioning
X	Heat only
	Freeze protection only
	Ventilation only
D. Other	

Range Operations and Control Area (ROCA)	
	Roll-up metal doors shall be provided over distribution windows in lieu of folding doors.
2	Latrine
	Aerated Vault Latrine Standard Size: 330 SQ FT, 26’ x 12’-8”
	Wet Latrine – Septic Field Standard Size: 550 SQ FT, 22’ x 25’
	Wet Latrine – Sewage System Standard Size: 550 SQ FT
	Other:
X	Port-A-John Slab three-sided walls
A. Construction	
X	D/B Contractors Discretion
	Concrete Masonry Unit (CMU)
	Metal
	Other:
B. Building Infrastructure and Features	
	Electrical Service
	Day and night operations lighting
	Lightning protection
	Water Supply: Linear feet to source:
	Water Supply - Well
	Sewage Hookup: Linear feet to tie in: [Not Supplied - MrfRocaLatrine : MRF_LAT_BI_LF2TI]
	Fire Extinguisher Cabinets or Brackets

Range Operations and Control Area (ROCA)	
	Fire Detection & Alarm (connected to Installation Emergency Services)
C. HVAC: Power Source: [Not Supplied - MrfRocaLatrine : MRF_LAT_HVAC_POWER]	
	Both heat and air conditioning
	Heat only
	Freeze protection only
	Ventilation only
D. Other	
1	Bleacher Enclosure Standard Size: 726 SQ FT, 33’ x 22’
A. Construction	
	D/B Contractors Discretion
	Concrete Masonry Unit (CMU)
X	Metal
	Other:
B. Building Infrastructure and Features	
X	Electrical Service
X	Day and night operations lighting
X	Lightning protection
C. Other	
0	Non-Standard Building: Size:
A. Construction	
	D/B Contractors Discretion

Range Operations and Control Area (ROCA)	
	Concrete Masonry Unit (CMU)
	Metal
	Other:
B. Building Infrastructure and Features	
	Electrical Service
	Day and night operations lighting
	Lightning protection
	Public Address (PA) System
	Data Service - Internet
	Telephone service:
	Water Supply: Linear feet to source:
	Water Supply - Well
	Sewage Hookup: Linear feet to tie in:
	Fire Extinguisher Cabinets or Brackets
	Fire Detection & Alarm (connected to Installation Emergency Services)
C. HVAC: Power Source:	
	Both heat and air conditioning
	Heat only
	Freeze protection only
	Ventilation only
D. Other	

Small Arms Range Design Submittal POCs and Quantities for Distribution

Each submittal will require three week review time. The data on the CD should include drawings (PDF or CAL), specs, calculations, and design analysis so the entire package can be reviewed.

All project types

U.S. Army Engineering and Support Center, Huntsville (HNC)
ATTN: CEHNC-ISP-MI (Stephenson)
4820 University Square
Huntsville, AL 35816-1822
Telephone: 256-895-1534
E-mail: william.c.stephenson@.usace.army.mil
Submittals: 4 Drawing sets (half size), 1 Specs, 1 Calc, 1 Design Analysis & 2 CDs for all review

U.S. Army Information Systems Engineering Command
ATTN: MCA/Construction (Mr. Rickey Smith)
1435 Porter Street
Fort Detrick, MD 21793
(301) 619-6226
Email: Rickey.smithsr@us.army.mil; George.gaffney@us.army.mil; deb.bonebrake@us.army.mil
Submittals: 2 CDs for all reviews

All Range projects

U.S. Army Environmental Command
Environmental Planning Branch (Attn: Jill Reilly-Hauck)
1835 Army Boulevard, BSMT (Bldg 2000)
Fort Sam Houston, TX 78234-2686
Tel No-
Email:
Submittals: 1 CD for all reviews

Send to the following 3 organizations per Range Classification

(1) Small Arms Ranges

Tank Automotive & Armament Command (TACOM)
ATTN: Ray Muskeyvalley Jr
TACOM Targetry
Building 110, 2nd Flr, Southeast
Rock Island, IL 61299-7630
Telephone: 309-782-6245
E-mail: Raymond.andrew.muskeyvalley@us.army.mil
Submittals: 2 Drawing sets & 2 CDs for all reviews

Small Arms Range Design Submittal POCs and Quantities for Distribution

U.S. Army Training Support Center (ATSC)
ATTN: TCM- L, Range Mod (Reggie Hollaway)
Bldg 2787 Harrison Loop
Fort Eustis, VA 23604
Telephone: 757-878-2320
E-mail: Reginald.g.holloway@us.army.mil
Submittals: 2 Drawing sets (half size) & 2 CDs for all reviews

IMCOM and ACOM: provide 1 CD (PDF) and 1 drawing set (half size) per submittal.

IMCOM:

HQ Installation Management Command
IMCOM G-7 (IMOP-T), Sustainable Range Program
11711 North I35, Suite 110, Cube U-23
San Antonio, TX 78233-5498
Office:210-424-8507
E-Mail: bob.wilson2@us.army.mil or daniel.lee.smith@us.army.mil
Submittals: 1 CD (PDF) per submittal.

ACOM: Contact HNC representative for ACOM distribution information.

4.0 APPLICABLE CRITERIA

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

4.1. INDUSTRY CRITERIA

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

Table 1: Industry Criteria

Air Conditioning and Refrigeration Institute (ARI)	
ARI 310/380	Packaged Terminal Air-Conditioners and Heat Pumps
ARI 440	Room Fan-Coil and Unit Ventilator
ANSI/ARI 430-99	Central Station Air Handling Units
ARI 445	Room Air-Induction Units
ARI 880	Air Terminals
Air Movement and Control Association (AMCA)	
AMCA 210	Laboratory Methods of Testing Fans for Rating
American Architectural Manufacturers Association (AAMA)	
AAMA 605	Voluntary Specification Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
AAMA 607.1	Voluntary Guide Specifications and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum
AAMA 1503	Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections
American Association of State Highway and Transportation Officials (AASHTO)	

	Roadside Design Guide [guardrails, roadside safety devices]
	Standard Specifications for Transportation Materials and Methods of Sampling and Testing [Road Construction Materials]
	Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals
	Guide for Design of Pavement Structures, Volumes 1 and 2 [pavement design guide]
	A Policy of Geometric Design of Highways and Streets
American Bearing Manufacturers Association (AFBMA)	
AFBMA Std. 9	Load Ratings and Fatigue Life for Ball Bearings
AFBMA Std. 11	Load Ratings and Fatigue Life for Roller Bearings
American Boiler Manufacturers Association (ABMA)	
ABMA ISEI	Industry Standards and Engineering Information
American Concrete Institute	
ACI 302.2R	Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials
ACI 318	Building Code Requirements for Structural Concrete
ACI SP-66	ACI Detailing Manual
ACI 530	Building Code Requirements for Masonry Structures
ADA Standards for Accessible Design	
See US Access Board	ADA and ABA Accessibility Guidelines for Buildings and Facilities, Chapters 3-10.
American Institute of Steel Construction (AISC)	
	Manual of Steel Construction – 13th Edition (or latest version)

American Iron and Steel Institute	
AISI S100	North American Specification for the Design of Cold-Formed Steel Structural Members
American National Standards Institute 11 (ANSI)	
ANSI Z21.10.1	Gas Water Heaters Vol. 1, Storage water Heaters with Input Ratings of 75,000 Btu per Hour or less
ANSI Z124.3	American National Standard for Plastic Lavatories
ANSI Z124.6	Plastic Sinks
ANSI Z21.45	Flexible Connectors of Other Than All-Metal Construction for Gas Appliances
ANSI/IEEE C2	National Electrical Safety Code
ANSI/AF&PA NDS	National Design Specification for Wood Construction
American Society of Civil Engineers (ASCE)	
ASCE 7	Minimum Design Loads for Buildings and Other Structures
ASCE 77	Manual of Practice No. 77, Design and Construction of Urban Stormwater Management Systems
ASCE 60	Gravity Sanitary Sewer Design and Construction (ASCE Manuals and Reports on Engineering Practice No. 60)
ASCE/SEI 31-03	Seismic Evaluation of Existing Buildings [Existing Building Alteration/Renovation]
ASCE/SEI 41-06	Seismic Rehabilitation of Existing Buildings [Existing Building Alteration/Renovation]
American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)	
ASHRAE 90.1	ANSI/ASHRAE/IESNA 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE Guideline 0	The Commissioning Process

ASHRAE Guideline 1.1	The HVAC Commissioning Process
ASHRAE Handbooks	Fundamentals, HVAC Applications, Systems and Equipment, Refrigeration (Applicable, except as otherwise specified)
ASHRAE Standard 15	Safety Standard for Refrigeration Systems
ASHRAE Standard 62.1	Ventilation for Acceptable Indoor Air Quality
ASHRAE Standard 55	Thermal Environmental Conditions for Human Occupancy (Design portion is applicable, except where precluded by other project requirements.)
ASHRAE Standard 189.1-2009	Standard for the Design of High-Performance Green Buildings (ANSI Approved; USGBC and IES Co-sponsored), - (APPLICABLE TO THE EXTENT SPECIFICALLY CALLED OUT IN THE CONTRACT)
American Society of Mechanical Engineers International (ASME)	
ASME BPVC SEC VII	Boiler and Pressure Vessel Code: Section VII Recommended Guidelines for the Care of Power Boilers
ASME A17.1	Safety Code for Elevators and Escalators
ASME B 31 (Series)	Piping Codes
American Water Works Association (AWWA)	
	Standards [standards for water line materials and construction]
American Welding Society	
	Welding Handbook
	Welding Codes and Specifications (as applicable to application, see International Building Code for example)
Architectural Woodwork Institute (AWI)	
Latest Version	AWI Quality Standards
Associated Air Balance Council (AABC)	

AABC MN-1	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems
	AABC Associated Air Balance Council Testing and Balance Procedures
ASTM International	
ASTM C1060-90(	Standard Practice for Thermographic Inspection of Insulation Installations in Envelope Cavities of Frame Buildings
ASTM E 779	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
ASTM E1827-96	Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
Builders Hardware Manufacturers Association (BHMA)	
ANSI/BHMA	The Various BHMA American National Standards
Building Industry Consulting Service International	
	Telecommunications Distribution Methods Manual (TDMM)
	Customer-Owned Outside Plant Design Manual (CO-OSP)
Code of Federal Regulations (CFR)	
49 CFR 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
10 CFR 430	Energy Conservation Program for Consumer Products
Consumer Electronics Association	
CEA 709.1B	Control Network Protocol Specification
CEA 709.3	Free-Topology Twisted-Pair Channel Specification
CEA 852	Tunneling Component Network Protocols Over Internet Protocol Channels
Electronic Industries Association (EIA)	

ANSI/EIA/TIA 568	Structured Cabling Series
ANSI/EIA/TIA 569	Commercial Building Standard for Telecommunications Pathways and Spaces (includes ADDENDA)
ANSI/TIA/EIA-606	Administrative Standard for the Telecommunications Infrastructure of Commercial Buildings
J-STD EIA/TIA 607	Commercial Building Grounding and Bonding Requirements for Telecommunications
Federal Highway Administration (FHWA)	
	Manual on Uniform Traffic Control Devices for Streets and Highways [signage and pavement markings for streets and highways]
FHWA-NHI-01-021	Hydraulic Engineering Circular No. 22, Second Edition, URBAN DRAINAGE DESIGN MANUAL
Illuminating Engineering Society of North America (IESNA)	
IESNA RP-1	Office Lighting
IESNA RP-8	Roadway Lighting
IESNA Lighting Handbook	Reference and Application
Institute of Electrical and Electronics Engineers Inc. (IEEE)	
	Standard for Use of the International System of Units (SI): the Modern Metric System
Standard 1100	Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
International Code Council (ICC)	
IBC 2009	International Building Code Note: All references in the International Building Code to the International Electrical Code shall be considered to be references to NFPA 70. All references in the International Building Code to the International Fuel Gas Code shall be considered to be references to NFPA 54 and

	NFPA 58. All references in the International Building Code to the International Fire Code and Chapter 9 shall be considered to be references to Unified Facilities Criteria (UFC) 3-600-01.
IMC	International Mechanical Code – Note: For all references to “HEATING AND COOLING LOAD CALCULATIONS”, follow ASHRAE 90.1 Note: For all references to “VENTILATION”, follow ASHRAE 62.1
IRC	International Residential Code
IPC	International Plumbing Code
IEC	Energy Conservation Code (IEC) –Applicable only to the extent specifically referenced herein. Refer to Paragraph 5, ENERGY CONSERVATION requirements.
IGC	International Gas Code - not applicable. Follow NFPA 54, National Fuel Gas Code and NFPA 58, Liquified Petroleum Gas Code.
International Organization for Standardization (ISO)	
ISO 6781:1983	Qualitative detection of thermal irregularities in building envelopes – infrared method
LonMark International (LonMark)	
LonMark Interoperability Guidelines	(available at www.lonmark.org), including: Application Layer Guidelines, Layer 1-6 Guidelines, and External Interface File (XIF) Reference Guide
LonMark Resource Files	(available at www.lonmark.org), including Standard Network Variable Type (SNVT) definitions
Metal Building Manufacturers Association (MBMA)	
	Metal Building Systems Manual
Midwest Insulation Contractors Association (MICA)	
	National Commercial and Industrial Insulation Standards Manual

National Association of Corrosion Engineers International (NACE)	
NACE RP0169	Control of External Corrosion on Underground or Submerged Metallic Piping Systems
NACE RP0185	Extruded, Polyolefin Resin Coating Systems with Adhesives for Underground or Submerged Pipe
NACE RP0285	Corrosion Control of Underground Storage Tank Systems by Cathodic Protection
NACE RP0286	Electrical Isolation of Cathodically Protected Pipelines
National Electrical Manufacturers Association (NEMA)	
National Environmental Balancing Bureau (NEBB)	
	Procedural Standards Procedural Standards for Testing Adjusting Balancing of Environmental Systems
National Fire Protection Association (NFPA)	
NFPA 10	Standard for Portable Fire Extinguishers
NFPA 13	Installation of Sprinkler Systems
NFPA 13R	Residential Occupancies up to and Including Four Stories in Height Sprinkler Systems
NFPA 14	Standard for the Installation of Standpipes and Hose Systems
NFPA 20	Installation of Centrifugal Fire Pumps
NFPA 24 NFPA 25	Standard for the Installation of Private Fire Service Mains and Their Appurtenances [underground fire protection system design] Inspection, Testing And Maintenance Of Water-Based Fire Protection Systems
NFPA 30	Flammable and Combustible Liquids Code
NFPA 30A	Motor Fuel Dispensing Facilities and Repair Garages
NFPA 31	Installation of Oil Burning Equipment

NFPA 54	National Fuel Gas Code
NFPA 58	Liquefied Petroleum Gas Code
NFPA 70	National Electrical Code
NFPA 70E	Standard for Electrical Safety in the Workplace
NFPA 72	National Fire Alarm Code
NFPA 76	Fire Protection of Telecommunications Facilities
NFPA 80	Standard for Fire Doors and Fire Windows
NFPA 90a	Installation of Air Conditioning and Ventilating Systems
NFPA 96	Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
NFPA 101	Life Safety Code
NFPA 780	Standard for the Installation of Lightning Protection Systems
National Roofing Contractor's Association (NRCA)	
	Roofing and Waterproofing Manual
National Sanitation Foundation, International	
NSF/ANSI Std. 2, 3, 4, 5, 6, 7, 8, 12, 13, 18, 20, 21, 25, 29, 35, 36, 37, 51, 52, 59, 169	Food Equipment Standards
ANSI/UL Std. 73, 197, 471, 621, 763	Food Equipment Standards
CSA Std. C22.2 No. 109, 120, 195	Food Equipment Standards
Occupational Safety and Health Administration (OSHA)	
Title 29, Part 1926	OSHA Construction Industry Standards, Title 29, Code of Federal

	Regulations, Part 1926, Safety and Health Regulations for Construction
Plumbing and Drainage Institute (PDI)	
PDI G 101	Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data
PDI WH201	Water Hammer Arrestors
Precast Concrete Institute	
PCI Design Handbook	Precast and Prestressed Concrete
Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)	
SMACNA HVAC Duct Construction Standards	HVAC Duct Construction Standards - Metal and Flexible
SMACNA Architectural Manual	Architectural Sheet Metal Manual
SMACNA HVAC TAB	HVAC Systems - Testing, Adjusting and Balancing
State/Local Regulations	
	State Department of Transportation Standard Specifications for Highway and Bridge Construction
	Sedimentation and Erosion Control Design Requirements
	Environmental Control Requirements
	Storm Water Management Requirements
Steel Door Institute (SDI)	
ANSI A250.8/SDI 100	Standard Steel Doors and Frames
Steel Deck Institute	
	SDI Diaphragm Design Manual
Steel Joist Institute	

	Catalog of Standard Specifications and Load Tables for Steel Joists and Joist Girders
Underwriters Laboratories (UL)	
UL 96A	Installation Requirements for Lightning Protection Systems
UL 300	Standard for Safety for Fire Testing of Fire Extinguishing Systems for Protection of Restaurant Cooking Areas
UNITED STATES ACCESS BOARD: U.S. ARCHITECTURAL AND TRANSPORTATION BARRIERS COMPLIANCE BOARD	
ADA and ABA Accessibility Guidelines for Buildings and Facilities	ABA Accessibility Standard for DoD Facilities Derived from the ADA and ABA Accessibility Guidelines: Specifically includes: ABA Chapters 1 and 2 and Chapters 3 through 10. Use this reference in lieu of IBC Chapter 11. Excluded are: (a) Facilities, or portions of facilities, on a military installation that are designed and constructed for use exclusively by able-bodied military personnel (See Paragraph 3 for any reference to this exclusion). (b) Reserve and National Guard facilities, or portions of such facilities, owned by or under the control of the Department of Defense, that are designed and constructed for use exclusively by able-bodied military personnel. (See paragraph 3 for any reference to this exclusion).
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES	
	FDA National Food Code
U.S. GREEN BUILDING COUNCIL (USGBC)	
LEED-NC	Green Building Rating System for New Construction & Major Renovations
	Application Guide for Multiple Buildings and On-Campus Building Projects

4.2. MILITARY CRITERIA

The project shall conform to the following criteria. Certain design impacts and features due to these criteria are noted for the benefit of the offeror. However, all requirements of the referenced criteria will be applicable, whether noted or not, unless otherwise specified herein.

4.2.1. Energy Policy Act of 2005 (Public Law 109-58) (applies only to the extent specifically implemented in the contract, which may or may not directly cite or reference EPACT)

4.2.2. Energy Independence and Security Act of 2007- “EISA” (applies only to the extent specifically implemented in the contract)

4.2.3. 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.

4.2.4. TB MED 530: Occupational and Environmental Health Food Sanitation

4.2.5. Unified Facilities Criteria (UFC) 3-410-01FA: Heating, Ventilating, and Air Conditioning - applicable only to the extent specified in paragraph 5, herein.

4.2.6. UFC 3-101-0 Architectural Design, (Applies only to the extent specifically implemented herein).

4.2.7. UFC 3-210-10, Low Impact Development, applicable only to the extent specified herein.

4.2.8. 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.

4.2.9. UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings

4.2.10. 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.

4.2.11. UFC 4-021-01 Design and O&M: Mass Notification Systems

4.2.12. UFC 3-420-01, Plumbing Systems, (Applicable only to the extent specifically implemented herein).

4.2.13. Technical Criteria for Installation Information Infrastructure Architecture (I3A)

(a) Email: DetrickISECI3Aguide@conus.army.mil

4.2.14. U.S. Army Information Systems Engineering Command (USAISEC) SECRET Internet Protocol (IP) Router Network (SIPRNET) Technical Implementation Criteria (STIC).. See Paragraph 3 for applicability to specific facility type. May not apply to every facility. This is mandatory criteria for those facilities with SIPRNET.

4.2.14.1. Draft Guide Specification for Section 27 05 28 PROTECTIVE DISTRIBUTION SYSTEM (PDS) FOR SIPRNET COMMUNICATIONS SYSTEMS, found at http://mrsi.usace.army.mil/rfp/Shared%20Documents/SECTION_270528-v3.pdf

5.0 GENERAL TECHNICAL REQUIREMENTS

This paragraph contains technical requirements with general applicability to Army facilities. See also Paragraph 3 for facility type-specific operational, functional and technical requirements. Residential or similar grade finishes and materials are not acceptable for inclusion in these buildings, unless otherwise specifically allowed. References to ASHRAE Standard 189.1 are to ASHRAE Standard 189.1-2009 unless otherwise specified in this Paragraph.

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 SELECTION: Meet the allowable site requirements of ASHRAE Standard 189.1, Section 5.3, Manadatory Provisions, and either Section 5.4, Prescriptive Option, or Section 5.5, Performance Option; and ASHRAE Standard 189.1, Section 10.3.2.1.1, unless otherwise specified by the current Department of Defense Minimum Antiterrorism Standards for Buildings, UFC 4-010-01.

5.1.3. 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.

5.1.3.1. Enclosures and Visual Screens: 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.

5.1.3.2. Dumpster Pads: 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.

5.1.3.3. 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.

5.1.3.4. Emergency Vehicle Access: 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.

5.1.3.5. Stormwater Management and Low Impact Design: Employ design and construction strategies (Best Management Practices, or BMPs) that reduce stormwater runoff, reduce discharges of polluted water offsite and maintain or restore predevelopment hydrology with respect to temperature, rate, volume, quality and duration of flow. See “Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act (EISA)” (http://www.epa.gov/owow/NPS/lid/section438/pdf/final_sec438_eisa.pdf) and Paragraph 6, PROJECT SPECIFIC requirements for additional information. BMPs used to treat runoff must be capable of removing 80% of the average annual postdevelopment total suspended solids (TSS) load based on existing monitoring reports. BMPs are considered to meet these criteria if:

(a) They are designed in accordance with standards and specifications from a state or local program that has adopted these performance standardsOR

(b) There exists infield performance monitoring data demonstrating compliance with the criteria. Data must conform to accepted protocol (e.g., Technology Acceptance Reciprocity Partnership [TARP], Washington State Department of Ecology) for BMP monitoring.

(c) In addition, meet the requirements of ASHRAE Standard 189.1, Section 5.3, and either Section 5.4, Prescriptive Option or Section 5.5 Performance Option for Site Development and UFC 3-210-10. If any of the requirements in this subsection are prohibited by state law, state law shall take precedence but only as to those requirements found to be in conflict.

5.1.3.6. Erosion and Sedimentation Control: Meet the requirements of ASHRAE Standard 189.1, Section 10.3.1.3.

5.1.4. EXTERIOR SIGNAGE: Provide exterior signage in accordance with Appendix H, Exterior Signage. Provide exterior NO SMOKING signage that conveys building and grounds smoking policy. Meet the requirements of ASHRAE Standard 189.1, Section 8.3.1.4 (a).

5.1.5. 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. Subsurface Conditions Report: 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. Geotechnical Evaluation Report: 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. Pavement Requirements: Except in Department of Energy (DOE) Climate Zones 6, 7, and 8, meet ASHRAE Standard 189.1, Section 5.3.2.1. If the project is located in DOE Climate Zones 6, 7, or 8, 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 in all DOE Climate Zones shall comply with the Installation requirements and with the Manual on Uniform Traffic Control Devices. Develop a Transportation Management Plan that meets the requirements of ASHRAE Standard 189.1, Section 10.3.2.4.1.

5.2.3.2. Parking Requirements. This subsection is applicable only to parking lots/areas that permit POV parking:

(a) General Parking Requirements:

(1) 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.

(2) Handicap POV parking. All handicap POV parking lots (where applicable in the facility specific requirements) shall meet the ADA and ABA Accessibility Guidelines for accessible parking spaces.

(3) All handicap POV parking lots (where applicable in the facility specific requirements) shall meet the ADA and ABA Accessibility Guidelines for accessible parking spaces. 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.

(b) Preferred Parking:

(c) Low-Emitting and Fuel Efficient 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. In addition, meet the requirements of ASHRAE Standard 189.1, Section 5.3.2.1.

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 Paragraph 5.9.3.5 below for utility metering requirements.

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 and irrigation systems, if provided, shall comply with ASHRAE Standard 189.1, Section 6.3, Mandatory Provisions, and either Section 6.4, Prescriptive Option, or Section 6.5, Performance Option. In addition, meet the requirements of ASHRAE Standard 189.1, Standard 10.3.2.

5.2.8. EPA WATERSENSE PRODUCTS AND CONTRACTORS: Except where precluded in this Paragraph or by other project requirements, use EPA WaterSense labeled products and irrigation contractors that are certified through a WaterSense labeled program where available.

5.3. COMMISSIONING: Execute total building commissioning practices in order to verify performance of building components and systems and ensure that Owner Project Requirements (OPR) are met. Adopt and follow the requirements of ASHRAE Standard 189.1 Section 10.3.1.2, ASHRAE Guideline 0, ASHRAE Guideline 1.1, LEED Energy and Atmosphere (EA) Prerequisite 1 and LEED EA Credit 3. 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. Commissioning activities shall be consistent with the Pre-Design Phase, Design Phase, Construction Phase and Occupancy and Operations Phase. Perform and document a post occupancy system monitoring and inspection to review building operation within 12 months after beneficial occupancy. Post occupancy system monitoring and inspection results will be used to verify compliance with the Owner's Project Requirements (OPR), to revise and update the Systems Manual and for completion of the Final Commissioning Report.

5.3.1.

5.3.2. Plan Development: Meet the requirements for the development of the Maintenance Plan and Service Life Plan in ASHRAE Standard 189.1, Section 10.3.2.

5.4. ARCHITECTURE AND INTERIOR DESIGN.

5.4.1. STANDARDS AND CODES: The architecture and interior design shall conform to APPLICABLE CRITERIA.

5.4.2. GENERAL: Overall architectural goal is to provide a functional, quality, meet expected usable life standards, and visually appealing facility that is a source of pride for the installation and delivered within the available budget and schedule.

5.4.3. MATERIALS AND RESOURCES: Meet ASHRAE Standard 189.1, Section 9.3, Mandatory Provisions, and either Section 9.4, Prescriptive Option, or Section 9.5, Performance Option.

5.4.3.1. Construction and Demolition (C&D) Waste Management: Meet the requirements of ASHRAE Standard 189.1, Section 9.3.1. A waste management plan and waste diversion reports are required, as detailed in Section 01 57 20.00 10, ENVIRONMENTAL PROTECTION.

5.4.4. COMPUTATION OF AREAS: See APPENDIX Q of this RFP for how to compute gross and net areas of the facility(ies).

5.4.5. BUILDING EXTERIOR: Design buildings to enhance or compliment the visual environment of the Installation and reflect a human scale to the facility. Building entrance should be architecturally defined and easily seen. 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 materials colors shall conform to the Installation requirements and if brick or stone, have color that is throughout the material. See Paragraph 6 for project specific requirements.

5.4.5.1. 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 of this RFP.

5.4.5.2. Roofs and Exterior Walls: Meet the requirements of ASHRAE Standard 189.1, Section 5.3, Mandatory Provisions, and Section 5.4, Prescriptive Option, or Section 5.5, Performance Option. In addition, if a green roof is considered for this project, meet the requirements of ASHRAE Standard 6.2, Mandatory Provisions, and Section 6.3, Prescriptive Option, or Section 6.4, Performance Option.

5.4.6. BUILDING INTERIOR

5.4.6.1. Daylighting and Low Emitting Materials: Meet the requirements of ASHRAE Standard 189.1, Section 8.3, Mandatory Provisions, and either Section 8.4, Prescriptive Option, or 8.5, Performance Option. In addition, meet the daylighting requirements of ASHRAE Standard 189.1, Section 7.3, Mandatory Provisions, and either Section 7.4, Prescriptive Option, or Section 7.5, Prescriptive Option.

5.4.6.2. Surfaces and Color:

(a) 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. In daylit zones, meet the requirements of ASHRAE Standard 189.1 section 8.4.1.

(b) 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 finishes with 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 grout 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.) to the ceiling color.

5.4.6.3. Builidng Entrance: Meet the requirements of ASHRAE Standard189.1, Section 8.3.1.5.

5.4.6.4. 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.

5.4.6.5. Window Treatment: All exterior windows and interior windows are to receive either blinds, mini-blinds or roller shades in a color selected by the architect from the manufacturer's standard range of colors. Color shall compliment building's design theme. Maintain uniformity of treatment color and material to the maximum extent possible within a building. For all other window treatments and accessories (draperies, curtains, lining, sheers, rods, pulls), refer to Attachment A&B.

5.4.6.6. Casework: Unless, otherwise specified, all casework for Cabinetry and cases shall be "custom grade", as described in the AWI Quality Standards

5.4.7. COMPREHENSIVE INTERIOR DESIGN

5.4.7.1. SID and FF&E: 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.

5.4.7.2. FF&E Package: 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.

5.5. STRUCTURAL DESIGN

5.5.1. STANDARDS AND CODES: The structural design shall conform to APPLICABLE CRITERIA.

5.5.2. 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.

5.5.3. 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.

5.5.4. TERMITE TREATMENT AND GREEN CLEANING: (Except Alaska) Provide termite prevention treatment in accordance with Installation and local building code requirements, using licensed chemicals and licensed applicator firm. In all States, meet the requirements of ASHRAE Standard 189.1, Section 10.3.2, regarding the building Green Cleaning Plan.

5.6. THERMAL PERFORMANCE

5.6.1. STANDARDS AND CODES: Building construction and thermal insulation for mechanical systems shall conform to APPLICABLE CRITERIA.

5.6.2. 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 that shall meet the requirements of ASHRAE Standard 189.1, Section 7.3, Mandatory Provisions, and either Section 7.4, Prescriptive Option, or 7.5, Performance Option. In addition, meet the requirements of ASHRAE Standard 189.1, Sections 10.3.1.4, 10.3.1.5, 10.3.1.6, and 10.3.2 as well as UFC 3-101-0, Section 3-6. Clearly identify all air barrier components of each envelope assembly on construction documents and detail the joints, interconnections and penetrations of the air barrier components. Clearly identify the boundary limits of the building air barriers, and of the zone or zones to be tested for building air tightness on the drawings. The use of painted interior walls is not an acceptable air barrier method.

5.6.2.1. Air Barrier: The air barrier must be durable to last the anticipated service life of the assembly. Provide a motorized damper in the closed position and connected to the fire alarm system to open on call and fail in the open position for any fixed open louvers at elevator shafts. Coordinate the motorized elevator hoistway vent damper(s) with the Fire Protection System design in Paragraph 5.10. Ensure that the damper(s) is accessible to facilitate regular inspection and maintenance.

5.6.2.2. Thermal Bridge. A Thermal Bridge (or cold bridge) occurs when a thermally conductive material (such as a metal stud, steel frame or concrete beam, slab or column) penetrates or bypasses the exterior insulation system. Design the building envelope to align all insulating elements, ie, the continuous wall insulation, insulated glazing, insulated doors from top of footing to bottom of roof deck. Wrap insulation around roof overhangs. Disconnect window and door sills from interior construction. Utilize thermally broken window and door frames. Provide details to eliminate thermal bridges particularly at floor slabs, roof/wall intersections, steel lintels and relief angles, metal through-wall flashings and at building corners.

5.6.2.3. Damper and Control: Close all ventilation or make-up air intakes and exhausts, , etc., when leakage can occur during inactive periods. Atrium smoke exhaust and intakes shall only open when activated per IBC and other applicable Fire Code requirements.

5.6.2.4. Garages: Compartmentalize garages under buildings by providing air-tight vestibules at building access points.

5.6.2.5. Spaces Under Negative Pressure: Compartmentalize spaces under negative pressure such as boiler rooms and provide make-up air for combustion.

5.6.2.6. 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.

5.6.2.7. Performance Criteria and Substantiation: Test the completed building for air tightness in accordance with UFC 3-101-0, Section 3-6.3. 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) Air Barrier Quality Control Plan: Develop an Air Barrier Quality Control plan to assure that a competent air barrier inspector/specialist inspects the critical components prior to them being concealed. At a minimum, three onsite inspections are required during construction to assure the completeness of the construction and design.

(b) Notification of Testing: 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.

5.7. PLUMBING AND WATER CONSUMING EQUIPMENT

5.7.1. STANDARDS AND CODES: The plumbing system and water consuming equipment shall conform to APPLICABLE CRITERIA and ASHRAE Standard 189.1, Section 6.3, Mandatory Provisions, and either Section 6.4, Prescriptive Option, or Section 6.5, Performance Option. In addition, meet the requirements of ASHRAE Standard 189.1, Section 10.3.2.

5.7.2. 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.

5.7.3. HOT WATER SYSTEMS: For hot water heating and supply systems, meet the requirements in UFC 3-420-01 and amendments, and the service water heating requirements of ASHRAE 189.1, Section 7.4.4.

5.7.4. SIZING HOT WATER SYSTEMS: Unless otherwise specified or directed in Paragraph 3, design in accordance with ASHRAE Handbook HVAC Applications, Chapter 49, “Service Water Heating,” UFC 3-420-01 and amendments, and ASHRAE 189.1, Section 7.4.3. Size and place equipment so that it is easily accessible and removable for repair or replacement.

5.7.5. 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).

5.7.6. 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.

5.7.7. WATER EFFICIENT PLUMBING FIXTURES: Indoor plumbing fixture equipment shall comply with the following criteria: ASHRAE 189.1, Section 6.3, Mandatory Provisions, and either Section 6.4, Prescriptive Option, or Section 6.5, Performance Option.

5.7.7.1. Water Closets (Toilets): ASHRAE 189.1, Sections 6.3.2.1.a and b. requirements for water closets (toilets) shall be as follows: Flushometer valve type: For single flush, maximum flush volume shall be determined in accordance with ASME A112.19.2/CSA B45.1 and shall be 1.28 gal (4.8 L). For dual-flush, the effective flush volume shall be determined in accordance with ASME A112.19.14 and shall be 1.28 gal (4.8 L). Water closets (toilets)—tank-type: Tank-type water closets shall be certified to the performance criteria of the U.S. EPA WaterSense Tank-Type High-Efficiency Toilet Specification and shall have a maximum flush volume of 1.28 gal (4.8 L).

5.7.7.2. URINALS: As required by ASHRAE 189.1, Section 6.3.2.1.c, maximum flush volume when determined in accordance with ASME A112.19.2/CSA B45.1 shall be 0.5 gal (1.9 L). Non-water urinals shall comply with ASME A112.19.19 (vitreous china) or IAPMO Z124.9 (plastic) as appropriate.

5.7.7.3. PUBLIC LAVATORY FAUCETS: Lavatory faucets in a public setting shall have a maximum flow rate of 0.5 gallons per minute and be in accordance with ASME A112.18.1/CSA B125.1.

5.7.7.4. PUBLIC METERING SELF-CLOSING FAUCETS: Faucets in a public setting that supply a specific amount of water over a given period shall have a maximum water use of 0.25 gallons per cycle and be in accordance with ASME A112.18.1/CSA B125.1.

5.7.7.5. PRIVATE LAVATORY FAUCETS: Faucets in a private setting such as barracks, family housing, or hospitals shall have a maximum flow rate of 1.5 gallons per minute and be in accordance with ASME A112.18.1/CSA B125.1 and shall comply with the performance requirements of the US EPA WaterSense High-Efficiency Lavatory Faucet Specification.

5.7.7.6. KITCHEN FAUCETS: Kitchen faucets shall have a maximum flow rate of 2.2 gallons per minute and be in accordance with ASME A112.18.1/CSA B125.1.

5.7.7.7. Cooling Towers: In addition to the requirements of Subsection 5.7.1. above, conduct a one-time potable water analysis, measuring at least the following control parameters, in ppm or mg/l: calcium (Ca); total alkalinity; silica (Si); chloride (Cl); and conductivity . Calculate the number of cooling tower cycles by dividing the amount of each parameter in the condenser water by the amount in the potable makeup water. The maximum acceptable levels of the parameters in the condenser water are: Ca (as $CaCO_3$) and Total alkalinity – 1000 ppm; SiO_2 –100 ppm; Cl – 250 ppm; Conductivity – 3500 µS/ml. Limit cooling tower cycles to avoid exceeding maximum values for any of these parameters. AND Complete the following: A system to monitor and control microbiological growth is recommended; Meter the potable makeup water to the cooling tower and blowdown from the cooling; Blowdown must be controlled with a conductivity meter; Report monthly results of the amount of potable water used, microbiological levels, blowdown, and corrosion; On cooling towers, install drift eliminators that achieve minimum efficiencies of 0.2% for counter-flow systems or 0.5% for cross-flow systems.

5.7.7.8. Drainage Systems: Do not use engineered vent or Sovent® type drainage systems.

5.7.7.9. Pipe Location and Insulation: Where the seasonal design temperature of the cold water entering a building is below the seasonal design dew point of the indoor ambient air 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. Meet pipe insulation requirements of ASHRAE 189.1, Section 7.4.3.11 and Table C-11 of Normative Appendix C.

5.7.7.10. Pipe Protection During Construction: Cover all drain, waste and vent piping to prevent mortar or other debris during such construction activities.

5.8. ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

5.8.1. STANDARDS AND CODES: The electrical systems for all facilities shall conform to APPLICABLE CRITERIA.

5.8.2. 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.

5.8.3. 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.

5.8.3.1. Space Capacity: Provide 10% space for future circuit breakers in all panelboards serving residential areas of buildings and 15% spaces in all other panelboards.

5.8.4. 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.

5.8.5. LIGHTING: Comply with the recommendations of the Illumination Engineering Society (IES) and requirements of EPAct-2005 and Federal Energy Management Program (FEMP) for lighting products.

5.8.5.1. Interior Lighting:

(a) Reflective Surfaces: Coordinate daylighting requirements and interior architectural space surfaces and colors with the lighting systems to provide the most energy-efficient workable combinations.

(1) Fluorescent Lighting: Fluorescent lighting systems shall utilize NEMA premium electronic ballasts and high performance fluorescent lamps with a Correlated Color Temperature (CCT) of 4100 Kelvin (K) to 5000 K. Linear fluorescent and compact fluorescent lamps shall have a Color Rendering Index (CRI) of ≥ 82. All fluorescent lamps (compact and linear) shall be reclaimed through a process that captures and properly disposes of or recycles the mercury content. Do not use surface mounted luminaires on acoustical tile ceilings. Provide outside each building emergency egress door an un-switched emergency egress luminaire controlled by photocell or astronomical time clock. All other emergency egress luminaires shall be controlled the same as non-emergency luminaires in a shared space during normal (non-emergency) operation.

(2) Solid-State Lighting: Fixtures shall have a lumen maintenance life expectancy (L_{70}) of ≥ 36,000 hours, a CRI of ≥ 82, and a CCT of 4100 K to 5000 K. Each solid-state fixture model shall be tested in accordance with IES LM-79. Test reports shall verify the fixture performance (lumen output, lumen maintenance, power consumption, efficacy and color) meets or exceeds the fixture manufactures published data. Laboratory testing shall be completed by a National Voluntary Laboratory Accreditation Program laboratory. Provide a five year warranty for fixtures.

(3) Light Level Tuning: Light level tuning is a closed-loop feedback system that measures the illumination level in a space and dims the luminaires when the measured level exceeds the target level, thereby saving the energy that otherwise would be used to compensate for future light depreciation. Provide a life-cycle cost-benefit analysis (LCCA) of light level tuning for all spaces where the general lighting luminaires are equipped with dimming ballasts or LED drivers. The LCCA shall follow the methodology contained in 10 CFR 436. Provide light level tuning where the LCCA shows it to be life cycle cost effective.

(4) Lighting Systems and Controls: Lighting systems (including lighting controls, daylighting controls, and lighting power density limits) shall comply with the requirements of Section 7.4.6 of ASHRAE Standard 189.1 and Section 9 of ANSI/ASHRAE/IES 90.1-2007. Lighting designs shall follow the recommended practices of the IES and shall target the recommended illumination levels of the IES.

(5) Occupancy or Vacancy Sensors: Use occupancy or vacancy sensors to automatically turn off lighting a specified time after all occupants leave the space. The off time shall be user adjustable to 5, 15, or 30 minutes. Selection of the sensor type (single or dual technology, wired or wireless) shall be based on the space configuration, user functionality and life-cycle cost-benefit analysis. Single technology solutions shall incorporate signal processing technology that distinguishes between background noise and actual motion without automatically changing their sensitivity.

(6) Automated Shading: Automated shading shall be considered in spaces utilizing daylight harvesting to maximize the energy savings of the daylighting system. The shades shall be controlled to reduce glare and unwanted heat gain while still allowing natural light to enter the space. When utilizing automated shading consider the following :

i. For ease of use and space aesthetics, incorporate the automated shades with the lighting control system.

ii. For maximum energy savings the automated shading system shall predictably position the shades based on a combination of time of day, façade direction, and sky conditions.

iii. For maximum design flexibility and ease of installation, shade system should have the capability to address and control each shade individually.

iv. The shading system shall have a manual override that allows the occupant to temporarily adjust the shades to any desired position. The system shall revert back to automatic control after a specified period of time.

(b) Provide a life-cycle cost-benefit analysis (LCCA) of automated shading for all spaces where daylight harvesting is provided. The LCCA shall follow the methodology contained in 10 CFR 436. Provide automated shading where the LCCA shows it to be economical.

(1) Scene-Based Dimming: Use scene based dimming in multiple-use areas including auditoriums, conference rooms and classrooms. Also provide scene based dimming in dining rooms and gymnasiums with multiple functions. One button preset touch recall shall allow multiple zones of light within a space to go to the appropriate light levels, known as a scene, for a specific task or use. Scene based control shall allow the integration of AV controls, shading/projection screens and lighting to work seamlessly with one button preset touch (i.e. lights dim, projection screen lowers, and shades go down).

(2) Personal Lighting Control: Personal lighting controls exceeding ASHRAE requirements shall be considered. Personal lighting controls allow users to vary the general light level based on the task at hand. Personal control can be achieved by wall mounted controls (hard wired or wireless), Infrared or Radio Frequency (RF) wireless devices, or via computer. Digital addressable ballasts and light emitting diode (LED) drivers allow the control flexibility of personal dimming of installed lighting on the occupant's work area (i.e. dim the luminaire over their cubicle to the appropriate light level).

(3) Wireless and Plug-and-Play Controls: Wireless and plug-and-play lighting controls shall be considered for all installations where flexibility is paramount. To avoid interference, wireless products shall communicate in an FCC frequency band that does not allow continuous transmissions.

(4) Testing Agent: An independent agent with no less than three years experience in testing of complex lighting control systems shall be hired to conduct and certify functional testing of lighting control devices and control systems. The testing agent shall not be directly involved in either the design or construction of the project and shall certify the installed lighting controls meet or exceed all requirements of ASHRAE Standard 189.1, ANSI/ASHRAE/IES Standard 90.1-2007, and all documented performance criteria. The lighting control manufacturer's authorized technical representative may serve as the testing agent. Submit qualifications of the testing agent for approval.

(5) Manufacturer Support: shall include technical phone support located in the United States. The technical phone support shall be available 24 hours a day, 365 days a year.

5.8.5.2. Exterior Lighting Requirements: These requirements apply to exterior lighting illuminating any building, site, property, structure, gate, sign, roadway, parking lot, pathway, sidewalk, landscape, structure, etc. that is owned, operated by, or constructed to be leased to the Department of the Army. This includes all Sustainment, Restoration, and Modernization (SRM) and Military Construction activities within the United States, its territories, and overseas on permanent Active Army installations, Army Reserve Centers, Army National Guard Readiness Facilities, and Armed Forces Reserve Centers, regardless of funds source. See Paragraph 6.9 for site specific information, if any, on exterior lighting systems.

(a) General: Exterior lighting technology should be selected based on a balance of energy performance and quality of light, while remaining life-cycle cost effective and environmentally responsible. Exterior lighting systems or luminaires selected for use should have demonstrated adherence to quality standards by being recognized by the DesignLights Consortium (reference e), the ENERGY STAR Program, the FEMP or other third-party qualifier appropriate to the technology. Manufacturers should also stand behind their products by providing a Luminaire warranty for at least five years or more. Design teams should carefully consider the occupancy and purpose of the lighting requirements and incorporate energy-saving controls, sensors, and the use of bi-level fixtures to provide exterior lighting levels only as appropriate and only during the hours of night needed. Other energy-saving and lighting quality design considerations include ensuring better uniformity of lighting distribution to required levels to reduce over-lighted hotspots and control light trespass outside the area of intended coverage.

(b) Exterior Lighting Performance by Application: Exterior lighting systems should meet, at a minimum, the better of the standards below in Table 1 or the DLC Product Qualification Criteria (reference e) or current ENERGY STAR qualification or FEMP designation requirements.

(c) General Exterior Lighting: Typically lighting to provide visibility for security and people moving along established circulation pathways through an illuminated area to or from a destination. Examples include roadways, parking lots, parking structures, sidewalks, tarmacs, service areas, and secondary exits from buildings.

(d) Architectural Lighting: Lighting in use where exterior spaces are occupied at night for a functional purpose, such as plazas, gas stations, pavilions, or amphitheaters. Also, for use where a higher quality of light is desired, such as building entrances, wall-wash luminaires, illumination of architectural or landscaping features, sculpture, displays, exhibits, flags, gates, primary signage, etc.

(e) Exceptions: Where a non-white light color is specifically desired by aesthetic design or a color-specific functional requirement (e.g. water feature lighting, entertainment, signal lights, airfield lights, marine wildlife protection, etc.), the CRI and CCT range values indicated may not apply. Specialized lighting, such as lighting for monitoring systems designed to use non-visible spectrum light, are also exempt from the minimum CRI and CCT standards as well. Luminaires primarily powered by on-site renewable energy (e.g. solar and/or wind) are also exempt from the requirements herein.

Table 1 – Minimum Exterior Lighting Performance by Application. These values represent minimum standards and do not supersede higher standards that may also be applicable or specified by design.

Application	Luminaire Efficacy	CRI	Nominal CCT Ranges	Lamp Life
General Exterior Lighting	65	65	3000-5700	50,000
Architectural Lighting	50	75	3500-5000	50,000

Units:

Luminaire Efficacy (with complete fixture load including ballast/driver loads) is in lumens per watt

CRI (Color Rendering Index) is a value without units
CCT (Correlated Color Temperature) Range is in Kelvin Temperature
Minimum Lamp Life is in Rated Hours per TM-21

(f) Life-Cycle Cost Analysis (LCCA) and Renewable Energy Opportunities. On-site renewable or alternative energy power system cost over a 25-year life-cycle should be compared to the cost of the conventional grid-connection infrastructure, operation and maintenance costs thereof, proper time-of-use grid energy cost with line losses and price escalation. Renewable or alternative energy systems should be used wherever the payback period less than or equal to the life cycle period. Design team selections and Value Engineering evaluations are to prioritize a reduced total cost of ownership during the full life-cycle period over the first costs of design and construction. The LCCA shall follow the methodology contained in 10 CFR 436.

(g) Sustainability and Environmental Impact Reduction. To meet the mercury-use reduction intent of EISA 2007 (Reference c) and other sustainability goals, lighting systems should not contain added mercury in excess of 5mg per lamp or 80 picograms per Lumen Hour. Whenever two or more viable lighting technologies are substantially equal in life-cycle cost and performance, preference should be given to the technology with the lowest mercury content per Lumen Hour.

5.8.6. 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.

5.8.6.1. Testing: 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 5.9.2.5 for design of environmental systems for Telecommunications Rooms.

5.8.6.2. Installation: 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.

5.8.6.3. End to End Test: 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.

5.8.7. LIGHTNING PROTECTION SYSTEM: Provide a lightning protection system where recommended by the Lightning Risk Assessment of NFPA 780, Annex L.

5.9. HEATING, VENTILATING, AND AIR CONDITIONING

5.9.1. STANDARDS AND CODES: The HVAC system shall conform to APPLICABLE CRITERIA.

5.9.2. DESIGN CONDITIONS:

5.9.2.1. Outdoor and Indoor Calculations and Requirements: Indoor design conditions and load calculations 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 62.1-2007. Outdoor design conditions are in UFC 3-410-01FA except that weather data is specified in paragraph 6, rather than at the URL (web link) listed in the UFC.

5.9.2.2. Indoor Air Quality: Buildings indoor air quality sytems, thermal comfort, acoustical control, equipment, calculation procedures, construction and start-up shall comply with ASHRAE Standard 189.1, Section 8.3, Mandatory Provisions, and Section 8.4, Prescriptive Option, and either Section 8.5, Performance Option unless otherwise specified in this subsection.

5.9.2.3. Outdoor Air Delivery Monitoring: Spaces Ventilated by Mechanical Systems. Reference Sections 7.4.3.2, 8.3.1.2.1, and 10.3.2, of ASHRAE Standard 189.1. A densely occupied space is defined as those spaces with a design occupant density greater than or equal to 25 people per 1000 ft^2 ($100m^2$).

5.9.2.4. Environmental Tobacco Smoke: a. Smoking shall not be allowed inside the building. Signage stating such shall be posted within 10 ft (3 m) of each building entrance. b. Any exterior designated smoking areas shall be located a minimum of 50 ft (7.5 m) away from *building entrances*, *outdoor air* intakes, and operable windows. c. Section 6.2.9 of ANSI/ASHRAE Standard 62.1 shall not apply.

5.9.2.5. 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.

5.9.2.6. Controls Maintenance: Locate all equipment so that service, adjustment and replacement of controls or internal components are readily accessible for easy maintenance.

5.9.2.7. Environmental Requirements for Telecommunications Rooms and Telecommunications Equipment Rooms, (including SIPRNET ROOMS, where applicable for specific facility type): Comply with ANSI/EIA/TIA 569 (including applicable Addenda**)**. Maintain environmental conditions at the Class 1 and 2 Recommended Operating Environment. Before being introduced into the room, filter and pre-condition outside air to remove particles with the minimum MERV filtration quality shown in the ASHRAE HVAC Applications, Chapter 19. Maintain rooms under positive pressure relative to surrounding spaces. Design computer room air conditioning units specifically for telecommunications room applications. Build and test units in accordance with the requirements of ANSI/ASHRAE Standard 127. A complete air handling system shall provide ventilation, air filtration, cooling and dehumidification, humidification (as determined during the design phase), and heating. The system shall be independent of other facility HVAC systems and shall be required year round.

5.9.2.8. 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.

5.9.3 Utility Meters: Measurement devices with remote communication capability shall be provided to collect energy and water consumption data for each energy supply source and water supply source to each facility, including gas, water (potable, reclaimed and rainwater), electricity, and distributed energy that exceeds the thresholds listed in ASHRAE Standard 189.1. Meet the requirements of ASHRAE Standard 189.1, Sections 6.3.3, 7.3.3, 10.3.2 and AR 420-1, Chapter 22. For Government owned utilities, install meters with remote communication capability as well as have a continuous manual reading option. Water meters shall provide daily data and shall record hourly consumption. 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 to a meter data management system 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. Exception: Renovation or energy projects with programmed costs less than $200,000 shall incorporate lower-cost energy monitors when cost effective over the life-cycle of the building following the monitoring guidance as detailed in ASHRAE Standard 189.1 Section 7.3.3.

5.9.3.1 Data Storage and Retrieval. The meter data management system shall be capable of electronically storing water meter and sub-meter data and creating user reports showing calculated hourly, daily, monthly and annual water consumption for each meter and sub-meter and provide alarming notification capabilities as needed. In addition, verification of meter operation will be conducted at installation.

5.9.3.2 Evaporative Cooling Sub-metering: For buildings that use evaporative cooling, cooling tower(s), hot water makeup systems, or automatic landscape irrigation system(s), separate submeters shall be provided for each such application. Water use data shall be collected at each source (e.g. *potable water*, reclaimed water, rainwater) for any source that exceeds the thresholds of: Potable water- 3,800 L/day (1,000 gal/day); Municipally reclaimed water - 3,800 L/day (1,000 gal/day); and Alternate sources of water - 1,900 L/day (500 gal/day).

5.9.3.3 Water Sub-metering: Sub-metering shall also be provided to collect water use data for each of following building subsystems, if they are sized above the threshold levels: Cooling towers – Primary flow > 30 L/s (500 gpm); Evaportative Coolers – Makeup water > 0.04 L/s (0.6 gpm); Steam and hot water boilers - > 50 kW (500,000 Btu/h) input; Irrigated landscape area with controllers - > 2500 m2 (25,000 ft2); Any large water using process – Consumption > 3,800 L/day (1000 gal/day).

5.9.3.4 Outdoor Irrigation: Outdoor irrigation shall have smart controllers that will shut off when rainfall is sensed (ASHRAE Standard 189.1 paragraph 6.3.1.3 (2011 version)). Outdoor irrigation shall be used only to temporarily for plant establishment and shall be removed within a period not to exceed 18 months of installation.

5.9.3.5 Energy Metering: Meters with remote metering capability or automatic meter reading (AMR) capability shall be provided to collect energy use data for each supply energy source (e.g. gas, electricity, district steam) to the building that exceed thresholds of: Electrical service - > 200 kVA; On-site renewable electric power – All systems > 1 kVA (peak); Gas and steam service - >300 kW (1,000,000 Btu/h); Geothermal - >300 kW (1,000,000 Btu/h0 heating; Solar thermal - >10 kW (30,000 Btu/h). Utility company service entrance/interval meters are allowed to be used provided they are configured for automatic meter reading (AMR) capability. Sub-metering with remote metering capability shall be provided to collect energy use data for each subsystem component that meet the following thresholds: Chillers/heat pumps - >70 kW (240,000 Btu/h) cooling capacity; Packaged AC units - > 70 kW (240,000 Btu/h) cooling; Fans - > 15 kW (20 hp); Pumps - > 15 kW (20 hp); Cooling towers - > 15 kW (20 hp); Boilers and other heating equipment - >300 kW (1,000,000 Btu/h) input; General lighting circuits - > 100 kVA; Miscellaneous electric loads - > 100 kVA).

5.9.4 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.

5.9.4.1 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.

5.9.4.2 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.

5.9.4.3 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.

5.9.4.4 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.

5.9.4.5 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.

5.9.4.6 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.

5.9.4.7 Gateways may be used provided that each gateway communicates with and performs protocol translation for control hardware controlling one and only one package unit.

5.9.4.8 Not Used

5.9.4.9 Perform all necessary actions needed to fully integrate the building control system. These actions include but are not limited to:

(a) 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.

(b) Install IP routers or ANSI/CEA-852 routers as needed to connect the building control network to the UMCS IP network. Routers shall be capable of configuration via DHCP and use of an ANSI/CEA-852 configuration server but shall not rely on these services for configuration. All communication between the UMCS and building networks shall be via the ANSI/CEA-709.1B protocol over the IP network in accordance with ANSI/CEA-852.

5.9.4.10 Provide the following to the Government for review prior to acceptance of the system:

(a) The latest version of all software and user manuals required to program, configure and operate the system.

(b) Points Schedule drawing that shows every DDC Hardware device. The Points Schedule shall contain the following information as a minimum:

(1) Device address and NodeID.

(2) Input and Output SNVTs including SNVT Name, Type and Description.

(3) Hardware I/O, including Type (AI, AO, BI, BO) and Description.

(4) Alarm information including alarm limits and SNVT information.

(5) Supervisory control information including SNVTs for trending and overrides.

(6) Configuration parameters (for devices without LNS plug-ins) Example Points Schedules are available at https://eko.usace.army.mil/fa/besc/

(c) Riser diagram of the network showing all network cabling and hardware. Label hardware with ANSI.CEA-709.1 addresses, IP addresses, and network names.

(d) Control System Schematic diagram and Sequence of Operation for each HVAC system.

(e) Operation and Maintenance Instructions including procedures for system start-up, operation and shut-down, a routine maintenance checklist, and a qualified service organization list.

(f) LONWORKS® Network Services (LNS®) database for the completed system.

(g) Quality Control (QC) checklist (below) completed by the Contractor's Chief Quality Control (QC) Representative

Table 5-1: QC Checklist

Instructions: Initial each item, sign and date verifying that the requirements have been met.		
#	Description	Initials
1	All DDC Hardware is installed on a TP/FT-10 local control bus.	
2	Communication between DDC Hardware is only via EIA 709.1B using SNVTs. Other protocols and network variables other than SNVTs have not been used.	
3	All sequences are performed using DDC Hardware.	
4	LNS Database is up-to-date and accurately represents the final installed system	
5	All software has been licensed to the Government	
6	M&C software monitoring displays have been created for all building systems, including all override and display points indicated on Points Schedule drawings.	
7	Final As-built Drawings accurately represent the final installed system.	
8	O&M Instructions have been completed and submitted.	
9	Connections between the UMCS IP network and ANSI/CEA-709.1B building networks are through ANSI/CEA-852 Routers.	
By signing below I verify that all requirements of the contract, including but not limited to the above, been met.		
Signature:____________________________ Date:_____________		

5.9.4.11 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.

5.9.4.12 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.

5.9.4.13 Provide training at the project site on the installed building system, including all commissioned systems and equipment (ASHRAE Standard 189.1, Section 10.3.1.2), . 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.

5.10 ENERGY CONSERVATION

5.10.1 ENERGY EFFICIENCY: The building(s), including the envelope(s), HVAC systems, service water heating, power, and lighting systems, shall meet, at a minimum, the Mandatory Provisions in Section 7.3 and either the Prescriptive Option in Section 7.4 or the Performance Option in Section 7.5 of ASHRAE Standard 189.1. ASHRAE 189.1 is the minimum requirement that incorporates by reference the requirements of ASHRAE Standard 90.1-2007 and shall be used as the project baseline for life-cycle cost comparisons. A LCCA is not required on the baseline project. Substantiation requirements are defined in Section 01 33 16, Design After Award and ASHRAE Standard 189.1, Section 10.3.2. Exception 1: The on-site renewable energy systems included in ASHRAE Standard 189.1, Section 7.4.1.1 are not required.

5.10.1.1 Minimum Energy Consumption: The building, including the building envelope, HVAC systems, service water heating, power, lighting systems and process and plug loads shall achieve an energy consumption that is a minimum of 30% below the consumption of a baseline building meeting the minimum requirements of ANSI/ASHRAE/IESNA Standard 90.1-2007 and that is life cycle cost effective. Energy calculation methodologies and substantiation requirements are defined in Section 01 33 16, Design After Award. A LCCA is required.

5.10.1.2 EISA 2007 Requirement: Design the building to achieve the maximum possible fossil fuel-generated energy consumption reduction based on the requirements of EISA 2007 Section 433 that is life cycle cost effective. A LCCA is required.

5.10.1.3 LCCA: Where a LCCA is required, an incremental LCCA shall be completed for all energy efficiency or conservation features provided in excess of the baseline to ensure the payback period is no greater than the lesser of 40 years or the projected life of the facility. Equipment procurement, fuel, maintenance, repair, replacement, and any other quantifiable benefits and costs are to be included in the LCCA. The LCCA will be documented and made part of the design analysis. The LCCA shall follow the methodology contained in 10 CFR 436.

5.10.2 EnergyStar AND FEMP PRODUCTS: The heating, ventilation, and air conditioning shall comply with Section 6 of ANSI/ASHRAE/IESNA 90.1-2007 and Section 7.4.2.1.b of ASHRAE Standard 189.1, including the Normative Appendix C of ASHRAE Standard 189.1 with the following modification: Purchase Energy Star products, except use FEMP designated products where FEMP is applicable to the product type. The term “Energy Star” means a product that is rated for energy efficiency under an Energy Star program. The term “FEMP designated” 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. For projects located OCONUS the products listed in ASHRAE Standard 189.1, Section 7.4.7, shall have an equipment efficiency that is equivalent or greater than the criteria required to achieve the ENERGY STAR label or meets or exceeds the equivalent of FEMP designated efficiency requirements.

5.10.3 SOLAR HOT WATER HEATING: Design and construct all new construction projects with an average daily non-industrial hot water requirement of 50 gallons or more, and located in an area shown on the NREL solar radiation maps (http://www.nrel.gov.gis.solar.html) as receiving an annual average of 4kWh/m2/day or more to provide a minimum of 30 percent of the facility’s hot water demand by solar water heating. Waste heat harvesting, integrated co-generation systems, or a combination thereof may be used in lieu of solar water heating where they achieve equivalent energy savings, as documented in the project’s design analysis and commissioning analysis.

5.10.4 WATER USED FOR HEATING AND COOLING: Meet the requirements of ASHRAE 189.1 Section 6.3.2.3 – HVAC Systems and Equipment and Section 6.4.2.1 – Cooling Towers. When potable water is used to improve a building’s energy efficiency, employ life-cycle cost effective water conservation measures per requirements of EPAct 2005 Section 109. This includes potable water used for both domestic and process purposes.

5.10.5 RENEWABLE ENERGY: See Paragraph 6, PROJECT SPECIFIC REQUIREMENTS for renewable energy requirements for this project.

5.10.6 FUNDAMENTAL REFRIGERANT MANAGEMENT: Meet the requirements of ASHRAE Standard 189.1, Section 9.3.3.

5.11 FIRE PROTECTION

5.11.2 STANDARDS AND CODES Provide the fire protection system conforming to APPLICABLE CRITERIA.

5.11.3 INSPECTION AND TESTING: 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.

5.11.4 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.

5.11.5 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.

5.11.6 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".

5.11.7 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.

5.12 SUSTAINABLE DESIGN

5.12.2 STANDARDS: Sustainable design shall conform to APPLICABLE CRITERIA. See Paragraph 6, PROJECT-SPECIFIC REQUIREMENTS for which version of LEED applies to this project, however, this project shall achieve a minimum of LEED Silver Certification by Green Building Certification Institute (GBCI). Each building must individually comply with the requirements of paragraphs ENERGY CONSERVATION and PLUMBING AND WATER CONSUMING EQUIPMENT. The project must earn the points associated with compliance with paragraph 5.10, ENERGY CONSERVATION,of this RFP.

5.12.3 In accordance with the National Defense Appropriations Acto fo 2012, Section 2830, the contractor will not be compensated for any expenses associated with the express intent to obtain LEED certification above the SILVER level. It is recognized that competitive best balue proposal details and requirements cited else where in this document and supporting documents may provide for features which allow for a certification higher than SILVER to be obtained. Whether to achieve a future marketing advantage or for toher purposes, the contractor may obtain LEED GOLD or PLATINUM certification(s) provided that achieving such certification imposes no additional cost to the government.

5.12.4 CONSTRUCTION WASTE MANAGEMENT: A minimum of 60% of non hazardous construction and demolition waste material generated prior to the issuance of the final certificate of occupancy shall be diverted from discposal in landfills and incinerators by recycling and/or reuse. Reuse includes donation of materials ot charitable organization, salvage of existing materials onsite, and packaging materials returned ot the manufacturer, shipper, or other source that will reuse the packaging in future shipments. Excavated soil and land clearing debris shall not be included in the calculation. Calculations are allowed to be done by either weight or volume, but shall be consistent throughout. Specific area(s) on the construction site shall be designated for collection of recyclable and reusable materials. Off-site storage and sorting of materials shall be allowed. Civersion oefforts shall be tracked throughout the construction process.

5.12.5 LEED INNOVATION AND DESIGN AND REGIONAL PRIORITY 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 and RP 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.

5.12.6 DOCUMENTATION FOR CERTIFICATION: All LEED Prerequisite and Credit documentation shall be provided to GBCI and the Owner (if requested) in addition to any other documentation requirements Online documentation shall be uploaded to GBCI and updated at each phase of the project.

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 HOOD, 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 [Not Supplied - PS_SitePlanningGeneral : WALKWAYS]

6.3.1.7. Parking Areas:

Provide an aggregate surface course parking area. The location shall be per the proposed site layout plan provided. Pavement grades shall provide positive surface drainage with a 1-1/2% minimum slope in the direction of drainage.

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:

The Contractor shall design and provide 16 standard firing lanes with 16 Fighting Positions, 144 Stationary Infantry Targets, Limit Markers, Downrange Lane Markers, Emplacement Markers and Target

Markers. The standard fighting positions are shown in the Civil Details in the Appendix of this document. Refer to the Range Design Guides MRF Modified Record Fire Range for design and detail information on these features.

HYPERLINK "http://www.hnd.usace.army.mil/rdg/RDGdownload2.aspx?RangeID=23"http://www.hnd.usace.army.mil/rdg/RDGdownload2.aspx?RangeID=23

Contractor shall provide the Modified Record Fire Range facilities as shown on the Site Development Plan provided in the Appendix Drawings. Provide access drives, and parking areas as shown. Provide new access gates as shown. One gate for the main access to the Modified Record Fire Range and another gate to the Ammo Breakdown Building. Provide Lockable gates.

6.3.3. Site Functional Requirements:

6.3.3.1. Stormwater Management (SWM) Systems.

(a) Comply with the requirements of general permit number

Firing Range Area shall be graded to drain generally with the natural runoff from the site. Storm runoff from the west side of the site should be directed to the south and west. Runoff should be directed to the existing ditch at the southwest of the firing range. Runoff from the west half of the firing range will exit the site at the southwest corner of the site. Storm runoff from the east side of the site will be directed south and east. Runoff from the east side of the site will exit the site at the southeast corner of the site.

Drainage for Stationary Infantry Targets SIT:

Ensuring proper drainage is critical in the design and construction of target emplacements. Even though the electrical and target equipment is designed for outdoor installation, many of the issues with range targetry can be avoided with proper emplacement drainage. The ground should slope away from the emplacement whenever possible; add swales as necessary to ensure positive drainage. The floor of the emplacement must slope to the rear. Special care is required in the use of floor and trench drains as they tend to clog easily and freeze in some climates. Ensure proper compaction under the emplacement to avoid differential settlement. Drainage is especially critical on newly constructed ranges before vegetation is fully established. Above Grade placement of the SIT is preferred.

Finished Floor Elevations: A building's finished floor elevation shall be a minimum of 6 inches above the highest point of the adjacent outside finished grade, unless there is an overriding technical reason to deviate. The finished grade shall be sloped a minimum of 5% for the first 10 feet away from the building.

Turfed Areas Adjacent to Building: Outside finished grade shall slope away from the building at a 5% grade for the first 10 feet. The 5% grade should be extended to 20 to 30 feet in areas with expansive soils. When site conditions require the use of steep slopes near buildings, a berm that is a minimum of 6 feet wide at a 5% grade will be provided adjacent to the building. These requirements shall be indicated on the grading plan with critical spot elevations.

Firing Range Areas: Range areas beyond the 5% finished grade of buildings stated above shall have a 2% minimum slope and a desirable maximum slope of 25%.

Ditches and Swales: A minimum longitudinal ditch or swale gradient of 0.5% shall be used. Side slopes on ditches or swales shall be no steeper than 1 vertical on 4 horizontal. Turf Reinforcement Matting (TRM) in conjunction with velocity dissipation devices should be used in ditches that are subject to high shear stress from storm runoff. Erosion control matting shall also be utilized as necessary to control erosion on slopes steeper than 4:1horizontal to vertical.

(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.

A three dimensional digital topographic and utility survey for this site has been prepared by the Governement and included as part of this solicitation. any discrepancies which are found in the Govvernment furnished survey shall be brought to the immediate attention of the Governement for clarification. The survey provided is a 3D Microstation CAD file.

The Contractor shall provide electronic design files (CADD/GIS) for the site as part of their design and construction responsibilities. See Specification 01 35 10.00 44 for requirements. The electronic files shall follow the coordinate system utilized in the government furnished survey, and must be included as an as-built condition. The government furnished survey Horizontal and Vertical control for the project complies with Corps of Engineers standards as outlined in EM 1110-1-8005, Table 2-1, Military Construction, Building or structure Design. Horizontal control is based on Texas State Plane Coordinate System, South Central Zone, NAD-83. Vertical control is based on NAVD 88. The survey was performed using English units in survey feet and using the level names of the AEC 4.0CADD standards with South West District (SWF) file naming Convention.

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

A Government Geotechnical Report has been prepared, and is appended to this RFP. 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 (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.

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. 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.

Foundation Design: 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.

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.

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.

No fire flow tests will be provided as part of the solicitation. Range facilities are not required to be sprinkled.

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:

Provide Gravel Surface access drives and parking areas per the Geotechnical Report provided in the Appendix A.

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. Emergency access drives shall have minimum turning radii of 45 feet to accommodate fire vehicles. 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 American Water Operations and Maintenance, Inc. 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 American Water Operations and Maintenance, Inc. 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 the installation DPW. The Installation DPW will provide natural gas service to the face of the building and shall install the site gas distribution piping. The Installation DPW 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 the Installation DPW. 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 constructthe 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.

The contractor shall grade the site to accomplish a balanced cut and fill to the maximum extent possible. However, no waste earth material shall be removed from the site. The existing site has several low areas that currently pond storm runoff. These areas shall be filled and graded to drain. The existing berm that divides the site shall be cut down to accommodate the new 16 lane firing range. All turfed areas shall provide a minimum of 2% slope and a maximum if 25% slope. Minimum slope for swales or ditches shall be 0.5% slope.

Line-of-Sight Analysis: The designer must insure that all targets and firing positions must be site adapted, and a graphical and/or numerical line-of-sight analysis must be performed for all targets and corresponding firing positions. The line-of-sight shots should be taken from the height of the gun barrel at the firing position to a point 150mm (6in) above the front wall of the target emplacement. Because of the size of this range, this analysis should be possible without any special software beyond normal design tools (simple profile cuts from firing position to the target should suffice). In order to verify any changes during design, a line-of-sight analysis must be completed before or concurrent with the 35-percent design and validated at the final design stage.

6.4.8. Borrow Material

No earth material shall be removed from the project site. The project site shall be graded in order to keep all existing earth material on the project site. The material from the existing berm near the center of the range as well as other areas that may need to be cut shall be placed on or throughout the project limits and graded to meet the line of site and grade requirements for the new Modified Record Fire Range.

Borrow required for the project shall be obtained from off-post sources.

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:

In general, small arms qualification ranges are cleared of all vegetation on the whole downrange footprint, since the purpose of these ranges is to instruct and qualify troops. However, some vegetation can be left between the firing lanes as long as it does not interfere with line of sight between the firing point and the target. If the tower needs to see all the down range targets, total removal of the vegetation in the down range area may be required. On small arms battle courses and techniques ranges it is desirable to leave the terrain as natural as possible to maintain training realism. The range may require thinning of dense woods and ground cover or no clearing around objectives. The designer must coordinate with the installation's trainers to understand their mission requirements in order to provide the best clearing design.

All areas graded and disturbed for the placement of the Modified Record Firing Range facilities shall be cleared and grubbed.

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.

No landscaping required on this project.

6.4.12. Turf:

Turfing - Turfing shall be required on all graded, unpaved and disturbed areas resulting from the Contractor's operations. The contractor shall establish vegetation on all turfed areas within the project site with native turf grass seed and/or sod. Hydromulching or equal shall be the preferred method for site seeding. Areas requiring sod shall use organic fertilizing processes and principles.

Professional Licensing Requirements - As part of this project, the contractor shall obtain the services of a Licensed Plantsman certified in the State of Texas, with minimum 3 years of experience with a total of 5 completed projects, to give recommendations on how to establish and maintain plant material without an irrigation system. Recommendations are to be submitted to the Contracting Officer or his authorized representative prior to placement of new plant material.

Drainage - Provide proper grading and drainage of turfed areas. Provide sub surface drainage where soil or other conditions do not allow surface drainage.

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 Hood’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 Hood’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:

[Not Supplied - PS_Architecture : THEME_DESCRIPTION]

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 Hood. 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

6.5.3. Programmable Electronic Key Card Access Systems:

[Not Supplied - PS_Architecture : PROGRAMMABLE_KEY_CARD]

6.5.4. INTERIOR DESIGN

[Not Supplied - PS_Architecture : INTERIORS]

Interior building signage requirements:

- Building number sign plates shall be 8"x30"x1/8" aluminum plate, with White reflective background and 6" Black Helvetica lettering.

- Room ID Signage shall be 9"x9" fiberglass plate, moisture, abrasion, solvent, and heat resistant, non-glare matte finish, with square corners. Dark Brown sign plate color and light Beige color for pictograms and lettering. Minimum 1" height lettering, Helvetica font. Heavy duty adhesive tape and dots of silicon are recommended to install all interior room ID signs. All exterior room ID signs shall be hardware mounted.

6.6. STRUCTURAL DESIGN

6.6.1. General

Analyze, design, and detail each building as a complete structural system. Design structural elements to preclude damage to finishes, partitions, and other frangible, nonstructural elements; to prevent impaired operability of moveablecomponents; 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 (BIA).

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

6.6.2. Project Specific Design Loads:

6.6.2.1. Wind Speed: 90 mph

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

Ss (at short periods) = 8% g

S_1 (at 1-second period) = 4% 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.

6.6.2.3. 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

Coordinate the need for a vapor barrier with the architectural floor finishes and requirements of the geotechnical report. Use a a vapor barrier system with a minimum 10-mil polyethylene membrane under all slab-on-grade to receive a coating (e.g. epoxy) or to receive an overlaying finish (e.g. carpet or tile).

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

[Not Supplied - PS_Plumbing : PLUMBING]

6.9. SITE ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

6.9.1. Derive electrical service from the existing aerial 7200/12,470 Volt primary service located as shown on the exterior power plans in Appendix J. Primary service shall be 3-phase. Coordinate construction associated with the removal of the existing and the installation of the new primary electrical system and communication systems at the site with the Fort Hood DPW. Perform all work on existing systems “hot” unless permission is obtained in advance from the contracting officer and Fort Hood DPW. Obtain permission for any connections a minimum of 72 hours in advance from the contracting officer and Fort Hood DPW. All underground electrical shall be in conduit, and all underground primary shall be concrete encased with red concrete. For secondary system, utilize marker tape – minimum 12 inches below finished grade – except in isolated areas.

(a) Jack and bore all road crossings . Open cuts are not permissible.

(b) If outages are unavoidable, schedule them with the DPW no less than two weeks in advance.

(c) Coordinate all communications work through the Ft. Hood DOIM.

(d) Transformers shall be pad mounted and loop fed with load break switches (3-2 position).

6.9.2. Install an aerial to underground transition with fused cutout switch at the power riser pole. Use 15 KV primary conductors for primary service. Provide one spare 4" conduit for future primary.

(a) Use armor rods rather than ties for connection of conductors to pin insulators.

(b) Use heavy air switches with arc snuffers for all branch distribution circuits that serve multiple buildings.

(c) Provide fiberglass guy insulators for all guys that come in proximity to phase conductors.

(d) Use three quarter inch minimum size bolts for pole hardware.

(e) Use spring washers under all hardware bolts including cross-arms.

(f) Use flat metal braces or wood braces for #4 ACSR conductors and smaller. Use angle braces for conductors larger than #4 ACSR.

(g) Provide at least one thru-bolt for all pole-mounted floodlights. Do not use lag bolts.

(h) Use metal gains for all cross-arms that do not come pre-gained.

(i) Use arm construction rather than armless construction for phase 3 aerial lines and equipment poles.

(j) Use minimum three quarter inch ground rods.

(k) Use ACSR aluminum rather than copper for all aerial conductors with minimum size of #4 AWG.

(l) At the pole mounted overhead to underground transition, use wet process porcelain terminators rather than elastomeric terminators.

(m) Use the two bushing aerial pole mount transformers rather than the self-protected (lightning arrestor) terminators,

(n) Connect line to lightning arrestor to cutout rather than from line to cutout and jumper to lightning arrestor.

(o) Provide 29 foot clearance of electrical high voltage lines at street crossing.

6.9.3. Lighting: Provide power for all required site lighting to include parking lot lighting from the new facility. Site lighting shall be pulse-start metal-halide (PSMH) or induction type. Operate lighting off of a lighting contactor and shall be 480 volt where available.

6.9.4. Provide for demolition (if necessary) as noted on the exterior power plans in Appendix J.

6.9.5. Provide electric meter mounted to the pad mounted transformer. Electrical watt-hour demand meters at Ft. Hood shall be encoded type, electromechanical type conforming to ANSI C12.10 and equipped with an electronic pulse initiator, or an electronic type meter with pulse output. Pulse type meters shall be capable of operating at speeds up to 500 pulses per minute with no false pulses and shall provide a pulse output of one pulse per kilowatt-hour. Supply all programming device or software required for programming with the meter. Further requirements for metering are included in the appendices for Metering Requirements.

6.9.6. Telecommunications Install all communications cabling in ducts as shown on the exterior communications plans in Appendix J. Where 1” inner duct is required per the drawings, do not extend the inner duct more than 4” beyond the entrance and exit ducts within manholes. Install nylon pull cord in all empty conduits. Outside plant cables to the new facility shall consist of 1-12 strand single mode fiber optic cable installed in a 1” inner duct and 150 pairs copper cabling in a 4” duct. Coordinate all associated work and requirements including final location of duct banks and manholes with Fort Hood DOIM thru the contracting officer’s representative and Fort Hood DPW.

6.9.6.1. Use concrete encased duct banks.

6.9.6.2. Core drill existing MHs.

6.9.6.3. Ducts entering MHs shall start at the bottom of the wall and work up.

6.10. FACILITY ELECTRICAL AND TELECOMMUNICATIONS SYSTEMS

6.10.1. Telecommunications:

6.10.2. Cable TV (CATV):

6.10.2.1. Leave ten feet of slack cable in the telecommunications room at a location designated for the CATV box.Homerun all cabling throughout the building back to the main telecommunications room to allow for just one connectivity point to the outside cable provided by the local CATV company. All CATV cabling shall be RG6 Quad shield, and all CATV cabling shall be tested for operability.

6.10.2.2. Covers for CATV outlets shall match electrical and other outlet plates; either white or ivory plastic. Mismatched colors are unacceptable.

6.10.3. Metering: All electrical and water meters shall include ability to interface and connect to the installation's existing LonWorks network. The controls contractor is responsible for final connection of the gas, water, and electric meters to the ILON 600 – making data points available to the EMCS.

6.10.4. Mount motor starters at 4 foot above flood level for ease of maintenance.

6.11. HEATING, VENTILATING, AND AIR CONDITIONING

The existing UMCS is LonWorks.

6.11.1. Supply Building Point of Connection to Base-wide UMCS: A Building Point of Connection (BPOC) in accordance with ANSIIEIA 709.1 B. Routers (including routers configured as repeaters) shall meet the requirements of ANSI/EIA 709.1B and shall provide connection between two or more ANSIIEIA 709.3 TPIFT-1O channels. The building point of connection (BPOC) router shall be iLon 600 *TP/FT* -10 24v *ac/dc* Model 72603R which is required for proper integration to the existing UMCS head-end and insure maintaining Networthiness/ DIACAP" certifications (security of the DOIM/basewide LAN). Integration of building into base-wide UMCS is not a part of this contract (NIC).

6.11.2. UMCS Interoperability: Be fully compatible for future interface with the existing Fort Hood base-wide LonWorks UMCS. Utility meters shall be LonWorks certified.

6.11.3. DDC Panels: DDC panels shall include a Local Display Panel (LDP) that provides an operator interface with the control system (mainly to view LonWorks I/O and change setpoints). The LDP shall reside as a node on the building LON bus.

6.11.4. Required Additional Deliverables to Government upon acceptance of system: XIF files and plug-ins.

6.11.5. Programmable Controllers:

6.11.5.1. Programmable Controllers shall have a fixed Program ID and shall be programmable over the network using an LNS Plug-in. Programmable controllers shall have a fixed XIF file (the XIF file shall not change when the controller programming changes).

6.11.5.2. Analog outputs and binary outputs (also known as "digital outputs") of programmable controllers which are connected to another device shall have a hardware manual override. Analog outputs and binary outputs of application specific controllers used for non-terminal unit control and that are connected to an output device shall have a hardware manual override.

(a) The manual override switch for binary outputs shall provide for overriding the output open or closed.

(b) The manual override switch for analog outputs shall either provide for overriding the output to 0% or 100% or provide for overriding through the range of 0% to 100%.

(c) The manual override shall be integrated with the controller hardware or an external override co-located with the controller (in the same enclosure).

6.11.6. HVAC Refrigerants: HVAC equipment shall use non-R22 refrigerants.

6.11.7. Outdoor Design Conditions

Please see Appendix BB for Fort Hood Weather Conditions.

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:

Not applicable.

6.13. FIRE PROTECTION

6.13.1. Verify the hydrant flow test data listed in Appendix D prior to design of the building fire protection sprinkler system.

6.13.2. DELETED

6.13.3. Fire Alarm System: Fire alarm systems shall be Class A looped.

6.13.3.1. The RF Transceiver shall be compatible with the Fire Department receiving system.

(a) The receiver shall be equivalent to a Monaco BT-XM operating on a frequency of 139.3750 MHz.

(b) The installation fire alarm receiving system is a Monaco D-21 system.

(c) All applicable ZIDs shall report fire alarm system Alarm, Supervisory and Trouble conditions to the central reporting station by from the following choices: a) Individual fire sprinkler riser flow switches identified by location. b) Room smoke detectors as a supervisory upon activation. c) Elevator smoke detectors by floor, machine room, and hoist-way. d) Elevator machine room tamper switch. e) Elevator machine room flow switch. f) Elevator pit tamper switch. g) Fire Suppression tamper switches grouped by room identified by location. h). Exterior PIV. I) Supervisory low temperature for fire sprinkler systems not in controlled environments. j) Manual pull stations by floor and wing. k) Fire alarm panel general trouble. l) Fire alarm panel general alarm. m) Each knox-box identified by location at location(s) preferred by FHFD. n) AC failure. o) Fire Pump running. p) Fire Pump trouble.

6.13.3.2. Key all fire alarm pull stations to single bitted, 5 disc keyway based on the Fort Lock KS00V key blank, key coded to CAT 15.

6.13.3.3. Key the fire alarm control panel(s) to single bitted, 5 disc keyway based on the Fort Lock KS00V key blank, key coded to CAT 15.

6.13.3.4. Fire Lanes shall be in accordance with applicable building codes, ADA, UFAS and Force Protection UFC and NFPA 1 and the striping and signage scheme provided.

6.13.3.5. All special tools, software, connecting cables, and proprietary equipment necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to the Contracting Officer Representative.

6.13.4. Mass Notification System (MNS)

6.13.4.1. Key to single bitted, 5 disc keyway based on the Fort Lock KS00V key blank key coded to CAT 15.

6.13.4.2. Program the following 4 messages into the system:

(a) FIRE (Siren X 5 Seconds) (Female voice) "ATTENTION, ATTENTION, A FIRE EMERGENCY HAS BEEN REPORTED. PLEASE REMAIN CALM AND EXIT THE BUILDING USING THE NEAREST EXIT".

(b) WEATHER (100 KHZ Steady tone X 5 Seconds) (Female voice) "THE NATIONAL WEATHER SERVICE HAS ISSUED A SEVERE WEATHER ALERT FOR THIS AREA. TUNE TO LOCAL RADIO AND TELEVISION STATIONS FOR FURTHER GUIDANCE".

(c) SUSPICIOUS ACTIVITY (Fast whoop X 5 Seconds) (Female voice) "MAY I HAVE YOUR ATTENTION PLEASE! A POSSIBLE BREACH IN SECURITY HAS BEEN REPORTED. PLEASE REMAIN CALM. YOU ARE INSTRUCTED TO TAKE APPROPRIATE SECURITY MEASURES AND TO REPORT SUSPICIOUS PERSONNEL, VEHICLES, PACKAGES OR ACTIVITIES TO SECURITY PERSONNEL".

(d) TOXIC CHEMICAL HAZARD EMERGENCY (Chime tone X 5 Seconds) (Female Voice) "MAY I HAVE YOUR ATTENTION PLEASE! A TOXIC CHEMICAL HAZARD HAS BEEN REPORTED, PLEASE REMAIN CALM AND TAKE APPROPRIATE MEASURES TO AVOID THE HAZARD".

6.14. SUSTAINABLE DESIGN

6.14.1. LEED Rating Tool Version. This project shall be executed using Other.

6.14.2. LEED Minimum Rating. This project includes no facilities that are required to achieve a specific LEED achievement level. Project shall achieve and document all points required by other portions of the RFP and all points that are feasible, but there is no minimum required LEED achievement level.

6.14.3. Credit Validation: LEED registration, compiling of documentation at LEED OnLine and use of the LEED Letter Templates is not required. Contractor has the option to register the project, compiling of documentation at LEED OnLine and use the LEED Letter Templates. In this case, payment of registration fees and administration/team management of the online project will be by the Contractor.

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

[Not Supplied - PS_SustDesign_Additional : MR2]

6.15. ENVIRONMENTAL

NO ADDITIONAL REQUIREMENTS

6.16. PERMITS

Prior to any excavation a digging permit must be obtained by the contractor, provided by the Directorate of Public Works.

6.17. DEMOLITION

The Contractor shall demolish all existing site sturctures necessary to construct the Modified Record Fire Range. Structures to be demolished completely are shown on the Existing Conditions Site drawing. Electrical features to be removed are shown on the Electrical Demolition Plan. The barb-wire fence on the western edge of the site shall be removed and relocated to the west edge of the new range. This fence is a barb-wire fence to keep livestock from entering the Firing Range.

6.18. ADDITIONAL FACILITIES

6.19 SUPPLEMENTAL REQUIREMENTS TO THE RFP

6.19.1 Revise the language in Section 01 10 00 per the following:

Replace "Directorate of Information Management" with "Network Enterprise Center"

Replace "DOIM" to "NEC"

6.19.2 Replace Paragraph 6.10.1 and 6.10.2 in their entirety with the following:

Provide two telecommunications outlets for the Range Operations Tower. Each telecommunications outlet shall consist of with one 8-pin modular jack for voice and one 8-pin modular jack for data.

Provide two telephone outlets each for the Operations Storage and Classroom buildings. Each telephone outlet shall consist of one 8-pin modular jack for voice.

Provide one combination voice/data cabinet for the Range Operations Tower. In addition, provide a standard floor mounted 19" equipment rack to support the Down Range base network.

Provide one voice cabinet each for the Operations Storage and Classroom buildings.

Cable TV (CATV) is not required.

6.19.3 Replace Paragraph 6.13.3 in it's entirety with the following:

Provide smoke detectors with local audible alarm for Operations Storage, Classroom, Range Operations Tower, and Ammo buildings.

6.19.4 Replace Paragraph 6.13.4 in it's entirety with the following, "Mass Notification System (MNS) is not required."

6.19.5 Range Control Tower: Information provided by TACOM has indicated that at normal operation (60%), the data rack equipment in the Control Tower will have a heat release of approximately 5,300 BTU/hr.

6.19.6 Provide condensate drain from Control Tower HVAC unit, routed to grade, to prevent condensate from dripping onto levels, stairs, or ground below unit. The drain shall be secured to the building structure at intervals not to exceed 5 feet.

6.19.7 Replace Paragraph 6.9.6 in it's entirety with the following:

Contractor shall provide, install and terminate copper and fiber optic outside plant cables from the point of service to the new telecommunications cabinets or rack in the Operations Storage, Classroom, and Range Operations Tower buildings. The contractor shall provide service entrance termination hardware and any cabling element within the facility. The contractor shall test the cables "end-to-end." The contractor shall provide and install outside plant (OSP) in according with the exterior electrical plans in Appendix J.

6.19.8 Replace Paragraph 6.9.3 in it's entirety with the following:

Site lighting for parking areas, roadways and walkways, within the designated construction area, shall be designed and installed by the contractor. Light poles shall be placed on a concrete base and height shall be such that maintenance can be done using standard equipment. All white lighting controlled by a photocell shall have a disconnecting means to turn off power to lights during night training exercises.

Due to night training exercises, all lighting within the range buildings and along the fire line will need both standard white and red lighting to ensure range operations. Standard white light is required for range set-up, emergencies, and cleaning up "bass". Red light is required during training to enable soldier's night vision. Separate switches for both types of lighting shall also be provided.

6.19.9 Downrange Electrical Systems: Provide hard wired power and hard wired data to each target emplacement. Data cables shall be supplied to support an Ethernet based network. The data cable infrastructure complete with patch panels and surge protection shall be provided. The electronic networking components will be GFGI. The contractor shall provide voltage drop calculations for all down range secondary target feeders. The limit markers shall be provided with a control system that enables the lights to be switched from the control room of the Range Operations Tower.

6.19.10 In previous paragrapgh 6.4.6.2 (a) Potable Water Disinfection - Replace the second to last sentence in the paragraph

~~Provide the water sample analytical results to the DPW's Environmental Office for record keeping~~ with the following sentence: Provide the water sample analytical results to the American Water Utility Manager for record Keeping.

6.19.11 In previous paragraph 6.4.6.4 Sanitary Sewer System: Replace the second sentence in the paragraph ~~Coordinate points of connection through the COR with the DPW.~~ with the following sentence:

Coordinate points of connection through the COR with the American Water Operations and Maintenance, Inc.

6.19.12 In previous paragraph 6.3.3.1(b) of section 01 10 00: Replace the first two sentences of the paragraph ~~Storm Drain System Plans are shown within the SDP. Tie into these systems as appropriate for his area of design responsibility.~~ with the following: The existing storm drain pattern and conditions for the Modified Record Fire Range site are shown on the Existing Site Conditions drawing. Design of the new storm drain systems shall keep the current runoff conditions to match the existing runoff from the site to the greatest extent possible. Designer shall assure all new culverts, ditches, swales are sized in accordance with the criteria mentioned in this paragraph. Design shall assure the existing ditches and culverts leaving the site continue to function close to the current conditions and are not overloaded**.**

End of Section 01 10 00.12-1477

SECTION 01 33 00.12-1477
SUBMITTAL PROCEDURES
(DESIGN-BUILD TASK ORDERS)

1.0 GENERAL

1.13. GOVERNMENT APPROVED OR CONCURRED WITH SUBMITTALS

1.14. INFORMATION ONLY SUBMITTALS

1.0 GENERAL

1.1.1. This section contains requirements specifically applicable to this task order. The requirements of Base ID/IQ contract Section 01 33 30 apply to this task order, except as otherwise specified herein.

1.13. GOVERNMENT APPROVED OR CONCURRED WITH SUBMITTALS

Upon completion of review of submittals requiring Government approval or concurrence, the Government will stamp and date the submittals as approved or concurred. The Government will retain one (1) copies of the submittal and return one (1) copy(ies) of the submittal.

1.14. INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the Contracting Officer is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the Contracting Officer from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe. The Government will retain one (1) copies of information only submittals.

End of Section 01 33 00.12-1477

SECTION 01 33 16
DESIGN AFTER AWARD

ATTACHMENT E LEED SUBMITTALS

ATTACHMENT F BUILDING INFORMATION MODELING REQUIREMENTS

ATTACHMENT G DESIGN SUBMITTAL DIRECTORY AND SUBDIRECTORY FILE ARRANGEMENT

1.0 GENERAL INFORMATION

1.1. INTRODUCTION

1.1.1. The information contained in this section applies to the design required after award. After award, the Contractor will develop the accepted proposal into the completed design, as described herein.

1.1.2. The Contractor may elect to fast track the design and construction that is, proceed with construction of parts of the sitework and facilities prior to completion of the overall design. To facilitate fast tracking, the Contractor may elect to divide the design into no more than six (6) design packages per major facility type and no more than three (3) design packages for site and associated work. Designate how it will package the design, consistent with its overall plan for permitting (where applicable) and construction of the project. See Sections 01 33 00 SUBMITTAL PROCEDURES and 01 32 01.00 10 PROJECT SCHEDULE for requirements for identifying and scheduling the design packaging plan in the submittal register and project schedule. See also Sections 01 10 00 STATEMENT OF WORK and 01 57 20.00 10 ENVIRONMENTAL PROTECTION for any specified permit requirements. If early procurement of long-lead item construction materials or installed equipment, prior to completion of the associated design package, is necessary to facilitate the project schedule, also identify those long-lead items and how it will assure design integrity of the associated design package to meet the contract requirements (The Contract consists of the Solicitation requirements and the accepted proposal). Once the Government is satisfied that the long-lead items meet the contract requirements, the Contracting Officer will allow the Contractor to procure the items at its own risk.

1.1.3. The Contractor may proceed with the construction work included in a separate design package after the Government has reviewed the final (100%) design submission for that package, review comments have been addressed and resolved to the Government's satisfaction and the Contracting Officer (or the Administrative Contracting Officer) has agreed that the design package may be released for construction.

1.1.4. INTEGRATED DESIGN. To the maximum extent permitted for this project, use a collaborative, integrated design process for all stages of project delivery with comprehensive performance goals for siting, energy, water, materials and indoor environmental quality and ensures incorporation of these goals. Consider all stages of the building lifecycle, including deconstruction.

1.2. DESIGNER OF RECORD

Identify, for approval, the Designer of Record (“DOR”) that will be responsible for each area of design. One DOR may be responsible for more than one area. Listed, Professional Registered, DOR(s) shall account for all areas of design disciplines. The DOR’s shall stamp, sign, and date each design drawing and other design deliverables under their responsible discipline at each design submittal stage (see contract clause Registration of Designers). If the deliverables are not ready for release for construction, identify them as "preliminary" or "not for release for construction" or by using some other appropriate designation. The DOR(s) shall also be responsible for maintaining the integrity of the design and for compliance with the contract requirements through construction and documentation of the as-built condition by coordination, review and approval of extensions of design, material, equipment and other construction submittals, review and approval or disapproval of requested deviations to the accepted design or to the contract, coordination with the Government of the above activities, and by performing other typical professional designer responsibilities.

2.0 PRODUCTS (Not Applicable)

3.0 EXECUTION

3.1. PRE-WORK ACTIVITIES & CONFERENCES

3.1.1. Design Quality Control Plan

Submit for Government acceptance, a Design Quality Control Plan in accordance with Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL before design may proceed.

3.1.2. Post Award Conference

3.1.2.1. The government will conduct a post award contract administration conference at the project site, as soon as possible after contract award. This will be coordinated with issuance of the contract notice to proceed (NTP). The Contractor and major sub-contractor representatives shall participate. All designers need not attend this first meeting. Government representatives will include COE project delivery team members, facility users, facility command representatives, and installation representatives. The Government will provide an agenda, meeting goals, meeting place, and meeting time to participants prior to the meeting.

3.1.2.2. The post award conference shall include determination and introduction of contact persons, their authorities, contract administration requirements, discussion of expected project progress processes, and coordination of subsequent meetings for quality control (see Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL), Partnering (see below and SCR: Partnering), and the initial design conference (see below).

3.1.2.3. The government will introduce COE project delivery team members, facility users, facility command representatives, and installation representatives. The DB Contractor shall introduce major subcontractors, and other needed staff. Expectations and duties of each person shall be defined for all participants. A meeting roster shall be developed and distributed by the government with complete contact information including name, office, project role, phone, mailing and physical address, and email address.

3.1.3. Partnering & Project Progress Processes

3.1.3.1. The initial Partnering conference may be scheduled and conducted at any time with or following the post award conference. The Government proposes to form a partnership with the DB Contractor to develop a cohesive building team. This partnership will involve the COE project delivery team members, facility users, facility command representatives, installation representatives, Designers of Record, major subcontractors, contractor quality control staff, and contractor construction management staff. This partnership will strive to develop a cooperative management team drawing on the strengths of each team member in an effort to achieve a quality project within budget and on schedule. This partnership will be bilateral in membership and participation will be totally voluntary. All costs, excluding labor and travel expenses, shall be shared equally between the Government and the Contractor. The Contractor and Government shall be responsible for their own labor and travel costs. Normally, partnering meetings will be held at or in the vicinity of the project installation.

3.1.3.2. As part of the partnering process, the Government and Contractor shall develop, establish, and agree to comprehensive design development processes including conduct of conferences, expectations of design development at conferences, fast-tracking, design acceptance, Structural Interior Design (SID)/ Furniture, Fixtures & Equipment (FF&E) design approval, project closeout, etc. The government will explain contract requirements and the DB Contractor shall review their proposed project schedule and suggest ways to streamline processes.

3.1.4. Initial Design Conference

The initial design conference may be scheduled and conducted at the project installation any time after the post award conference, although it is recommended that the partnering process be initiated with or before the initial design conference. Any design work conducted after award and prior to this conference should be limited to site and is discouraged for other items. All Designers of Record shall participate in the conference. The purpose of the meeting is to introduce everyone and to make sure any needs the contractor has are assigned and due dates established as well as who will get the information. See also Attachment F, BUILDING INFORMATION MODELING REQUIREMENTS for discussion concerning the BIM Implementation Plan demonstration at this meeting. The DB Contractor shall conduct the initial design conference.

3.1.5. Pre-Construction Conference

Before starting construction activities, the Contractor and Government will jointly conduct a pre-construction administrative conference to discuss any outstanding requirements and to review local installation requirements for start of construction. It is possible there will be multiple Pre-Construction Conferences based on the content of the design packages selected by the Contractor. The Government will provide minutes of this meeting to all participants.

3.2. STAGES OF DESIGN SUBMITTALS AND OVER THE SHOULDER PROGRESS REVIEWS

The stages of design submittals described below define Government expectations with respect to process and content. The Contractor shall determine how to best plan and execute the design and review process for this project, within the parameters listed below. As a minimum, the Government expects to see at least one interim design submittal, at least one final design submittal before construction of a design package may proceed and at least one Design Complete submittal that documents the accepted design. The Contractor may sub-divide the design into separate packages for each stage of design and may proceed with construction of a package after the Government accepts the final design for that package. See discussion on waivers to submission of one or more intermediate design packages where the parties partner during the design process. See also Attachment F, BUILDING INFORMATION MODELING REQUIREMENTS for discussion concerning BIM and the various stages of design submittals and over-the-shoulder progress reviews.

3.2.1. Site/Utilities

To facilitate fast-track design-construction activities the contractor may submit a final (100%) site and utility design as the first design submittal or it may elect to submit interim and final site and utility design submittals as explained below. Following review, resolution, and incorporation of all Government comments, and submittal of a satisfactory set of site/utility design documents, after completing all other pre-construction requirements in this contract and after the pre-construction meeting, the Government will allow the Contractor to proceed with site development activities, including demolition where applicable, within the parameters set forth in the accepted design submittal. For the first site and utility design submission, whether an interim or final, the submittal review, comment, and resolution times from this specification apply, except that the Contractor shall allow the Government a 14 calendar day review period, exclusive of mailing time. No on-site construction activities shall begin prior to written Government clearance to proceed.

3.2.2. Interim Design Submittals

The Contractor may submit either a single interim design for review, representing a complete package with all design disciplines, or split the interim design into smaller, individual design packages as it deems necessary for fast-track construction purposes. As required in Section 01 32 01.00 10 PROJECT SCHEDULE, the Contractor shall schedule its design and construction packaging plan to meet the contract completion period. This submission is the Government's primary opportunity to review the design for conformance to the solicitation and to the accepted contract proposal and to the Building Codes at a point where required revisions may be still made, while minimizing lost design effort to keep the design on track with the contract requirements. The requirements for the interim design review submittals and review conferences are described hereinafter. This is not necessarily a hold point for the design process; the Contractor may designate the interim design submittal(s) as a snapshot and proceed with design development at its own risk. See below for a waiver, where the parties establish an effective over-the-shoulder progress review procedure through the partnering process that would eliminate the need for or expedite a formal intermediate design review on one or more individual design packages.

3.2.3. Over-the-Shoulder Progress Reviews

To facilitate a streamlined design-build process, the Government and the Contractor may agree to one-on-one reviewer or small group reviews, electronically, on-line (if available within the Contractor's standard design practices) or at the Contractor's design offices or other agreed location, when practicable to the parties. The Government and Contractor will coordinate such reviews to minimize or eliminate disruptions to the design process. Any data required for these reviews shall normally be provided in electronic format, rather than in hard copy. If the Government and Contractor establish and implement an effective, mutually agreeable partnering procedure for regular (e.g., weekly) over-the shoulder review procedures that allow the Government reviewers the opportunity to keep fully informed of the progress, contents, design intent, design documentation, etc. of the design package, the Government will agree to waive or to expedite the formal intermediate design review period for that package. The Contractor shall still be required to submit the required intermediate design documentation, however the parties may agree to how that material will be provided, in lieu of a formal consolidated submission of the package. It should be noted that Government funding is extremely limited for non-local travel by design reviewers, so the maximum use of virtual teaming methods must be used. Some possible examples include electronic file sharing, interactive software with on-line or telephonic conferencing, televideo conferencing, etc. The Government must still perform its Code and Contract conformance reviews, so the Contractor is encouraged to partner with the reviewers to find ways to facilitate this process and to facilitate meeting or bettering the design-build schedule. The Contractor shall maintain a fully functional configuration management system as described herein to track design revisions, regardless of whether or not there is a need for a formal intermediate design review. The formal intermediate review procedures shall form the contractual basis for the official schedule, in the event that the partnering process determines that the formal intermediate review process to be best suited for efficient project execution. However, the Government pledges to support and promote the partnering process to work with the Contractor to find ways to better the design schedule.

3.2.4. Final Design Submissions

This submittal is required for each design package prior to Government acceptance of that design package for construction. The requirements for the final design submittal review conferences and the Government's acceptance for start of construction are described herein after.

3.2.5. Design Complete Submittals

After the final design submission and review conference for a design package, revise the design package to incorporate the comments generated and resolved in the final review conferences, perform and document a back-check review and submit the final, design complete documents, which shall represent released for construction documents. The requirements for the design complete submittals are described hereinafter.

3.2.6. Holiday Periods for Government Review or Actions

Do not schedule meetings, Government reviews or responses during the last two weeks of December or other designated Government Holidays (including Friday after Thanksgiving). Exclude such dates and periods from any durations specified herein for Government actions.

3.2.7. Late Submittals and Reviews

If the Contractor cannot meet its scheduled submittal date for a design package, it must revise the proposed submittal date and notify the government in writing, at least one (1) week prior to the submittal, in order to accommodate the Government reviewers' other scheduled activities. If a design submittal is over one (1) day late in accordance with the latest revised design schedule, or if notification of a proposed design schedule change is less than seven (7) days from the anticipated design submission receipt date, the Government review period may be extended up to seven (7) days due to reviewers' schedule conflicts. If the Government is late in meeting its review commitment and the delay increases the Contractor's cost or delays completion of the project, the Suspension of Work and Defaults clauses provide the respective remedy or relief for the delay.

3.3. DESIGN CONFIGURATION MANAGEMENT

3.3.1. Procedures

Develop and maintain effective, acceptable design configuration management (DCM) procedures to control and track all revisions to the design documents after the Interim Design Submission through submission of the As-Built documents. During the design process, this will facilitate and help streamline the design and review schedule. After the final design is accepted, this process provides control of and documents revisions to the accepted design (See Special Contract Requirement: Deviating From the Accepted Design). The system shall include appropriate authorities and concurrences to authorize revisions, including documentation as to why the revision must be made. Include the DCM procedures in the Design Quality Control Plan. The DCM data shall be available to the Government reviewers at all times. The Contractor may use its own internal system with interactive Government concurrences, where necessary or may use the Government's "DrChecks Design Review and Checking System" (see below and Attachment C).

3.3.2. Tracking Design Review Comments

Although the Contractor may use its own internal system for overall design configuration management, the Government and the Contractor shall use the DrChecks Design Review and Checking System to initiate, respond to, resolve and track Government design compliance review comments. This system may be useful for other data which needs to be interactive or otherwise available for shared use and retrieval. See Attachment C for details on how to establish an account and set-up the DrChecks system for use on the project.

3.3.3. Design and Code Checklists

Develop and complete various discipline-specific checklists to be used during the design and quality control of each submittal. Submit these completed checklists with each design submittal, as applicable, as part of the project documentation. See Section 01 45 04.00 10 Contractor Quality Control, Attachment D for a Sample Fire Protection and Life Safety Code review checklist and Attachment E for LEED SUBMITTALS.

3.4. INTERIM DESIGN REVIEWS AND CONFERENCES

3.4.1. General

At least one interim design submittal, review and review conference is required for each design package (except that, per paragraph 3.2.1, the Contractor may skip the interim design submission and proceed directly to final design on the sitework and utilities package). The DB Contractor may include additional interim design conferences or over-the-shoulder reviews, as needed, to assure continued government concurrence with the design work. Include the interim submittal review periods and conferences in the project schedule and indicate what part of the design work is at what percentage of completion. The required interim design conferences shall be held when interim design requirements are reached as described below. See also Paragraph: **Over-the-Shoulder Progress Reviews** for a waiver to the formal interim design review.

3.4.2. Procedures

After receipt of an Interim Design submission, allow the Government fourteen (14) calendar days after receipt of the submission to review and comment on the interim design submittal. For smaller design packages, especially those that involve only one or a few separate design disciplines, the parties may agree on a shorter review period or alternative review methods (e.g., over-the–shoulder or electronic file sharing), through the partnering process. For each interim design review submittal, the COR will furnish, to the Contractor, a single consolidated, validated listing of all comments from the various design sections and from other concerned agencies involved in the review process using the DrChecks Design Review and Checking System. The review will be for conformance with the technical requirements of the solicitation and the Contractor's RFP proposal. If the Contractor disagrees technically with any comment or comments and does not intend to comply with the comment, he/she must clearly outline, with ample justification, the reasons for noncompliance within five (5) days after receipt of these comments in order that the comment can be resolved. Furnish disposition of all comments, in writing, through DrChecks. The Contractor is cautioned that if it believes the action required by any comment exceeds the requirements of this contract, that it should take no action and notify the COR in writing immediately. The Interim Review conference will be held for each design submittal at the installation. Bring the personnel that developed the design submittal to the review conference. The conference will take place the week after the receipt of the comments by the Contractor. For smaller fast-track packages that involve only a few reviewers, the parties may agree to alternative conferencing methods, such as teleconferencing, or televideo, where available, as determined through Partnering.

3.4.3. Conference Documentation

3.4.3.1. In order to facilitate and accelerate the Government code and contract conformance reviews, identify, track resolution of and maintain all comments and action items generated during the design process and make this available to the designers and reviewers prior to the Interim and subsequent design reviews.

3.4.3.2. The DB Contractor shall prepare meeting minutes and enter final resolution of all comments into DrChecks. Copies of comments, annotated with comment action agreed on, will be made available to all parties before the conference adjourns. Unresolved problems will be resolved by immediate follow-on action at the end of conferences. Incorporate valid comments. The Government reserves the right to reject design document submittals if comments are significant. Participants shall determine if any comments are critical enough to require further design development prior to government concurrence. Participants shall also determine how to proceed in order to obtain government concurrence with the design work presented.

3.5. INTERIM DESIGN REQUIREMENTS

Interim design deliverables shall include drawings, specifications, and design analysis for the part of design that the Contractor considers ready for review.

3.5.1. Drawings

Include comments from any previous design conferences incorporated into the documents to provide an interim design for the “part” submitted.

3.5.2. Design Analyses

3.5.2.1. The designers of record shall prepare and present design analyses with calculations necessary to substantiate and support all design documents submitted. Address design substantiation required by the applicable codes and references and pay particular attention to the following listed items:

3.5.2.2. For parts including sitework, include site specific civil calculations.

3.5.2.3. For parts including structural work, include structural calculations.

(a) Identify all loads to be used for design.

(b) Describe the method of providing lateral stability for the structural system to meet seismic and wind load requirements. Include sufficient calculations to verify the adequacy of the method.

(c) Provide calculations for all principal roof, floor, and foundation members and bracing and secondary members.

(d) Provide complete seismic analyses for all building structural, mechanical, electrical, architectural, and building features as dictated by the seismic zone for which the facility is being constructed.

(e) Computer generated calculations must identify the program name, source, and version. Provide input data, including loads, loading diagrams, node diagrams, and adequate documentation to illustrate the design. The schematic models used for input must show, as a minimum, nodes/joints, element/members, materials/properties, and all loadings, induced settlements/deflections, etc., and a list of load combinations. Include an output listing for maximum/minimum stresses/forces and deflections for each element and the reactions for each loading case and combination.

(f) See also the Security (Anti-Terrorism) requirements below for members subject to Anti-Terrorist Force Protection (ATFP) and Progressive Collapse requirements.

(g) Fully coordinate and integrate the overall structural design between two different or interfacing construction types, such as modular and stick-built or multistory, stacked modular construction. Provide substantiation of structural, consolidation/settlement analysis, etc., as applicable, through the interfaces.

3.5.2.4. For Security (Anti-Terrorism): Provide a design narrative and calculations where applicable, demonstrating compliance with each of the 22 standards in UFC 4-010-01, which includes Design of Buildings to Resist Progressive Collapse (use the most recent version of UFC 4-023-03, regardless of references to any specific version in UFC 4-010-01). Where sufficient standoff distance is not being provided, show calculations for blast resistance of the structural system and building envelope. Show complete calculations for members subjected to ATFP loads, e.g., support members of glazed items (jambs, headers, sills) connections of windows to support members and connections of support members to the rest of the structure. For 3 story and higher buildings, provide calculations to demonstrate compliance with progressive collapse requirements.

3.5.2.5. For parts including architectural work, include building floor area analysis.

3.5.2.6. For parts including mechanical work, include HVAC analysis and calculations. Include complete design calculations for mechanical systems. Include computations for sizing equipment, compressed air systems, air duct design, and U-factors for ceilings, roofs and exterior walls and floors. Contractor shall employ commercially available energy analysis techniques to determine the energy performance of all passive systems and features. Use of hourly energy load computer simulation is required (see paragraph 3.5.5.2 for list of acceptable software). Based on the results of calculations, provide a complete list of the materials and equipment proposed with the manufacturer's published cataloged product installation specifications and roughing-in data.

3.5.2.7. For parts including life safety, include building code analysis and sprinkler and other suppression systems. Notwithstanding the requirements of the Codes, address the following:

(a) A registered fire protection engineer (FPE) must perform all fire protection analyses. Provide the fire protection engineer’s qualifications. See Section 01 10 00, paragraph 5 for qualifications.

(b) Provide all references used in the design including Government design documents and industry standards used to generate the fire protection analysis.

(c) Provide classification of each building in accordance with fire zone, building floor areas and height and number of stories.

(d) Provide discussion and description of required fire protection requirements including extinguishing equipment, detection equipment, alarm equipment and water supply. Alarm and detection equipment shall interface to requirements of Electronic Systems.

(e) Provide hydraulic calculations based on water flow test for each sprinkler system to insure that flow and pressure requirements can be met with current water supply. Include copies of Contractor's water flow testing done to certify the available water source.

3.5.2.8. For parts including plumbing systems:

(a) List all references used in the design.

(b) Provide justification and brief description of the types of plumbing fixtures, piping materials and equipment proposed for use.

(c) Detail calculations for systems such as sizing of domestic hot water heater and piping; natural gas piping; LP gas piping and tanks, fuel oil piping and tanks, etc., as applicable.

(d) When the geotechnical report indicates expansive soils are present, indicate in the first piping design submittal how piping systems will be protected against damage or backfall/backflow due to soil heave (from penetration of slab to the 5 foot building line).

3.5.2.9. For elevator systems:

(a) List all criteria codes, documents and design conditions used.

(b) List any required permits and registrations for construction of items of special mechanical systems and equipment.

3.5.2.10. For parts including electrical work, include lighting calculations to determine maintained foot-candle levels, electrical load analysis and calculations, electrical short circuit and protective device coordination analysis and calculations and arc fault calculations.

3.5.2.11. For parts including telecommunications voice/data (including SIPRNET, where applicable), include analysis for determining the number and placement of outlets

3.5.2.12. For Cathodic Protection Systems, provide the following stamped report by the licensed corrosion engineer or NACE specialist with the first design submission. The designer must be qualified to engage in the practice of corrosion control of buried or submerged metallic surfaces. He/she must be accredited or certified by the National Association of Corrosion Engineers (NACE) as a NACE Accredited Corrosion Specialist or a NACE certified Cathodic Protection Specialist, or must be a registered professional engineer with a minimum of five years experience in corrosion control and cathodic protection, Clearly describe structures, systems or components in soil or water to be protected. Describe methods proposed for protection of each.

3.5.2.13. Air Barrier System: Provide a narrative of the design and installation requirements for the Air Barrier system. As part of the design quality control process an air barrier consultant shall review drawing details to assure that details of critical Air Barrier components are properly detailed and incorporated during the design drawings and process (i.e. window flashing details, penetration in air barrier details, door flashing details, roofing/ceiling barrier interface details and etc.). Furnish the Government written review details and results.

3.5.2.14. Life Cycle Cost Analysis (LCCA) Documentation: Sufficient documentation is required for all life cycle cost analyses required in paragraph 5 of Section 01 10 00, the Statement of Work. Each LCCA must be complete and substantial, sufficient of being read as a standalone document which defines all the parameters of the analysis. Use of commercially available software programs to calculate life cycle costs are acceptable, however, provide the LCCA Documentation requirements, as outlined below in addition to any input/output documents generated by the software. As a minimum, include the following items in the LCCA documentation:

(a) Definition of Baseline Condition

(b) Narrative Identification/Explanation of Each Alternative Considered

(c) Energy Usage Analysis (Narrative explanation as well as computer outputs)

(d) Energy Costs Used (Source of Rate Structure or Utility Rates)

(e) First Cost of Baseline Condition and Each Alternative (Cost information must demonstrate inclusion of applicable components and sub-components - single line, lump sum cost estimates for the baseline or alternative conditions are not acceptable)

(f) Cyclical Replacement Costs (Identify data source for equipment/component life used)

(g) Annual/Recurring Maintenance Costs (Identify data source for required maintenance tasks and duration/cost of tasks)

(h) Salvage Values (Identify data source for equipment/component life used)

(i) Life Cycle Cost Results Including:

(1) Life Cycle Cost of the Baseline Condition

(2) Life Cycle Cost of Each Alternative Evaluated

(3) Simple Payback Calculations for Each Alternative

(4) Savings to Investment Ratio for Each Alternative

(5) Study Period Utilized

(6) Net Savings for Each Alternative (As Applicable)

(7) Narrative Discussion/Analysis of Results

(8) Uncertainty Analysis

(9) Certification that the analysis conducted and documented is compliant with the terms, instructions, and conditions of 10 CFR 436 Subpart A.

3.5.3. Geotechnical Investigations and Reports:

3.5.3.1. The contractor's licensed geotechnical engineer shall prepare a final geotechnical evaluation report, to be submitted along with the first foundation design submittal. Make this information available as early as possible during the over-the-shoulder progress review process. Summarize the subsurface conditions and provide recommendations for the design of appropriate utilities, foundations, floor slabs, retaining walls, embankments, and pavements. Include compaction requirements for fill and backfill under buildings, sidewalks, other structures and open areas. Recommend foundation systems to be used, allowable bearing pressures for footings, lateral load resistance capacities for foundation systems, elevations for footings, grade beams, slabs, etc. Provide an assessment of post-construction settlement potential including total and differential. Provide recommendations regarding lateral earth pressures (active, at-rest, passive) to be used in the design of retaining walls. Include the recommended spectral accelerations and Site Class for seismic design along with an evaluation of any seismic hazards and recommendations for mitigation, if required. Include calculations to support the recommendations for bearing capacity, settlement, and pavement sections. Include supporting documentation for all recommended design parameters such as Site Class, shear strength, earth pressure coefficients, friction factors, subgrade modulus, California Bearing Ratio (CBR), etc. Provide earthwork recommendations, expected frost penetration, expected groundwater levels, recommendations for dewatering and groundwater control and the possible presence of any surface or subsurface features that may affect the construction of the project such as sinkholes, boulders, shallow rock, old fill, old structures, soft areas, or unusual soil conditions. Include pH tests, salinity tests, resistivity measurements, etc., required to design corrosion control and grounding systems. Include the raw field data. Arrange a meeting with the Government subsequent to completion and evaluation of the site specific geotechnical exploration to outline any differences encountered that are inconsistent with the Government provided preliminary soils information. Clearly outline differences which require changes in the foundation type, or pavement and earthwork requirements from that possible and contemplated using the Government furnished preliminary soils investigation, which result in a change to the design or construction. Any equitable adjustment is subject to the provisions of the contract's Differing Site Conditions Clause.

3.5.3.2. Vehicle Pavements: The Contractor's geotechnical report shall contain flexible and rigid pavement designs, as applicable for the project, including design CBR and modulus of subgrade reaction and the required compaction effort for subgrades and pavement layers. Provide Information on the types of base course materials available in the area and design strengths.

3.5.3.3. The Contractor and the professional geotechnical engineer consultant shall certify in writing that the design of the project has been developed consistent with the Contractor's final geotechnical report. The certification shall be stamped by the consulting professional geotechnical engineer and shall be submitted with the first design submission. If revisions are made to the initial design submission, a new certification shall be provided with the final design submission.

3.5.4. LEED Documentation:

Assign a LEED Accredited Professional, responsible to track LEED planning, performance and documentation for each LEED credit through construction closeout. Incorporate LEED credits in the plans, specifications and design analyses. Develop LEED supporting documentation as a separable portion of the Design Analysis and provide with each required design submittal. Include the LEED Project checklist for each non-exempt facility (one checklist may be provided for multiple facilities in accordance with the LEED-NC Application Guide for Multiple Buildings and On-Campus Building Projects and the LEED SUBMITTALS (Attachment E, herein) with each submittal. Final design submittal for each portion of the work must include all required design documentation relating to that portion of work (example - all site credit design documents with final site design). Submittal requirements are as indicated in Attachment E, LEED SUBMITTALS. Submit all documentation indicated on Attachment E as due at final design at final design submittal (for fast-track projects with multiple final design submittals, this shall be at the last scheduled final design submittal). All project documentation related to LEED shall conform to USGBC requirements for both content and format, including audit requirements and be separate from other design analyses. Maintain and update the LEED documentation throughout project progress to construction closeout and shall compile product data, receipts, calculations and other data necessary to substantiate and support all credits claimed. The Government may audit any or all individual credits. Audit documentation is not required to be submitted unless requested. These requirements apply to all projects. If the project requires the Contractor to obtain USGBC certification, the Contractor shall also be responsible for obtaining USGBC certification and shall provide written evidence of certification with the construction closeout LEED documentation submittal. Install the USGBC building plaque at the location indicated by the Government upon receipt. If Contractor obtains USGBC interim design review, submit the USGBC review to the Government within 30 days of receipt for information only.

3.5.4.1. LEED Documentation for Technology Solution Set. If the Solicitation provides a Prescriptive Technology Solution Set, use of the Technology Solution set has no effect on LEED documentation requirements. Provide all required LEED documentation, including energy analysis, in accordance with LEED requirements when using the Technology Solution Set.

3.5.5. Energy Conservation:

3.5.5.1. Refer to Section 01 10 00, Paragraph 5. Interim and Final Design submittals shall demonstrate that each building including the building envelope, HVAC systems, service water heating, power, and lighting systems meet the Mandatory Provisions and the Prescriptive Path requirements of ASHRAE 90.1. Use Compliance Documentation forms available from ASHRAE and included in the ASHRAE 90.1 User's Manual for this purpose. The Architectural Section of the Design Analysis shall include completed forms titled "Building Envelope Compliance Documentation Parts I and II". The Heating Ventilating and Air Conditioning (HVAC) Section of the Design Analysis shall include a completed form titled "HVAC Simplified Approach Option - Part I" if this approach is allowed by the Standard. Otherwise, the HVAC

Section of the Design Analysis shall include completed forms titled “HVAC Mandatory Provisions - Part II” and “HVAC Prescriptive Requirements - Part III”. The Plumbing Section of the Design Analysis shall include a completed form titled “Service Water Heating Compliance Documentation”. The Electrical Section of the Design Analysis shall include an explanatory statement on how the requirements of ASHRAE 90.1 Chapter 8 Power were met. The Electrical Section of the Design Analysis shall also include a completed form titled “Lighting Compliance Documentation”.

3.5.5.2. Interim and Final Design submittals which address energy consuming systems, (heating, cooling, service hot water, lighting, power, etc.) must also include calculations in a separate Energy Conservation Section of the Design Analysis which demonstrate and document (a) the baseline energy consumption for the facility or facilities under contract, that would meet the requirements of ANSI/ASHRAE/IESNA Standard 90.1 and (b) the energy consumption of the facility or facilities under contract utilizing the materials and methods required by this construction contract. Use the USGBC Energy and Atmosphere (EA) Credit 1 compliance template / form or an equivalently detailed form for documenting compliance with the energy reduction requirements. This template / form is titled PERFORMANCE RATING METHOD and is available when the project is registered for LEED. The calculation methodology used for this documentation and analysis shall follow the guidelines set forth in Appendix G of ASHRAE 90.1, with two exceptions: a) receptacle and process loads may be omitted from the calculation; and b) the definition of the terms in the formula for Percentage Improvement found in paragraph G1.2 are modified as follows: Baseline Building Performance shall mean the annual energy consumption calculated for a building design intended for use as a baseline for rating above standard design meeting the minimum requirements of the energy standard, and Proposed Building Performance shall mean annual energy consumption calculated for the proposed building design intended for construction. This calculation shall address all energy consuming systems in a single integrated methodology. Include laboratory fume hoods and kitchen ventilation loads in the energy calculation. They are not considered process loads. Individual calculations for heating, cooling, power, lighting, power, etc. systems will not be acceptable. The following building simulation software is acceptable for use in calculating building energy consumption: Hourly Analysis Program (HAP) by Carrier Corp., TRACE 700 by Trane Corp., DOE-2 by US Department of Energy, EnergyPlus by DOD/DOE.

3.5.6. Specifications

Specifications may be any one of the major, well known master guide specification sources. Uuse only one source. Examples include specifications from MASTERSPEC from the American Institute of Architects, SPECTEXT from Construction Specification Institute or Unified Facility Guide Specifications (UFGS using MASTERFORMAT 2004 numbering system), etc. The UFGS are available through the “Whole Building Design Guide” website, using a websearch engine. Manufacturers’ product specifications, utilizing CSI’s Manu-Spec, three part format may be used in conjunction with the selected specifications. The designers of record shall edit and expand the appropriate Specifications to insure that all project design requirements, current code requirements, and regulatory requirements are met. Specifications shall clearly identify, where appropriate, specific products chosen to meet the contract requirements (i.e., manufacturers’ brand names and model numbers or similar product information). Note that the UFGS are NOT written for Design-Build and must be edited appropriately. For instance, they assume that the Government will approve most submittals, whereas in Design-Build, the Designer of Record has that action, unless this Solicitation requires Government approval for specific submittals. The Designer of Record should also note that some UFGS sections might either prescribe requirements exceeding the Government’s own design standards in applicable references or contain requirements that should be selected where appropriately required by the applicable references. At any rate, where the UFGS are consistent with other major, well known master commercial guide specifications, then generally retain such requirements, as good practices.

3.5.7. Building Rendering

Present and provide a draft color computer, artist, or hand drawn rendering with the conceptual design submittal of the building exterior. Perspective renderings shall include a slightly overhead view of the entire building to encompass elevations and the roof configuration of the building. After Government review and acceptance, provide a final rendering, including the following:

Three (3) 18” x 24” color prints, framed and matted behind glass with project title underneath the print.

One (1) Image file (high resolution) in JPG format on CD for those in the submittal distribution list.

3.5.8. Interim Building Design Contents

The following list represents what the Government considers should be included in the overall completed design for a facility or project. It is not intended to limit the contractor from providing different or additional information as needed to support the design presented, including the require design analyses discussed above. As the Contractor develops individual design packages and submits them for Interim review, include as much of the applicable information for an individual design package as is developed at the Interim design level for review purposes. These pieces shall be developed as the design progresses toward the design complete stage.

3.5.8.1. Lawn and Landscaping Irrigation System

3.5.8.2. Landscape, Planting and Turfing

3.5.8.3. Architectural

(a) Design Narrative

(b) Architectural Floor Plans, Typical Wall and Roof Sections, Elevations

(c) Finish schedule

(d) All required equipment

(e) Special graphics requirements

(f) Door and Window Schedules

(g) Hardware sets using BHMA designations

(h) Composite floor plan showing all pre-wired workstations

(i) Structural Interior Design (SID) package: See ATTACHMENT A for specific requirements

(j) Furniture, Fixtures & Equipment (FF&E) design package: See ATTACHMENT B for specific requirements

(k) Air Barrier Design: Details of all Air Barrier components, (i.e. window flashing details, penetrations in air barrier details, door flashing details, roofing/ceiling barrier interface details and etc.)

3.5.8.4. Structural Systems. Include:

(a) Drawings showing principal members for roof and floor framing plans as applicable

(b) Foundation plan showing main foundation elements where applicable

(c) Typical sections for roof, floor, and foundation conditions

3.5.8.5. Plumbing Systems

(a) Show locations and general arrangement of plumbing fixtures and major equipment

(b) Plan and isometric riser diagrams of all areas including hot water, cold water, waste and vent piping. Include natural gas (and meter as required), (natural gas and meter as required), (LP gas), (fuel oil) and other specialty systems as applicable.

(c) Include equipment and fixture connection schedules with descriptions, capacities, locations, connection sizes and other information as required

3.5.8.6. HVAC Systems

(a) Mechanical Floor Plans: The floor plans shall show all principle architectural features of the building which will affect the mechanical design. The floor plans shall also show the following:

(1) Room designations.

(2) Mechanical legend and applicable notes.

(3) Location and size of all ductwork and piping.

(4) Location and capacity of all terminal units (i.e., registers, diffusers, grilles, hydronic baseboards).

(5) Pre-Fabricated Paint Spray Booth (where applicable to project scope)

(6) Paint Preparation Area (where applicable to project scope)

(7) Exhaust fans and specialized exhaust systems.

(8) Thermostat location.

(9) Location of heating/cooling plant (i.e., boiler, chiller, cooling tower, etc).

(10) Location of all air handling equipment.

(11) Air balancing information.

(12) Flue size and location.

(13) Piping diagram for forced hot water system (if used).

(b) Equipment Schedule: Provide complete equipment schedules. Include:

(1) Capacity

(2) Electrical characteristics

(3) Efficiency (if applicable)

(4) Manufacturer's name

(5) Optional features to be provided

(6) Physical size

(7) Minimum maintenance clearances

(a) Details: Provide construction details, sections, elevations, etc., only where required for clarification of methods and materials of design.

(b) HVAC Controls: Submit complete HVAC controls equipment schedules, sequences of operation, wiring and logic diagrams, Input/Output Tables, equipment schedules, and all associated information. See the Statement of Work for additional specific requirements.

3.5.8.7. Fire Protection and Life Safety.

(a) Provide plan for each floor of each building that presents a compendium of the total fire protection features being incorporated into the design. Include the following types of information:

(1) The location and rating of any fire-resistive construction such as occupancy separations, area separations, exterior walls, shaft enclosures, corridors, stair enclosures, exit passageways, etc.

(2) The location and coverage of any fire detection systems

(3) The location and coverage of any fire suppression systems (sprinkler risers, standpipes, etc.)

(4) The location of any other major fire protection equipment

(5) Indicate any hazardous areas and their classification

(6) Schedule describing the internal systems with the following information: fire hazard and occupancy classifications, building construction type, GPM/square foot sprinkler density, area of operation and other as required

(b) Working plans and all other materials submitted shall meet NFPA 13 requirements, with respect to required minimum level of detail.

3.5.8.8. Elevators. Provide:

(a) Description of the proposed control system

(b) Description, approximate capacity and location of any special mechanical equipment for elevators.

3.5.8.9. Electrical Systems.

(a) Electrical Floor Plan(s): Show all principle architectural features of the building which will affect the electrical design. Show the following:

(1) Room designations.

(2) Electrical legend and applicable notes.

(3) Lighting fixtures, properly identified.

(4) Switches for control of lighting.

(5) Receptacles.

(6) Location and designation of panelboards. Clearly indicate type of mounting required (flush or surface) and reflect accordingly in specifications.

(7) Service entrance (conduit and main disconnect).

(8) Location, designation and rating of motors and/or equipment which requires electrical service. Show method of termination and/or connection to motors and/or equipment. Show necessary junction boxes, disconnects, controllers (approximate only), conduit stubs, and receptacles required to serve the motor and/or equipment.

(b) Building Riser Diagram(s) (from pad-mounted transformer to unit load center panelboard): Indicate the types and sizes of electrical equipment and wiring. Include grounding and metering requirements.

(c) Load Center Panelboard Schedule(s): Indicate the following information:

(1) Panelboard Characteristics (Panel Designation, Voltage, Phase, Wires, Main Breaker Rating and Mounting.

(2) Branch Circuit Designations.

(3) Load Designations.

(4) Circuit Breaker Characteristics. (Number of Poles, Trip Rating, AIC Rating)

(5) Branch Circuit Connected Loads (AMPS).

(6) Special Features

(d) Lighting Fixture Schedule(s): Indicate the following information:

(1) Fixture Designation.

(2) General Fixture Description.

(3) Number and Type of Lamp(s).

(4) Type of Mounting.

(5) Special Features.

(e) Details: Provide construction details, sections, elevations, etc. only where required for clarification of methods and materials of design.

3.5.8.10. Electronic Systems including the following responsibilities:

(a) Fire Detection and Alarm System. Design shall include layout drawings for all devices and a riser diagram showing the control panel, annunciator panel, all zones, radio transmitter and interfaces to other systems (HVAC, sprinkler, etc.)

(b) Fire Suppression System Control. Specify all components of the Fire Suppression (FS) System in the FS section of the specifications. Clearly describe how the system will operate and interact with other systems such as the fire alarm system. Include a riser diagram on the drawings showing principal components and interconnections with other systems. Include FS system components on drawing legend. Designate all components shown on floor plans “FS system components” (as opposed to “Fire Alarm components”). Show location of FS control panels, HVAC control devices, sensors, and 120V power panel connections on floor plans. Indicate zoning of areas by numbers (1, 2, 3) and detectors sub-zoned for cross zoning by letter designations (A and B). Differentiate between ceiling mounted and under floor detectors with distinct symbols and indicate sub-zone of each.

(c) Public Address System

(d) Special Grounding Systems. Completely reflect all design requirements in the specifications and drawings. Specifications shall require field tests (in the construction phase), witnessed by the Government, to determine the effectiveness of the grounding system. Include drawings showing existing construction, if any.

(e) Cathodic Protection.

(f) Intrusion Detection, Card Access System

(g) Central Control and Monitoring System

(h) Mass Notification System

(i) Electrical Power Distribution Systems

3.5.8.11. Separate detailed Telecommunications drawings for Information Systems including the following responsibilities:

(a) Telecommunications Cabling

(b) Supporting Infrastructure

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

(d) Include a layout of the voice/data outlets (including voice only wall & pay phones) on telecommunication floor plan drawing, location of SIPRNET data outlets (where applicable), and a legend and symbol definition to indicate height above finished floor. Show size of conduit and cable type and size on Riser Diagram. Do not show conduit runs between backboard and outlets on the floor plans. Show underground distribution conduit and cable with sizing from point of presence to entrance facility of building.

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

(f) Communication Equipment Rooms - Plan Views - Tech and AMEP/Elevations - Racks and Walls. Elevations with a detailed look at all telecomm rooms. Indicate technology layout (racks, ladder-racks, etc.), mechanical/electrical layout, rack elevation and backboard elevation. They may also be an enlargement of a congested area of T1 or T2 series drawing.

3.6. FINAL DESIGN REVIEWS AND CONFERENCES

A final design review and review conference will be held upon completion of final design at the project installation, or – where equipment is available - by video teleconference or a combination thereof, for any design package to receive Government acceptance to allow release of the design package for construction. For smaller separate design packages, the parties may agree on alternative reviews and conferences (e.g., conference calls and electronic file sharing, etc.) through the Partnering process. Include the final design conference in the project schedule and shall indicate what part of the design work is at 100% completion. The final design conference will be held after the Government has had seven (7) calendar days after receipt of the submission to review the final design package and supporting data. For smaller packages, especially those involving only one or a few design disciplines the parties may agree on a shorter period.

3.7. FINAL DESIGN REQUIREMENTS

Final design deliverables for a design package shall consist of 100% complete drawings, specifications, submittal register and design analyses for Government review and acceptance. The 100% design submission shall consist of drawings, specifications, updated design analyses and any permits required by the contract for each package submitted. In order to expedite the final design review, prior to the conference, ensure that the design configuration management data and all review comment resolutions are up-to-date. Include the 100% SID and 100% FF&E binders for government approval. The Contractor shall have performed independent technical reviews (ITR's) and back-checks of previous comment resolutions, as required by Section 01 45 04.00 10 CONTRACTOR QUALITY CONTROL, including providing documentation thereof. Use DrChecks or other acceptable comment tracking system during the ITR and submit the results with each final design package

3.7.1. Drawings

3.7.1.1. Submit drawings complete with all contract requirements incorporated into the documents to provide a 100% design for each package submitted.

3.7.1.2. Prepare all drawings with the Computer-Aided Design and Drafting (CADD)/Computer-Aided Design (CAD) system, organized and easily referenced electronically, presenting complete construction information.

3.7.1.3. Drawings shall be complete. The Contractor is encouraged to utilize graphics, views, notes, and details which make the drawings easier to review or to construct but is also encouraged to keep such materials to those that are necessary.

3.7.1.4. Provide detail drawings that illustrate conformance with the contract. Include room finish schedules, corresponding color/finish/special items schedules, and exterior finish schedules that agree with the submitted SID binders.

3.7.1.5. The design documents shall be in compliance with the latest version of the A/E/C CAD Standard, available at https://cadbim.usace.army.mil/CAD. Use the approved vertical Corps of Engineers title blocks and borders on all drawings with the appropriate firm name included within the title block area.

3.7.1.6. CAD System and Building Information Modeling (BIM) (NOTE: If this is a Single Award or Multiple Award, Indefinite Delivery/Indefinite Quantity Contract, this information will be provided for each task order.)

All CAD files shall be fully compatible with MicroStation V8 format. Save all design CAD files as MicroStation V8 format files. All submitted BIM Models and associated Facility/Site Data shall be fully compatible with Bentley BIM with associated USACE Bentley BIM Workspace file formats.

(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) **halfsize** Full Sets/ *Partial Sets	Design Analyses & Specs Full Sets/ *Partial Sets	Drawing Size (Half Size) **fullsize** 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 **Fort Worth**	1/0	1/0	1/0	1	1	1	1
Commander, U.S.Army Engineer District, Center of Standardization **HNC**	1/0	1/0	1/0	1	1	1	1
Installation	2/0	2/0	1/0	0	2	0	0
U.S.Army Corps of Engineers Construction Area Office	4/0	4/0	1/0	4	1	0	4
Information Systems Engineering Command (ISEC)	0/0	0/0	0/0	1	*Partial Set (Work Station/System Furniture- IT Details)	N/A	1
Huntsville Engineer & Support Center, Central Furnishings Program	N/A	N/A	N/A	N/A	1 Interim/Refer to attachment B for the final submission Qty	N/A	N/A
Other Offices	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

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 four (4) different addresses. Assemble drawing sheets, specs, design analyses, etc. into individual sets; do not combine duplicate pages from individual sets so that the government has to assemble a set.

3.9.3.2. Each design submittal shall have a transmittal letter accompanying it indicating the date, design percentage, type of submittal, list of items submitted, transmittal number and point of contact with telephone number.

3.9.3.3. Provide partial sets of drawings, specifications, design analyses, etc., as designated in the Table in paragraph 3.9.1, to those reviewers who only need to review their applicable portions of the design, such as the various utilities. The details of which office receives what portion of the design documentation will be worked out after award.

3.10. AS-BUILT DOCUMENTS

Provide as-built drawings and specifications in accordance with Section 01 78 02.00 10, CLOSEOUT SUBMITTALS. Update LEED design phase documentation during construction as needed to reflect construction changes and advancing project completion status (example - Commissioning Plan updates during construction phase) and include updated LEED documentation in construction closeout submittal.

ATTACHMENT A
STRUCTURAL INTERIOR DESIGN (SID) REQUIREMENTS

1.0 GENERAL INFORMATION

Structural Interior Design includes all building related elements and components generally part of the building itself, such as wall finishes, ceilings finishes, floor coverings, marker/bulletin boards, blinds, signage and built in casework. Develop the SID in conjunction with the furniture footprint.

2.0 STRUCURAL INTERIOR DESIGN (SID) REQUIREMENTS FOR THE INTERIM AND FINAL DESIGN SUBMITTALS

2.1. FORMAT AND SCHEDULE

Prepare and submit for approval an interior and exterior building finishes scheme for an interim design submittal. The DOR shall meet with and discuss the finish schemes with the appropriate Government officials prior to preparation of the schemes to be presented. Present original sets of the schemes to reviewers at an interim design conference.

At the conclusion of the interim phase, after resolutions to the comments have been agreed upon between DOR and Government reviewers, the Contractor may proceed to final design with the interior finishes scheme presented.

The SID information and samples are to be submitted in 8 ½” x 11” format using three ring binders with pockets on the inside of the cover. When there are numerous pages with thick samples, use more than one binder. Large D-ring binders are preferred to O-ring binders. Use page protectors that are strong enough to keep pages from tearing out. Anchor large or heavy samples with mechanical fasteners, Velcro, or double-faced foam tape rather than rubber cement or glue. Fold out items must have a maximum spread of 25 ½”. Provide cover and spine inserts sheets identifying the document as “Structural Interior Design” package. Include the project title and location, project number, Contractor/A/E name and phone number(s), submittal stage and date.

Design submittal requirements include, but are not limited to:

2.1.1. Narrative of the Structural Interior Design Objectives

The SID shall include a narrative that discusses the building related finishes. Include topics that relate to base standards, life safety, sustainable design issues, aesthetics, durability and maintainability, discuss the development and features as they relate to the occupants requirements and the building design.

2.1.2. Interior Color Boards

Identify and key each item item on the color boards to the contract documents to provide a clear indication of how and where each item will be used. Arrange finish samples to the maximum extent possible by room type in order to illustrate room color coordination. Label all samples on the color boards with the manufacturer’s name, patterns and colors name and number. Key or code samples to match key code system used on contract drawings.

Material and finish samples shall indicate true pattern, color and texture. Provide photographs or colored photocopies of materials or fabrics to show large overall patterns in conjunction with actual samples to show the actual colors. Finish samples must be large enough to show a complete pattern or design where practical.

Color boards shall include but not be limited to original color samples of the following:

All walls finishes and ceiling finishes, including corner guards, acrylic wainscoting and wall guards/chair rail finishes

All tile information, including tile grout color and tile patterns.

- All flooring finishes, including patterns.
- All door, door frame finishes and door hardware finishes
- All signage, wall base, toilet partitions, locker finishes and operable/folding partitions and trim
- All millwork materials and finishes (cabinets, counter tops, etc.)
- All window frame finishes and window treatments (sills, blinds, etc.)

Color board samples shall reflect all actual finish textures, patterns and colors required as specified. Patterned samples shall be of sufficient size to adequately show pattern and its repeat if a repeat occurs.

2.1.3. Exterior Color Boards

Prepare exterior finishes color boards in similar format as the interior finishes color boards, for presentation to the reviewers during an interim design conference. Provide original color samples of all exterior finishes including but not limited to the following:

- All Roof Finishes
- All Brick and Cast Stone Samples
- All Exterior Insulation and Finish Samples
- All Glass Color Samples
- All Exterior Metals Finishes
- All Window & Door Frame Finishes
- All Specialty Item Finishes, including trim

Identify each item on the exterior finishes color boards and key to the building elevations to provide a clear indication of how and where each item will be used.

2.2. STRUCTURAL INTERIOR DESIGN DOCUMENTS

2.2.1. General

Structural interior design related drawings must indicate the placement of extents of SID material, finishes and colors and must be sufficiently detailed to define all interior work. The following is a list of minimum requirements:

2.2.2. Finish Color Schedule

Provide finish color schedule(s) in the contract documents. Provide a finish code, material type, manufacturer, series, and color designations. Key the finish code to the color board samples and drawings.

2.2.3. Interior Finish Plans

Indicate wall and floor patterns and color placement, material transitions and extents of interior finishes.

2.2.4. Furniture Footprint Plans

Provide furniture footprint plans showing the outline of all freestanding and systems furniture for coordination of all other disciplines.

2.2.5. Interior Signage

Include interior signage plans or schedules showing location and quantities of all interior signage. Key each interior sign to a quantitative list indicating size, quantity of each type and signage text.

2.2.6. Interior Elevations, Sections and Details

Indicate material, color and finish placement.

ATTACHMENT B
FURNITURE, FIXTURES & EQUIPMENT (FF&E) REQUIREMENTS

1.0 FF&E REQUIREMENTS FOR THE INTERIM AND FINAL DESIGN SUBMITTALS

1.1. FORMAT AND SCHEDULE

Prepare and submit for approval a comprehensive FF&E scheme for an interim design submittal. The Contractor's interior designer, NOT A FURNITURE DEALER, shall develop the design. FF&E is the selection, layout, specification and documentation of furniture and includes but is not limited to workstations, seating, tables, storage and shelving, filing, trash receptacles, clocks, framed artwork, artificial plants, and other accessories. Contract documentation is required to facilitate pricing, procurement and installation. The FF&E package is based on the furniture footprint developed in the Structural Interior Design (SID) portion of the interior design. Develop the FF&E package concurrently with the building design to ensure that there is coordination between the electrical outlets, switches, J-boxes, communication outlets and connections, and lighting as appropriate. In addition, coordinate layout with other building features such as architectural elements, thermostats, location of TV's, GF/GI equipment (for example computers, printers, copiers, shredders, faxes), etc. Locate furniture in front of windows only if the top of the item falls below the window and unless otherwise noted, do not attach furniture including furniture systems to the building. If project has SIPRNET and/or NIPRNET, coordinate furniture layout with SIPRNET and NIPRNET separation requirements. Verify that access required by DOIM for SIPRNET box and conduit is provided. The DOR shall interview appropriate Government personnel to determine FF&E requirements for furniture and furnishings prior to preparation of the scheme to be presented. Determine FFE items and quantities by, but not limited to: (1) the number of personnel to occupy the building, (2) job functions and related furniture/office equipment to support the job function, (3) room functions, (4) rank and grade. Present original sets of the scheme to reviewers at an interim design conference upon completion of the interim architectural submittal or three months prior to the submittal of the final FF&E package (whichever comes first).

Design may proceed to final with the FF&E scheme presented at the conclusion of the interim phase, after resolutions to the comments have been agreed upon between DOR and Government reviewers.

Provide sevencopies 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 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..

Submit five 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.

Design submittal requirements include, but are not limited to:

1.1.1. Narrative of Interior Design Objectives

Provide a narrative description of the furniture, to include functional, safety and ergonomic considerations, durability, sustainability, aesthetics, and compatibility with the building design.

1.1.2. Furniture Order Form

Prepare one Furnishings Order Form for each item specified in the design. This form identifies all information required to order each individual item. In addition to the project name and location, project number, and submittal phase, the order form must include:

(a) Furniture item illustration and code

(b) Furniture item name

(c) Job name, location, and date

(d) General Services Administration (GSA) FSC Group, part, and section

(e) GSA Contract Number, Special Item Number (SIN), and contract expiration date

(f) Manufacturer, Product name and Product model number or National Stock Number (NSN)

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

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

(i) Dimensions

(j) Item location by room number and room name

(k) Quantity per room

(l) Total quantity

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

(n) Written Product Description: include a non-proprietary paragraph listing the salient features of the item to include but not limited to:

(1) required features and characteristics

(2) ergonomic requirements

(3) functional requirements

(4) testing requirements

(5) furniture style

(6) construction materials

(7) minimum warranty

The following is an example for “m” features and characteristics, ergonomic requirements and functional requirements:

Chair Description:

(1) Mid-Back Ergonomic Task Chair

(2) Pneumatic Gaslift; Five Star Base

(3) Mesh Back; Upholstered Seat

(4) Height and Width Adjustable Task Arms:

a. Arm Height: 6”- 11” (+-1/2”)

b. Arm Width: 2”– 4” adjustment

(5) Height Adjustable Lumbar Support

(6) Adjustable Seat Height 16”-21” (+- 1”)

(7) Sliding Seat Depth Adjustment 15”-18” (+-1”)

(8) Standard Hard Casters (for carpeted areas)

(9) Overall Measurements:

a. Overall width: 25” - 27”

b. Overall depth: 25”– 28”

(10) Must have a minimum of the following adjustments (In addition to the above):

a. 360 Degree Swivel

b. Knee-Tilt with Tilt Tension

c. Back angle

d. Forward Tilt

e. Forward Tilt and Upright Tilt Lock

For projects with systems furniture, also provide a written description of the following minimum requirements:

(1) Type furniture systems (panel, stacking panels, spine wall, desk based system, or a combination)

(2) Minimum noise reduction coefficient (NRC)

(3) Minimum sound transfer coefficient (STC)

(4) Minimum flame spread and smoke development

(5) UL testing for task lighting and electrical system

(6) Panel widths and heights and their locations (this may be done on the drawings)Worksurface types and sizes (this may be done on the drawings)

(7) Worksurface edge type

(8) Varying panel/cover finish materials and locations (locations may be shown on the drawings)

(9) Storage requirements

(10) Keyboard requirements

(11) Lock and keying requirements

(12) Accessory components (examples: tack boards, marker boards, paper management)

(13) Electrical and communication raceway requirement; type, capacity and location (base, beltline, below and/or above beltline)

(14) Locations of communication cables (base, beltline, below and/or above beltline, top channel)

(15) Types of electrical outlets

(16) Types of communication jacks; provided and installed by others

(17) Locations of electrical outlets and communication jacks (this may be done on the drawings)

(18) Type of cable (examples: Cat. 5, Cat. 6, fiber optic; UTP or STP, etc.) system needs to support; provided and installed by others

1.1.3. Manufacturer & Alternate Manufacturer List

Provide a table consisting of all the major furniture items in the order forms and two alternate manufacturers for each item. ALTERNATE MANUFACTURER ITEMS MUST BE SELECTED FROM

GSA SCHEDULE AND MEET ALL THE SALIENT FEATURES OF THE ORIGINALLY SPECIFIED ITEM. Provide manufacturer name, address, telephone number, product series and product name for each item and the two alternate items. Major furniture items include, but are not limited to, casegoods, furniture systems, seating, and tables. Organize matrix by item code and item name.

1.1.4. FF&E Procurement List

Provide a table that lists all FF&E furniture, mission unique equipment and building Contractor Furnished/Contractor Installed (CF/CI) items. Give each item a code and name and designate whether item will be procured as part of the FF&E furniture, mission unique equipment or the building construction contract. Use the item code to key all FF&E documents including location plans, color boards, data sheets, cost estimate, etc. Divide the FF&E package into different sections based on this listing, applies to order forms and cost estimates.

1.1.5. Points of Contact (POCs)

Provide a comprehensive list of POCs needed to implement the FF&E package. This would include but not be limited to appropriate project team members, using activity contacts, interior design representatives, construction contractors and installers involved in the project. In addition to name, address, phone, fax and email, include each contact's job function. Divide the FF&E package into different sections based on this listing, applies to order forms and cost estimates.

1.1.6. Color Boards

Provide color boards for all finishes and fabrics for all FF&E items. Finishes to be included but not limited to paint, laminate, wood finish, fabric, etc.

1.1.7. Itemized Furniture Cost Estimate

Provide an itemized cost estimate of furnishings keyed to the plans and specifications of products included in the package. This cost estimate should be based on GSA price schedules. The cost estimate must include separate line items for general contingency, installation, electrical hook-up for systems furniture or other furniture requiring hardwiring by a licensed electrician, freight charges and any other related costs. Installation and freight quotes from vendors should be used in lieu of a percentage allowance when available. Include a written statement that the pricing is based on GSA schedules. An estimate developed by a furniture dealership may be provided as support information for the estimate, but must be separate from the contractor provided estimate.

1.2. INTERIOR DESIGN DOCUMENTS

1.2.1. Overall Furniture and Area Plans

Provide floor Plans showing locations and quantities of all freestanding, and workstation furniture proposed for each floor of the building. Key each room to a large scale Furniture Placement Plan showing the furniture configuration, of all furniture. Provide enlarged area plans with a key plan identifying the area in which the building is located. Key all the items on the drawings by furniture item code. Do not provide manufacturer specific information such as product names and numbers on drawings, Drawings shall be non-proprietary. This is typical for FFE on all plans, including those mentioned below. Coordinate the overall furniture and area plans with the Life Safety Code Review to ensure adequate clearances are provided for egress. Provide a narrative of this coordination to accompany the Furniture and Area plans.

1.2.2. Workstation Plans

Show each typical workstation configuration in plan view. In addition, provide either elevations or an isometric view. Drawings shall illustrate panels and all major components for each typical workstation configuration. Identify workstations using the same numbering system as shown on the project drawings. Key components to a legend on each sheet which identifies and describes the components along with dimensions. Provide the plan, elevations and isometric of each typical workstation together on the same drawing sheet.

1.2.3. Panel Plans

Show panel locations and critical dimensions from finished face of walls, columns, panels including clearances and aisle widths. Key panel assemblies to a legend which shall include width, height, configuration of frames, panel fabric and finishes (if there are different selections existing within a project), powered or non-powered panel and wall mount locations.

1.2.4. Desk Plans

Provide typical free standing desk configurations in plan view. In addition, provide either elevation or an isometric view and identify components to clearly represent each desk configuration.

1.2.5. Reflected Ceiling Plans

Provide typical plans showing ceiling finishes and heights, lighting fixtures, heating ventilation and air conditioning supply and return, and sprinkler head placement for coordination of furniture.

1.2.6. Electrical and Telecommunication Plans

Show power provisions including type and locations of feeder components, activated outlets and other electrical componentsShow locations and quantities of outlets for workstations. Clearly identify different outlets, i.e. electrical, LAN and telecommunication receptacles indicating each type proposed. Show wiring configuration, (circuiting, switching, internal and external connections) and provide as applicable.

1.2.7. Artwork Placement Plans

Provide an Artwork Placement Plan to show location of artwork, assign an artwork item code to each piece of artwork. As an alternative, artwork can be located on the Furniture Plans. Provide a schedule that identifies each piece by room name and number. Provide installation instructions; include mounting height.

1.2.8. Window Drapery Plans

Provide Interior Window Drapery Plans. Key each drapery treatment to a schedule showing color, pattern, material, drapery size and type, draw direction, location and quantities.

1.2.9. Portable Fire extinguishers:

Provide a list of all required portable fire extinguishers, with descriptions (location, size, type, etc.) and total number per type. See also attachment D, "SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW", paragraph 1.14.

1.3. FURNITURE SELECTION

1.3.1. Select furniture from the GSA Schedules. Specify furniture available open market when an item is not available on the GSA Schedules. Provide justification fort items not available on the GSA Schedules.

1.3.2. To the greatest extent possible when specifying furniture work within a manufacturer's family of furniture for selections, example: Steelcase, Turnstone, Brayton International, Metro, and Vecta are all Steelcase companies. Each alternate should also be specified from a manufacturer's family of furniture, example: first set of alternates would be specified from Knoll's family of furniture and the second from Herman Miller family of furniture. It may be necessary to make some selections from other than a manufacturer's family of furniture if costs are not reasonable for particular items, some items are not available or appropriate for the facility or the items are not on GSA Schedule. If this occurs, consider specifying product from an open line that is accessible by numerous dealerships. Select office furniture including case goods, tables, storage, seating, etc. that is compatible in style, finish and color. Select furniture that complies with ANSI/BIFMA and from manufacturer's standard product line as shown in the most recent published price list and/or amendment and not custom product.

1.4. CONSTRUCTION

1.4.1. Provide knee space at workstations and tables that is not obstructed by panels/legs that interfere with knee space of seated person and specificy modesty panels at walls to be of a height or be hinged to allow access to building wall electrical outlets and communication jacks. Provide desks, storage and tables with leveling devices to compensate for uneven floors.

1.4.2. Unless otherwise noted, specify workstations and storage of steel construction. Provide high pressure laminate worksurface tops constructed to prevent warpage (thermallyfused worksurfaces are not acceptable). Provide user friendly features such as radius edges. Do not use sharp edges and exposed connections and ensure the underside of desks, tables and worksurfaces are completely and smoothly finished. Provide abutting worksurfaces that mate closely and are of equal heights when used in side-by-side configurations in order to provide a continuous and level worksurface.

1.4.3. Drawers shall stay securely closed when in the closed position and protect wires from damage during drawer operation. Include a safety catch to prevent accidental removal when fully open

1.4.4. Unless otherwise noted, provide lockable desks and workstations, filing cabinets and storage. Key all locks within a one person office the same; key all one person offices within a building differently. If an office or open office area has more than one workstation, key all the workstations differently, but key all locks within an individual workstation the same. Use tempered glass glazing when glazing is required. Use light-emitting diode (LED)/solid state lighting where task lighting is required in furniture.

1.5. FINISHES AND UPHOLSTERY

1.5.1. Specify neutral colors for casegoods, furniture systems, storage and tables. Specify desk worksurfaces and table tops that are not too light or too dark in color and have a pattern to help hide soiling. Accent colors are allowed in break and lounge areas. Keep placement of furniture systems panel fabric accent colors to a minimum. All finishes shall be cleanable with ordinary household cleaning solutions.

1.5.2. Use manufacturer's standard fabrics; including textile manufacturers fabrics that have been graded into the furniture manufactures fabric grades and are available through their GSA Schedule. Customers Own Material (COM) can be used in headquarter buildings in command suites with executive furniture. Coordinate specific locations with Corps of Engineers Interior Designer.

1.5.3. Specify seating upholstery that meets Wyzenbeek Abrasion Test, 55,000 minimum rubs. Specify a soil retardant finish for woven fabrics if Crypton or vinyl upholstery is not provided for seating in dining areas. Use manufacturer's standard fabrics. This includes textile manufacturers fabrics that have been graded into the furniture manufactures fabric grades and are available through their GSA Schedule. Specify upholstery and finish colors and patterns that help hide soiling. Specify finishes that can be cleaned with ordinary household cleaning solutions.

1.6. ACCESSORIES

1.6.1. Specify all accessories required for completely finished furniture installation. Provide filing cabinets and storage for office supplies. Provide tack surfaces at workstations with overhead storage. Provide tackable surfaces at workstations with overhead storage.

1.6.2. Not Used.

1.6.3. Workstations are to be equipped with stable keyboard trays that have height adjustability, tilting capability, including negative tilt, have a mouse pad at same height as the keyboard tray that can accommodate both left and right handed users, and retractable under worksurface.

1.7. MISSION UNIQUE EQUIPMENT

Funding for FF&E furniture items and mission unique equipment (MUE) items are from two different sources. Separate the designs and procurement documentation for FFE items and MUE. MUE includes, but is not limited to, items such as commerical appliances, fitness equipment, IT equipment and supporting carts. The User will purchase and install mission unique equipment items, unless otherwise noted. Identify locations of known MUE items such as commercial appliances, etc. for space planning purposes.

1.8. SUSTAINABILITY

1.8.1. For all designs provided regardless of facility type, make every effort to implement all aspects of sustainability to the greatest extent possible for all the selections made in the FF&E package. This includes but is not limited to the selection of products that consider: **Material Chemistry and Safety of Inputs** (What chemicals are used in the construction of the selections?); **Recyclability** (Do the selections contain recycled content?); **Disassembly** (Can the selections be disassembled at the end of their useful life to recycle their materials?).

1.8.2. Make selections to the greatest extent possible of products that possess current McDonough Braungart Design Chemistry (MBDC) certification or other “third-party” certified Cradle to Cradle program, Forest Stewardship Council (FSC) certification, GREENGAURD certification or similar “third-party” certified products consisting of low-emitting materials.

1.9. FURNITURE SYSTEMS

1.9.1. General.

Where appropriate, design furniture systems in open office areas. Coordinate style and color of furniture systems with other storage, seating, etc. in open office areas. Minimize the number of workstation typicals and the parts and pieces required for the design to assist in future reconfiguration and inventorying.

1.9.2. Connector Systems.

Specify a connector system that allows removal of a single panel or spine wall within a typical workstation configuration without requiring disassembly of the workstation or removal of adjacent panels. Specify connector system with tight connections and continuous visual seals. When Acoustical panels are used, provide connector system with continuous acoustical seals. Specify concealed clips, screws, and other construction elements, where possible.

1.9.3. Panels and Spine Walls

Specify panels and spine walls with hinged or removable covers that permit easy access to the raceway when required but are securely mounted and cannot be accidentally dislodged under normal conditions. Panels shall be capable of structurally supporting more than 1 fully loaded component per panel per side. Raceways are to be an integral part of the panel and must be able to support lay-in cabling and have a large capacity for electrical and IT. Do not thread cables through the frame.

1.9.4. Electrical And Information/Technology (IT)

Design furniture with electrical systems that meets requirements of UL 1286 when powered panels are required and UL approved task lights that meet requirements of NFPA 70. Dependent on user requirements and Section 01 10 00, paragraph 3 requirements, it is recommended that workstation electrical and IT wiring entry come from the building walls to eliminate the use of power poles and access at the floor. Design electrical and IT systems that are easily accessed in the spine wall and panels without having to move return panels and components. Electrical and IT management will be easily accessible by removable wall covers which can be removed while workstation components are still attached. Specify connector system that has continuation of electrical and IT wiring within workstations and workstation to workstation.

1.9.5. Pedestals

Specify pedestals that are interchangeable from left to right, and right to left, and retain pedestal locking system capability.

1.10. EXECUTIVE FURNITURE

1.10.1. Design for executive furniture in command areas, coordinate specific locations with Corps of Engineers Interior Designer. Use upgraded furniture, upholsteries and finishes in command suites. This includes but is not limited to wood casegoods, seating and tables. Select executive furniture casegoods from a single manufacturer and style line, to include workstations, credenzas, filing, and storage, etc.

1.10.2. Specify furniture with wood veneer finish with mitered solid wood edge of same wood type. Other executive office furniture such as seating, tables, executive conference room furniture, etc. shall be compatible in style, finish and color with executive furniture casegoods.

1.11. SEATING

1.11.1. General

Specify appropriate chair casters and glides for the floor finish where the seating is located. All task seating shall support up to a minimum of 250 lbs.

1.11.2. Desk and Guest Seating

Select ergonomic desk chairs with casters, waterfall front, swivel, tilt, variable back lock, adjustable back height or adjustable lumbar support, pneumatic seat height adjustment, and padded, contoured upholstered seat and back. Desk and guest chair backs may be other than upholstered such as mesh fabric if it is ergonomically designed, forms to back and is comfortable. Depending on scale of desk chair provide seat pan forward and back adjustment to increase or decrease depth of seat pan. All desk chairs shall have an adjustable seat height range of 4 1/2", range to include 16 1/2-20". Select guest chairs that are compatible in style, finish and color with the desk chairs.

1.11.3. Conference Room Seating

At tables, select ergonomic conference seating with casters, non-upholstered arms, waterfall front, swivel, tilt, pneumatic seat height adjustment, and padded, contoured seat and back, unless otherwise noted.

Select arm height and/or design that allows seating to be moved up closely to the table top. Conference chair backs may be other than upholstered such as mesh fabric if it is ergonomically designed, forms to back and is comfortable. Perimeter conference chairs shall be compatible in style, finish and color with conference seating at the tables.

1.11.4. Lounge, Waiting and Reception Area Seating

Select seating with arms and cushioned, upholstered seat and back. In heavy use areas, arms shall be easily cleaned such as non-upholstered arms or upholstered arms with wood arm caps unless otherwise noted.

1.11.5. Break Room Seating

Select stackable seating that is easily cleaned. Seating shall be appropriate for table and counter heights as applicable with non-upholstered arms if arms are required. Chairs shall have metal legs and composite materials for seats.

1.12. FILING AND STORAGE.

Select storage and shelving units that meet customer’s functional load requirements for stored items. Specify counterweights for filing cabinets when required by the manufacturer for stability. File drawers shall allow only one drawer to be opened at a time. Provide heavy duty storage and shelving if information is not available.

1.13. TRAINING TABLES.

raining tables shall be reconfigurable, moveable and storable; lighter weight folding with dollies or castered as necessary. Plastic laminate self edges are unacceptable. Specify power and data requirements and dollies as required.

1.14. FURNITURE WARRANTIES.

Specify manufacturer's performance guarantees or warranties that include parts, labor and transportation as follows:

Furniture System, unless otherwise noted – 10 year minimum
Furniture System Task Lights – 2 year minimum, excluding bulbs
Furniture System Fabric – 3 year minimum
Wood Desks - 10 year minimum

Metal Desks – 12 year minimum
Seating, unless otherwise noted - 10 year minimum
Seating Mechanisms and Pneumatic Cylinders - 10 years
Seating Fabric - 3 years minimum
Wood Filing and Storage - 10 year minimum

Tables, unless otherwise noted - 10 year minimum
Table Mechanisms – 5 year minimum
Table Ganging Device - 1 year minimum
Items not listed above - 1 year minimum

ATTACHMENT C
TRACKING COMMENTS IN DRCHECKS

1.0 General

The Government and DB Contractor shall set up the project in Dr Checks. Throughout the design process, the parties shall enter, track, and back-check comments using the DrChecks system. Government and Contractor reviewers enter design review comments into DrChecks. Designers of Record shall annotate comments timely and specifically to indicate for the review conference exactly what action will be taken or why the action is not required. After the design review conference and prior to the next design submittal for the package, the DOR's will annotate those comments that require DOR action, design revision, etc. to show how and where it has been addressed in the design documents, This shall be part of the required design configuration management plan. Comments considered critical by the conference participants shall be flagged as such.

2.0 DrChecks Review Comments

The Contractor and the Government shall monitor DrChecks to assure all comments are annotated and resolved prior to the next submittal. Print and include the DrChecks comments and responses and included in the design analysis for record in the next design submittal for that package.

2.1. Upon review of comments prior to the design review conference, the DOR(s) shall identify whether they concur, non-concur, mark it "for information only" or mark it "check and resolve". Indicate exactly what action will be taken or why the action is not required.

2.2. Conference participants (reviewers) will expect coordination between Design Analysis calculations and the submitted design. Reviewers will also focus on the design submittal's satisfaction of the contract requirements.

2.3. After the conference, the DOR(s) shall formally respond to each applicable comment in DrChecks a second time prior to the next submittal, clearly indicating what action was taken and what drawing/spec/design analysis changed. Designers of Record are encouraged to directly contact reviewers to discuss and agree to the formal comment responses rather than relying only on DrChecks and review meetings to discuss comments. With the next submittal, reviewers will back-check answers to the comments against the new submittal, in addition to reviewing additional design work.

2.4. Clearly annotate in DrChecks those comments that, in the DB Contractor's opinion, require effort outside the scope of the contract. Do not proceed with work outside the contract until a modification to the contract is properly executed, if one is necessary.

3.0 DrChecks Initial Account Set-Up

To initialize an office's use of DrChecks, choose a contact person within the office to call the DrChecks Help Desk at 800-428-HELP, M-F, 8AM-5PM, Central time. This POC will be given an office password to distribute to others in the office. Individuals can then go to the hyperlink at http://www.projnet.org and register as a first time user. Upon registration, each user will be given a personal password to the DrChecks system.

3.1. Once the office and individuals are registered, the COE's project manager or lead reviewer will assign the individuals and/or offices to the specific project for review. At this point, persons assigned can make comments, annotate comments, and close comments, depending on their particular assignment.

4.0 DrChecks Reviewer Role

The Contractor is the technical reviewer and the Government is the compliance reviewer of the DB's design documents. Each reviewer enters their own comments into the Dr Checks system. To enter comments:

4.1. Log into DrChecks.

4.2. Click on the appropriate project.

4.3. Click on the appropriate review conference. An Add comment screen will appear.

4.4. Select or fill out the appropriate sections (particularly comment discipline and type of document for sorting) of the comment form and enter the comment in the space provided.

4.5. Click the Add Comment button. The comment will be added to the database and a fresh screen will appear for the next comment you have.

4.6. Once comments are all entered, exit DrChecks by choosing “My Account” and then Logout.

5.0 DrChecks Comment Evaluation (Step 1 of 2)

The role of the DOR(s) is to evaluate and respond to the comments entered by the Government's and DB Contractor's reviewers. To respond to comments:

5.1. Log into DrChecks.

5.2. Click on the appropriate project.

5.3. Under “Evaluate” click on the number under “Pending”.

5.4. Locate the comments that require your evaluation. (Note: If you know the comment number you can use the Quick Pick window on your home page in DrChecks; enter the number and click on go.)

5.5. Select the appropriate evaluation radio button (concur, non-concur, for information only, or check and resolve) and respond with a brief explanation in the Discussion field. An explanation other than to say “concur” is not necessary for “Concur”, but may be useful for the Design Configuration Management purposes.

5.6. Click on the Add button. The evaluation will be added to the database and a fresh screen will appear with the next comment.

5.7. Once evaluations are all entered, exit DrChecks by choosing “My Account” and then Logout.

6.0 DrChecks Comment Evaluation (Step 2 of 2)

This is where the DOR(s) respond to each applicable comment in DrChecks after the design review conference, prior to the next submittal, clearly indicating what action was taken and what drawing/spec/design analysis changed. Respond to the previous comments, following the same steps as above, adding the narrative in the discussion field.

7.0 DrChecks Back-Check

At the following design conference, (where applicable) or at some other agreed time, Government and Contractor reviewers will back-check comment annotations against newly presented documents to verify that the designers' responses are acceptable and that all revisions have been completed. Reviewers shall either enter additional back-check comments, if necessary, or close those where actions are complete.

7.1. Log into DrChecks.

7.2. Click on the appropriate project.

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

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

7.5. If you do not agree with the designer’s response or the submittal does not reflect the response given, select “Issue Open”, enter additional information.

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

7.7. Once back-checks are all entered, exit DrChecks by choosing “My Account” and then Logout. The design is completed and final when there are no pending comments to be evaluated and there are no pending or open comments under back-check.

ATTACHMENT D
SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW

Instructions: Use the information outlined in this document to provide the minimum requirement for development of Fire Protection and Life Safety Code submittals for all building projects. Additional and supplemental information may be used to further develop the code review. Insert N/A after criteria, which may be “not applicable”.

1.0 SAMPLE FIRE PROTECTION AND LIFE SAFETY CODE REVIEW

1.1. Project Name (insert name and location)

1.2. Applicable Codes and Standards

1.2.1. Unified Facilities Criteria (UFC): 3-600-01, Design: Fire Protection Engineering For Facilities

1.2.2. International Building Code (IBC) for fire resistance requirements, allowable floor area, building height limitations and building separation distance requirements, except as modified by UFC 3-600-01.

1.2.3. National Fire Protection Association (NFPA) 101 Life Safety Code (latest edition), for building egress and life safety and applicable criteria in UFC 3-600-01.

1.2.4. ADA and ABA Accessibllity Guidelines. For Buildings and Facilities See Section 01 10 00, Paragraph 3 for facility specific criteria.

1.3. Occupancy Classification
IBC chapters 3 and 4

1.4. Construction Type
IBC chapter 6

1.5. Area Limitations
IBC chapter 5, table 503

1.6. Allowable Floor Areas
IBC section 503, 505

1.7. Allowable area increases
IBC section 506, 507

1.8. Maximum Height of Buildings
IBC section 504

1.9. Fire-resistive substitution

1.10. Occupancy Separations
IBC table 302.3.2

1.11. Fire Resistive Requirements

1.11.1. Exterior Walls - [_____] hour rating, IBC table 601, 602

1.11.2. Interior Bearing walls - [_____] hour rating

1.11.3. Structural frame - [_____] hour rating

1.11.4. Permanent partitions - [_____] hour rating

1.11.5. Shaft enclosures - [_____] hour rating

1.11.6. Floors & Floor-Ceilings - [_____] hour rating

1.11.7. Roofs and Roof Ceilings - [_____] hour rating

1.12. Automatic Sprinklers and others used to determine the need for automatic Extinguishing Equipment, Extinguishing Systems, Foam Systems, Standpipe

1.12.1. UFC 3-600-01, chapters 4 and 6 systems, wet chemical systems, etc. State which systems are required and to what criteria they will be designed.

1.12.2. UFC 3-600-01, Appendix B Occupancy Classification. Note the classification for each room. This may be accomplished by classifying the entire building and noting exceptions for rooms that differ (E.g. The entire building is Light Hazard except boiler room and storage rooms which are [_____], etc.)

1.12.3. UFC 3-600-01, Chapter 3 Sprinkler Design Density, Sprinkler Design Area, Water Demand for Hose Streams (supply pressure and source requirements).

1.12.4. UFC 3-600-01, Chapter 4 Coverage per sprinkler head. Extended coverage sprinkler heads are not permitted.

1.12.5. Available Water Supply. Provide the results of the water flow tests showing the available water supply static pressure and residual pressure at flow. Based on this data and the estimated flow and pressure required for the sprinkler system, determine the need for a fire pump.

1.12.6. NFPA 13, Para. 8.16.4.6.1. Provide backflow preventer valves as required by the local municipality, authority, or water purveyor. Provide a test valve located downstream of the backflow preventer for flow testing the backflow preventer at full system demand flow. Route the discharge to an appropriate location outside the building.

1.13. Kitchen Cooking Exhaust Equipment

Describe when kitchen cooking exhaust equipment is provided for the project. Type of extinguishing systems for the equipment should be provided. per NFPA 96. Show all interlocks with manual release switches, fuel shutoff valves, electrical shunt trips, exhaust fans, and building alarms.

1.14. Portable Fire Extinguishers, fire classification and travel distance. per NFPA 10

1.15. Enclosure Protection and Penetration Requirements. - Opening Protectives and Through Penetrations

1.15.1. IBC Section712, 715 and Table 715.3. Mechanical rooms, exit stairways, storage rooms, janitor [_____] hour rating. IBC Table 302.1.1

1.15.2. Fire Blocks, Draft Stops, Through Penetrations and Opening Protectives

1.16. Fire Dampers. Describe where fire dampers and smoke dampers are to be used (IBC Section 716 and NFPA 90A}. State whether isolation smoke dampers are required at the air handler.

1.17. Detection Alarm and Communication. UFC 3-600-01, (Chapter 5); NFPA 101 para. 3.4 (chapters 12-42); NFPA 72

1.18. Mass Notification. Describe building/facility mass notification system (UFC 4-021-01) type and type of base-wide mass notification/communication system. State whether the visible notification appliances will be combined with the fire alarm system or kept separate. (Note: Navy has taken position to combine visible notification appliances with fire alarm).

1.19. Interior Finishes (classification). NFPA 101.10.2.3 and NFPA 101.7.1.4

1.20. Means of Egress

1.20.1. Separation of Means of Egress, NFPA 101 chapters 7 and 12-42; NFPA101.7.1.3

1.20.2. Occupant Load, NFPA101.7.3.1 and chapters 12-42.

1.20.3. Egress Capacity (stairs, corridors, ramps and doors) NFPA101.7.3.3

1.20.4. Number of Means of Egress, NFPA101.7.4 and chapters 12-42.

1.20.5. Dead end limits and Common Path of Travel, NFPA 101.7.5.1.6 and chapters 12-42.

1.20.6. Accessible Means of Egress (for accessible buildings), NFPA101.7.5.4

1.20.7. Measurement of Travel Distance to Exits, NFPA101.7.6 and chapters 12-42.

1.20.8. Discharge from Exits, NFPA101.7.7.2

1.20.9. Illumination of Means of Egress, NFPA101.7.8

1.20.10. Emergency Lighting, NFPA101.7.9

1.20.11. Marking of Means of Egress, NFPA101.7.10

1.21. Elevators, UFC 3-600-01, Chapter 6; IBC and ASME A17.1 - 2000,(Safety Code for Elevators and Escalators)

1.22. Accessibility Requirements, ADA and ABA Accessibility Guidelines for Buildings and Facilities

1.23. Certification of Fire Protection and Life Safety Code Requirements. (Note: Edit the Fire team membership if necessary). Preparers of this document certify the accuracy and completeness of the Fire Protection and Life Safety features for this project in accordance with the attached completed form(s).

1.24. Designer of Record. Certification of Fire protection and Life Safety Code Requirements. (Note: Edit the Fire team members if necessary). Preparers of this document certify the accuracy and completeness of the Fire Protection and Life Safety features of this project.

Fire Protection Engineer of Record:

Signature and Stamp

Date

OR

Architect of Record:

Signature and Stamp

Date

Mechanical Engineer of Record:

Signature and Stamp

Date

Electrical Engineer of Record:

Signature/Date

ATTACHMENT E
LEED SUBMITTALS

LEED-NC v3 Submittals (OCT09)

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	LEED-NC v3 Submittals (OCT09)		Provide for Credit Audit Only		Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		FEATURE	DUE AT		REQUIRED DOCUMENTATION	DATE	REV
GENERAL							
	GENERAL - All calculations shall be in accordance with LEED 2009 Reference Guide.						
	GENERAL: Obtain excel version of this spreadsheet at http://en.sas.usace.army.mil/enWeb, "Engineering Criteria".						
	GENERAL - For all credits, narrative/comments may be added to describe special circumstances or considerations regarding the project's credit approach.						
	GENERAL - Include all required LEED drawings indicated below in contract drawings with applicable discipline drawings, labeled For Reference Only.						
	NOTE: Each submittal indicated with "**" differs from LEED certified project submittals by either having a different due date or being an added submittal not required by GBCI.						
	NOTE: Projects seeking LEED certification need only submit to GBCI whatever documentation is acceptable to GBCI (for example, licensed professional certifications). This checklist identifies what must be submitted to the Government for internal review purposes. Government review of LEED documentation in no way supercedes or modifies the requirements and rulings of of GBCI for purposes of compliance with project requirement to obtain LEED certifiaction.						
	GENERAL - Audit documentation may include but is not limited to what is indicated in this table.						
			Closeout		List of all Final Design submittals revised after final design to reflect actual closeout conditions. Revised Final Design submittals. - OR - Statement confirming that no changes have been made since final design that effect final design submittal documents.		Proj Engr (PE)
CATEGORY 1 - SUSTAINABLE SITES							
SSPR1		Construction Activity Pollution Prevention (PREREQUISITE)	**Final Design		List of drawings and specifications that address the erosion control, particulate/dust control and sedimentation control measures to be implemented.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			**Final Design		Narrative that indicates which compliance path was used (NPDES or Local standards) and describes the measures to be implemented on the project. If a local standard was followed, provide specific information to demonstrate that the local standard is equal to or more stringent than the NPDES program.		CIV
SS1		Site Selection	Final Design		Statement confirming that project does not meet any of the prohibited criteria.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design	X	LEED Site plan drawing that shows all proposed development, line depicting boundary of all bodies of water and/or wetlands within 100 feet of project boundary and a line depicting 5' elevation above 100 year flood line that falls within project boundary. Not required if neither condition applies.		CIV
SS2		Development Density & Community Connectivity	Final Design		Option 1: LEED Site vicinity plan showing project site and surrounding development. Show density boundary or note drawing scale.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design		Option 1: Table indicating, for project site and all surrounding sites within density radius (keyed to site vicinity plan), site area and building area. Project development density calculation. Density radius calculation. Development density calculation within density radius.		CIV
			Final Design		Option 2: LEED Site vicinity plan showing project site, the 1/2 mile community radius, pedestrian walkways and the locations of the residential development(s) and Basic Services surrounding the project site.		CIV
			Final Design		Option 2: List (including business name and type) of all Basic Services facilities within the 1/2 mile radius, keyed to site vicinity plan.		CIV
SS3		Brownfield Redevelopment	Final Design		Narrative describing contamination and the remediation activities included in project. Include statement indicating how site was determined to be a brownfield.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
SS4.1		Alternative Transportation: Public Transportation Access	Final Design		Statement indicating which option for compliance applies. State whether public transportation is existing or proposed and, if proposed, cite source of this information.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design		Option 1: LEED Site vicinity plan showing project site, mass transit stops and pedestrian path to them with path distance noted.		CIV
			Final Design		Option 2: LEED Site vicinity plan showing project site, bus stops and pedestrian path to them with path distance noted.		CIV
SS4.2		Alternative Transportation: Bicycle Storage & Changing Rooms	Final Design		FTE calculation. Bicycle storage spaces calculation. Shower/changing facilities calculation.		CIV
			Final Design		List of drawings that show the location(s) of bicycle storage areas. Statement indicating distance from building entrance.		CIV
			Final Design		List of drawings that show the location(s) of shower/changing facilities and, if located outside the buiding, statement indicating distance from building entrance.		ARC

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	LEED-NC v3 Submittals (OCT09)		Provide for Credit Audit Only		Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		FEATURE	DUE AT		REQUIRED DOCUMENTATION	DATE	REV
SS4.3		Alternative Transportation: Low Emitting & Fuel Efficient Vehicles	Final Design		Statement indicating which option for compliance applies. FTE calculation. Statement indicating total parking capacity of site.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design		Option 1: Low-emission & fuel-efficient vehicle calculation.		CIV
			Final Design		Option 1: List of drawings and specification references that show location and number of preferred parking spaces for low-emission & fuel-efficient vehicles and signage.		CIV
			Final Design		Option 1: Statement indicating quantity, make, model and manufacturer of low-emission & fuel-efficient vehicles to be provided. Statement confirming vehicles are zero-emission or indicating ACEEE vehicle scores.		CIV
			Final Design		Option 2: Low-emission & fuel-efficient vehicle parking calculation.		CIV
			Final Design		Option 2: List of drawings and specification references that show location and number of preferred parking spaces and signage.		CIV
			Final Design		Option 3: Low-emission & fuel-efficient vehicle refueling station calculation.		CIV
			Final Design		Option 3: List of drawings and specifications indicating location and number of refueling stations, fuel type and fueling capacity for each station for an 8-hour period.		CIV
			Closeout	X	Option 3: Construction product submittals indicating what was provided and confirming compliance with respect to fuel type and fueling capacity for each station for an 8-hour period.		CIV
SS4.4		Alternative Transportation: Parking Capacity	Final Design		Statement indicating which option for compliance applies.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design		Option 1: Preferred parking calculation including number of spaces required, total provided, preferred spaces provided and percentage.		CIV
			Final Design		Option 2: FTE calculation. Preferred parking calculation including number of spaces provided, preferred spaces provided and percentage.		CIV
			Final Design		Options 1 and 2: List of drawings and specification references that show location and number of preferred parking spaces and signage.		CIV
			Final Design		Option 3: Narrative indicating number of spaces required and provided and describing infrastructure and support programs with description of project features to support them.		CIV
SS5.1		Site Development: Protect or Restore Habitat	**Final Design		Option 1: List of drawing and specification references that convey site disturbance limits.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			**Final Design		Option 2: LEED site plan drawing that delineates boundaries of each preserved and restored habitat area with area (sf) noted for each.		CIV
			**Final Design		Option 2: Percentage calculation of restored/preserved habitat to total site area. List of drawings and specification references that convey restoration planting requirements.		CIV
SS5.2		Site Development: Maximize Open Space	Final Design		Option 2: LEED site plan drawing delineating boundary of vegetated open space adjacent to building with areas of building footprint and designated open space noted.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
SS6.1		Stormwater Design: Quantity Control	Final Design		Statement indicating which option for compliance applies.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design		Option 1: Indicate pre-development and post-development runoff rate(cfs) and runoff quantity (cf) -OR - Narrative describing site conditions, measures and controls to be implemented to prevent excessive stream velocities and erosion.		CIV
			Final Design		Option 2: Indicate pre-development and post-development runoff rate(cfs) and runoff quantity (cf). Indicate percent reduction in each.		CIV
SS6.2		Stormwater Design: Quality Control	Final Design		For non-structural controls, list all BMPs used and, for each, describe the function of the BMP and indicate the percent annual rainfall treated. List all structural controls and, for each, describe the pollutant removal and indicate the percent annual rainfall treated.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
SS7.1		Heat Island Effect: Non-Roof	**Final Design		LEED site plan drawing indicating locations and quantities of each paving type, including areas of shaded pavement. Percentage calculation indicating percentage of reflective/shaded/open grid area.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV

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SS7.2		Heat Island Effect: Roof	Final Design		Option 1: Percentage calculation indicating percentage of SRI compliant roof area. List of drawings and specification references that convey SRI requirements and roof slopes.		ARC
			Final Design		Option 1: List of specified roof materials indicating, for each, type, manufacturer, product name and identification if known, SRI value and roof slope.		ARC
			**Closeout		Option 1: List of installed roof materials indicating, for each, manufacturer, product name and identification, SRI value and roof slope.		PE
			Closeout	X	Option 1: Manufacturer published product data or certification confirming SRI		PE
			Final Design		Option 2: Percentage calculation indicating percentage of vegetated roof area.		ARC
			Final Design		Option 3: Combined reflective and green roof calculation.		ARC
			Final Design		Option 3: List of specified roof materials indicating, for each, type, manufacturer, product name and identification if known, SRI value and roof slope.		ARC
			**Closeout		Option 3: List of installed roof materials indicating, for each, manufacturer, product name and identification, SRI value and roof slope.		PE
			Closeout	X	Option 3: Manufacturer published product data or certification confirming SRI		PE
SS8		Light Pollution Reduction	Final Design		Interior Lighting: List of drawings and specification references that convey interior lighting requirements (location and type of all installed interior lighting, location of non-opaque exterior envelope surfaces, allowing confirmation that maximum candela value from interiorfixtures does not intersect non-opaque building envelope surfaces). - OR - List of drawings and specification references that show automatic lighting controls compliance with credit requirement.		ELEC
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		ELEC
			Final Design		Exterior Lighting: List of drawings and specification references that convey exterior lighting requirements (location and type of all site lighting and building façade/landscape lighting).		ELEC
			Final Design		Exterior Site Lighting Power Density (LPD): Tabulation for exterior site lighting indicating, for each location identification or description, units of measure, area or distance of the location, actual LPD using units consistent with ASHRAE 90.1, and the ASHRAE allowable LPD for that type of location. Percentage calculation of actual versus allowable LPD for all site lighting.		ELEC
			Final Design		Exterior Building Facade/Landscape Lighting Power Density (LPD): Tabulation for exterior building facade/landscape lighting indicating, for each location identification or description, units of measure, area or distance of the location, actual LPD using units consistent with ASHRAE 90.1, and the ASHRAE allowable LPD for that type of location. Percentage calculation of actual versus allowable LPD for all building facade/landscape lighting.		ELEC
			Final Design		Exterior Lighting IESNA Zone: Indicate which IESNA zone is applicable to the project.		ELEC
			Final Design		Exterior Lighting Site Lumen table indicating, for each fixture type, quantity installed, initial lamp lumens per luminaire, initial lamp lumens above 90 degrees from Nadir, total lamp lumens and total lamp lumens above 90 degrees. Percentage of site lamp lumens above 90 degrees from nadir to total lamp lumens.		ELEC
			Final Design		Exterior Lighting Narrative describing analysis used for addressing requirements for light trespass at site boundary and beyond.		ELEC
CATEGORY 2 – WATER EFFICIENCY							
WEPR1		Water Use Reduction: 20% Reduction	Final Design		Statement confirming which occupancy breakdown applies (default or special). For special occupancy breakdown, indicate source and explanation for ratio.		MEC
			Final Design		Occupancy calculation including male/female numbers for FTEs, visitors, students, customers, residential and other type occupants/users		MEC
			Final Design		Statement indicating percent of male restrooms with urinals. Statement indicating annual days of operation.		MEC

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			Final Design		Baseline flush fixture calculation spreadsheet indicating, for each fixture type, gender, flush rate, daily uses per person for each occupant type identified in occupancy calculation and annual baseline flush fixture water usage.		MEC
			Final Design		Design case flush fixture calculation spreadsheet indicating, for each fixture type, gender, fixture manufacturer, fixture model number, flush rate, percent of occupants using this fixture type, daily uses per person for each occupant type identified in occupancy calculation and annual design case flush fixture water usage.		MEC
			Closeout	X	Manufacturer published product data or certification confirming fixture water usage.		PE
WE1.1		Water Efficient Landscaping: Reduce by 50%	Final Design		Statement indicating which option for compliance applies.		CIV
			**Final Design		Delineation and labeling of "LEED Project site boundary" on site plan.		CIV
			Final Design		Calculation indicating, for baseline and design case, total water applied, total potable water applied, total non-potable water applied. Design case percent potable water reduction. If nonpotable water is used, indicate source of nonpotable water.		CIV
			Final Design		List of landscape plan drawings.		CIV
			Final Design		Narrative describing landscaping and irrigation design strategies, including water use calculation methodology used to determine savings and, if non-potable water is used, specific information about source and available quantity.		CIV
WE1.2		Water Efficient Landscaping: No Potable Water Use or No Irrigation	Same as WE1.1		Same as WE1.1		CIV
WE2		Innovative Wastewater Technologies	Final Design		Statement confirming which option for compliance applies.		MEC
			Final Design		Statement confirming which occupancy breakdown applies (default or special). For special occupancy breakdown, indicate source and explanation for ratio.		MEC
			Final Design		Occupancy calculation including male/female numbers for FTEs, visitors, students, customers, residential and other type occupants/users		MEC
			Final Design		Statement indicating percent of male restrooms with urinals. Statement indicating annual days of operation.		MEC
			Final Design		Baseline flush fixture calculation spreadsheet indicating, for each fixture type, gender, flush rate, daily uses per person for each occupant type identified in occupancy calculation and annual baseline flush fixture water usage.		MEC
			Final Design		Design case flush fixture calculation spreadsheet indicating, for each fixture type, gender, fixture manufacturer, fixture model number, flush rate, percent of occupants using this fixture type, daily uses per person for each occupant type identified in occupancy calculation and annual design case flush fixture water usage.		MEC
			Final Design		Option 1: If onsite non-potable water is used, identify source(s), indicate annual quantity from each source and indicate total annual quantity from all onsite non-potable water sources.		MEC
			Final Design		Option 1: Summary calculation indicating baseline annual water consumption, design case annual water consumption, non-potable annual water consumption and total percentage annual water savings.		MEC
			Final Design		Option 2: Statement confirming on-site treatment of all generated wastewater to tertiary standards and all treated wastewater is either infiltrated or used on-site.		MEC
			Final Design		Option 2: List of drawing and specification references that convey design of on-site wastewater treatment features.		CIV
			Final Design		Option 2: On-site water treatment quantity calculation indicating all on-site wastewater source(s), annual quantity treated, annual quantity infiltrated and annual quantity re-used on site from each source and totals for annual quantity treated, annual quantity infiltrated and annual quantity re-used on site from all sources.		CIV
			Final Design		Option 2: Wastewater summary calculation indicating design case annual flush fixture water usage, annual on-site water treatment and percentage sewage convyance reduction.		MEC
			Final Design		Narrative describing project strategy for reduction of potable water use for sewage conveyance, including specific information on reclaimed water usage and treated wastewater usage.		MEC
WE3		Water Use Reduction: 30% - 40% Reduction	Same as WEPR1		Same as WEPR1		MEC
CATEGORY 3 – ENERGY AND ATMOSPHERE							

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EAPR1		Fundamental Commissioning of the Building Energy Systems (PREREQUISITE)	**Final Design		**Owner's Project Requirements document		ALL
			**Final Design		**Basis of Design document for commissioned systems		MEC, ELEC
			**Final Design		**Commissioning Plan		MEC, ELEC
			Closeout		Statement confirming all commissioning requirements have been incorporated into construction documents.		PE
			Closeout		Commissioning Report		PE
EAPR2		Minimum Energy Performance (PREREQUISITE)	Final Design		Statement listing the mandatory provisions of ASHRAE 90.1 that project meets relative to compliance with this prerequisite and indicating which compliance path was used.		MEC ELEC ARC
			Final Design		Statement indicating which compliance path option applies.		MEC
			Final Design		Option 1: Statement confirming simulation software capabilities and confirming assumptions and methodology.		MEC
			Final Design		Option 1: General information including simulation program, principal heating source, percent new construction and renovation, weather file, climate zone and Energy Star Target Finder score.		MEC
			Final Design		Option 1: Space summary listing, for each building use, the conditioned area, unconditioned area and total area and include total area for each category		MEC
			Final Design		Option 1: List of all simulation output advisory message data and show difference between baseline and proposed design		MEC
			Final Design		Option 1: Comparison summary for energy model inputs including description of baseline and design case energy model inputs, showing both by element type		MEC
			Final Design		Option 1: Energy type summary lising, for each energy type, utility rate description, units of energy and units of demand		MEC
			Final Design		Option 1: Statement indicating whether project uses on-site renewable energy. If yes, list all sources and indicate, for each source, backup energy type, annual energy generated, rated capacity and renewable energy cost		MEC
			Final Design		Option 1: If analysis includes exceptional calculation methods, statement describing how exceptional calculation measure cost savings is determined		MEC
			Final Design		Option 1: If analysis includes exceptional calculation methods, for each exceptional calculation method indicate energy types and, for each energy type, annual energy savings, annual cost savings, and brief descriptive narrative		MEC
			Final Design		Option 1: Baseline performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand for all four orientations. For each orientation indicate total annual energy use for each orientation and total annual process energy use.		MEC
			Final Design		Option 1: Baseline energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.		MEC
			Final Design		Option 1: Proposed Design performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand, baseline annual and peak energy demand and percent savings. Indicate total annual energy use and total annual process energy use for both proposed design and baseline and percent savings.		MEC
			Final Design		Option 1: Proposed Design energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.		MEC
			Final Design		Option 1: Energy cost and consumption by energy type report indicating, for each energy type, proposed design and baseline annual use and annual cost, percent savings annual use and annual cost. Indicate for renewable energy annual energy generated and annual cost. Indicate exceptional calculations annual energy savings and annual cost savings. Indicate building total annual energy use, annual energy cost for proposed design and baseline and indicate percent savings annual energy use and annual energy cost.		MEC

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			Final Design		Option 1: Compliance summaries from energy simulation software. If software does not produce compliance summaries provide output summaries and example input summaries for baseline and proposed design supporting data in the tables. Output summaries must include simulated energy consumption by end use and total energy use and cost by energy type. Example input summaries should represent most common systems and must include occupancy, use pattern, assumed envelope component sizes and descriptive features and assumed mechanical equipment types and descriptive features		MEC
			Final Design		Option 1: Energy rate tariff from project energy providers (only if not using LEED Reference Guide default rates)		MEC
EAPR3		Fundamental Refrigerant Management (PREREQUISITE)	Final Design		Statement indicating which option for compliance applies.		MEC
			Final Design		Option 2: Narrative describing phase out plan, including specific information on phase out dates and refrigerant quantities.		MEC
EA1		Optimize Energy Performance	Final Design		Statement indicating which compliance path option applies.		MEC
			Final Design		Option 1: Statement confirming simulation software capabilities and confirming assumptions and methodology.		MEC
			Final Design		Option 1: General information including simulation program, principal heating source, percent new construction and renovation, weather file, climate zone and Energy Star Target Finder score.		MEC
			Final Design		Option 1: Space summary listing, for each building use, the conditioned area, unconditioned area and total area and include total area for each category		MEC
			Final Design		Option 1: List of all simulation output advisory message data and show difference between baseline and proposed design		MEC
			Final Design		Option 1: Comparison summary for energy model inputs including description of baseline and design case energy model inputs, showing both by element type		MEC
			Final Design		Option 1: Energy type summary lising, for each energy type, utility rate description, units of energy and units of demand		MEC
			Final Design		Option 1: Statement indicating whether project uses on-site renewable energy. If yes, list all sources and indicate, for each source, backup energy type, annual energy generated, rated capacity and renewable energy cost		MEC
			Final Design		Option 1: If analysis includes exceptional calculation methods, statement describing how exceptional calculation measure cost savings is determined		MEC
			Final Design		Option 1: If analysis includes exceptional calculation methods, for each exceptional calculation method indicate energy types and, for each energy type, annual energy savings, annual cost savings, and brief descriptive narrative		MEC
			Final Design		Option 1: Baseline performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand for all four orientations. For each orientation indicate total annual energy use for each orientation and total annual process energy use.		MEC
			Final Design		Option 1: Baseline energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.		MEC
			Final Design		Option 1: Proposed Design performance rating compliance report table indicating, for each energy end use, whether it is a process load, energy type, annual and peak energy demand, baseline annual and peak energy demand and percent savings. Indicate total annual energy use and total annual process energy use for both proposed design and baseline and percent savings.		MEC
			Final Design		Option 1: Proposed Design energy cost table indicating, for each energy type, annual cost for all four orientations and building total energy cost.		MEC
			Final Design		Option 1: Energy cost and consumption by energy type report indicating, for each energy type, proposed design and baseline annual use and annual cost, percent savings annual use and annual cost. Indicate for renewable energy annual energy generated and annual cost. Indicate exceptional calculations annual energy savings and annual cost savings. Indicate building total annual energy use, annual energy cost for proposed design and baseline and indicate percent savings annual energy use and annual energy cost.		MEC

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			Final Design		Option 1: Compliance summaries from energy simulation software. If software does not produce compliance summaries provide output summaries and example input summaries for baseline and proposed design supporting data in the tables. Output summaries must include simulated energy consumption by end use and total energy use and cost by energy type. Example input summaries should represent most common systems and must include occupancy, use pattern, assumed envelope component sizes and descriptive features and assumed mechanical equipment types and descriptive features		MEC
			Final Design		Option 1: Energy rate tariff from project energy providers (only if not using LEED Reference Guide default rates)		MEC
EA2.1		On-Site Renewable Energy	Final Design		Statement indicating which compliance path option applies.		ELEC
			Final Design		List all on-site renewable energy sources and indicate, for each source, backup energy type, annual energy generated, rated capacity and renewable energy cost. Indicate total annual energy use (all sources), total annual energy cost (all sources) and percent renewable energy cost.		ELEC MEC
			Final Design		Option 1: Indicate, for renewable energy,proposed design total annual energy generated and annual cost.		ELEC MEC
			Final Design		Option 2: Indicate CBECS building type and building gross area. Provide the following CBECS data: median annual electrical intensity, median annual non-electrical fuel intensity, average electric energy cost, average non-electric fuel cost, annual electric energy use and cost, annual non-electric fuel use and cost.		ELEC MEC
			Final Design		Option 2: Narrative describing renewable systems and explaining calculation method used to estimate annual energy generated, including factors influencing performance.		ELEC MEC
EA2.2		On-Site Renewable Energy	Same as EA2.1		Same as EA2.1		ELEC MEC
EA2.3		On-Site Renewable Energy	Same as EA2.1		Same as EA2.1		ELEC MEC
EA3		Enhanced Commissioning	**Final Design		**Owner's Project Requirements document (OPR)		ALL
			**Final Design		**Basis of Design document for commissioned systems (BOD)		ELEC MEC
			**Final Design		**Commissioning Plan		ELEC MEC
			Closeout		Statement confirming all commissioning requirements have been incorporated into construction documents.		PE
			Closeout		**Commissioning Report		PE
			**Final Design		Statement by CxA confirming Commissioning Design Review		
			Closeout		Statement by CxA confirming review of Contractor submittals for compliance with OPR and BOD		PE
			Closeout		**Systems Manual		PE
			Closeout		Statement by CxA confirming completion of O&M staff and occupant training		PE
			Closeout		**Scope of work for post-occupancy review of building operation, including plan for resolution of outstanding issues		PE
			**Predesign		Statement confirming CxA qualifications and contractual relationships relative to work on this project, demonstrating that CxA is an independent third party.		MEC
EA4		Enhanced Refrigerant Management	Final Design		Refrigerant impact calculation table with all building data and calculation values as shown in LEED 2009 Reference Guide Example Calculations		MEC
			Final Design		Narrative describing any special circumstances or explanatory remarks		
			Closeout	X	Cut sheets highlighting refrigerant data for all HVAC components.		PE
EA5		Measurement & Verification	Closeout		Statement indicating which compliance path option applies.		PE
			Closeout		Measurement and Verification Plan including Corrective Action Plan		PE
			Closeout		**Scope of work for post-occupancy implementation of M&V plan including corrective action plan.		PE
EA6		Green Power	Closeout		Statement indicating which compliance path option applies.		PE
			Closeout		Option 1: Indicate proposed design total annual electric energy usage		PE
			Closeout		Option 2: Indicate actual total annual electric energy usage		PE
			Closeout		Option 3: Calculation indicating building type, total gross area, median electrical intensity and annual electric energy use		PE

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			Closeout		Green power provider summary table indicating, for each purchase type, provider name, annual quantity green power purchased and contract term. Indicate total annual green power use and indicate percent green power		PE
			Closeout		Narrative describing how Green Power or Green Tags are purchased		PE
CATEGORY 4 – MATERIALS AND RESOURCES							
MRPR1		Storage & Collection of Recyclables (PREREQUISITE)	Final Design		Statement confirming that recycling area will accommodate recycling of plastic, metal, paper, cardboard and glass. Narrative indicating any other materials addressed and coordination with pickup.		ARC
MR1.1		Building Reuse: Maintain 55% of Existing Walls, Floors & Roof	**Final Design		If project includes a building addition, confirm that area of building addition does not exceed 2x the area of the existing building.		ARC
			**Final Design		Spreadsheet listing, for each building structural/envelope element, the existing area and reused area. Total percent reused.		ARC
MR1.2		Building Reuse: Maintain 75% of Existing Walls, Floors & Roof	Same as MR1.1		Same as MR1.1		ARC
MR1.3		Building Reuse: Maintain 95% of Existing Walls, Floors & Roof	Same as MR1.1		Same as MR1.1		ARC
MR1.4		Building Reuse: Maintain 50% of Interior Non-Structural Elements	**Final Design		If project includes a building addition, confirm that area of building addition does not exceed 2x the area of the existing building.		ARC
			**Final Design		Spreadsheet listing, for each building interior non-structural element, the existing area and reused area. Total percent reused.		ARC
MR2.1		Construction Waste Management: Divert 50% From Disposal	**Preconstruction		Waste Management Plan		PE
			**Construction Quarterly and Closeout		Spreadsheet calculations indicating material description, disposal/diversion location (or recycling hauler), weight, total waste generated, total waste diverted, diversion percentage		PE
			**Construction Quarterly and Closeout		Receipts/tickets for all items on spreadsheet		PE
MR2.2		Construction Waste Management: Divert 75% From Disposal	Same as MR2.1		Same as MR2.1		PE
MR3.1		Materials Reuse: 5%	Closeout		Statement indicating total materials value and whether default or actual.		PE
			Closeout		Spreadsheet calculations indicating, for each reused/salvaged material, material description, source or vendor, cost. Total reused/salvaged materials percentage.		PE
MR3.2		Materials Reuse: 10%	Same as MR3.1		Same as MR3.1		PE
MR4.1		Recycled Content: 10% (post-consumer + 1/2 pre-consumer)	Closeout		Statement indicating total materials value and whether default or actual.		PE
			Closeout		Spreadsheet calculations indicating, for each recycled content material, material name/description, manufacturer, cost, post-consumer recycled content percent, pre-consumer recycled content percent, source of recycled content data. Total post-consumer content materials cost, total pre-consumer content materials cost, total combined recycled content materials cost, recycled content materials percentage.		PE
			Final Design or NLT Preconstruction		**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal.		PE
			Closeout	X	Manufacturer published product data or certification, confirming recycled content percentages in spreadsheet		PE
MR4.2		Recycled Content: 20% (post-consumer + 1/2 pre-consumer)	Same as MR4.1		Same as MR4.1		PE
MR5.1		Regional Materials:10% Extracted, Processed & Manufactured Regionally	Closeout		Statement indicating total materials value and whether default or actual.		PE
			Closeout		Spreadsheet calculations indicating, for each regional material, material name/description, manufacturer, cost, percent compliant, harvest distance, manufacture distance, source of manufacture and harvest location data. Total regional materials cost, regional materials percentage.		PE
			Preconstruction		**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal.		PE
			Closeout	X	Manufacturer published product data or certification confirming regional material percentages in spreadsheet		PE

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MR5.2		Regional Materials:20% Extracted, Processed & Manufactured Regionally	Same as MR5.1		Same as MR5.1		PE
MR6		Rapidly Renewable Materials	Closeout		Statement indicating total materials value and whether default or actual.		PE
			Closeout		Spreadsheet calculations indicating, for each rapidly renewable material, material name/description, manufacturer, cost, rapidly renewable content percent, rapidly renewable product value. Total rapidly renewable product value, rapidly renewable materials percentage.		PE
			Final Design		**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal.		ARC
			Closeout	X	Manufacturer published product data or certification confirming rapidly renewable material percentages in spreadsheet		PE
MR7		Certified Wood	Closeout		Statement indicating total materials value and whether default or actual.		PE
			Closeout		Spreadsheet calculations indicating, for each certified wood material, material name/description, vendor, cost, wood component percent, certified wood percent of wood component, FSC chain of custody certificate number. Total certified wood product value, certified wood materials percentage.		PE
			Final Design or NLT Preconstruction		**Purchasing Plan consisting of spreadsheet indicated above, filled in with estimated quantities to show strategy for achieving goal.		PE
			Closeout	X	Vendor invoices, FSC chain of custody certificates and anufacturer published product data or certification confirming all certified wood materials percentages in spreadsheet.		PE
INDOOR ENVIRONMENTAL QUALITY							
EQPR1		Minimum IAQ Performance (PREREQUISITE)	Final Design		Statement indicating which option for compliance applies, stating applicable criteria/requirement, and confirming that project has been designed to meet the applicable requirements.		MEC
			Final Design		Narrative describing the project's ventilation design, including specifics about fresh air intake volumes and special considerations.		MEC
EQPR2		Environmental Tobacco Smoke (ETS) Control (PREREQUISITE)	Final Design		Statement indicating which option for compliance applies, stating applicable criteria/requirement, and confirming that project has been designed to meet the applicable requirements.		ARC
			Final Design		List of drawing and specification references that convey conformance to applicable requirements (signage, exhaust system, room separation details, etc).		ARC
EQ1		Outdoor Air Delivery Monitoring	Final Design		Statement indicating which option for compliance applies and confirming that project has been designed to meet the applicable requirements.		MEC
			Final Design		List of drawing and specification references that convey conformance to applicable requirements.		MEC
			Final Design		Narrative describing the project's ventilation design and CO2 monitoring system, including specifics about monitors, operational parameters and setpoints.		MEC
			Closeout	X	Cut sheets for CO2 monitoring system.		PE
EQ2		Increased Ventilation	Final Design		Statement indicating which option for compliance applies and confirming that project has been designed to meet the applicable requirements.		MEC
			Final Design		Narrative describing the project's ventilation design, including specifics about zone fresh air intake volumes and demonstrating compliance.		MEC
			Final Design		Option 2: Narrative describing design method used for determining natural ventilation design, including calculation methodology/model results and demonstrating compliance.		MEC
			Final Design		List of drawing and specification references that convey conformance to applicable requirements.		MEC
EQ3.1		Construction IAQ Management Plan: During Construction	**Preconstruction		Construction IAQ Management Plan		PE
			Closeout		Statement confirming whether air handling units were operated during constructior		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

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	**LEED-NC v3 Submittals (OCT09)**		Provide for Credit Audit Only		Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		**FEATURE**	**DUE AT**		**REQUIRED DOCUMENTATION**	**DATE**	**REV**
			Closeout		Spreadsheet indicating, for each filter installed during construction, the manufacturer, model number, MERV rating, location installed, and if it was replaced immediately prior to occupancy.		PE
EQ3.2		Construction IAQ Management Plan: Before Occupancy	**Preconstruction		Construction IAQ Management Plan		PE
			Closeout		Statement indicating which option for compliance applies and confirming that required activities have occurred that meet the applicable requirements.		PE
			Closeout		Option 1a: Narrative describing the project's flushout process, including specifics about temperature, airflow and duration, special considerations (if any) and demonstrating compliance.		PE
			Closeout		Option 1b: Narrative describing the project's pre-occupancy and post-occupancy flushout processes, including specifics about temperature, airflow and duration, special considerations (if any) and demonstrating compliance.		PE
			Closeout		Option 2: Narrative describing the project's IAQ testing process, including specifics about contaminants tested for, locations, remaining work at time of test, retest parameters and special considerations (if any).		PE
			Closeout		Option 2: IAQ testing report demonstrating compliance.		PE
EQ4.1		Low Emitting Materials: Adhesives & Sealants	Closeout		Spreadsheet indicating, for each applicable indoor adhesive, sealant and sealant primer used, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data.		PE
			Closeout		Spreadsheet indicating, for each applicable indoor aerosol adhesive, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data - OR - Statement confirming no indoor aerosol adhesives were used for the project.		PE
			Closeout	X	Manufacturer published product data or certification confirming material VOCs in spreadsheet		PE
EQ4.2		Low Emitting Materials: Paints & Coatings	Closeout		Spreadsheet indicating, for each applicable indoor paint and coating used, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data.		PE
			Closeout		Spreadsheet indicating, for each applicable indoor anti-corrosive/anti-rust paint and coating used, the manufacturer, product name/model number, VOC content, LEED VOC limit, and source of VOC data - OR - Statement confirming no indoor anti-corrosive/anti-rust paints were used for the project .		PE
			Closeout	X	Manufacturer published product data or certification confirming material VOCs in spreadsheet		PE
EQ4.3		Low Emitting Materials: Flooring Systems	Closeout		Spreadsheet indicating, for each indoor flooring system used, the manufacturer, product name/model number, if it meets LEED requirement (yes/no) and source of LEED compliance data.		PE
			Closeout		Spreadsheet indicating, for each indoor carpet cushion used, the manufacturer, product name/model number, if it meets LEED requirement (yes/no) and source of LEED compliance data - OR - Statement confirming no indoor carpet cushion was used for the project.		PE
			Closeout	X	Manufacturer published product data or certification confirming material compliance label in spreadsheet		PE
EQ4.4		Low Emitting Materials: Composite Wood & Agrifiber Products	Closeout		Spreadsheet indicating, for each indoor composite wood and agrifiber product used, the manufacturer, product name/model number, if it contains added urea formaldehyde (yes/no) and source of LEED compliance data.		PE
			Closeout	X	Manufacturer published product data or certification confirming material urea formaldehyde in spreadsheet		PE
EQ5		Indoor Chemical & Pollutant Source Control	Closeout		Spreadsheet indicating, for each permanent entryway system used, the manufacturer, product name/model number and description of system.		PE
			Final Design		List of drawing and specification references that convey locations and installation methods for entryway systems.		ARC
			Final Design		Spreadsheet indicating, for each chemical use area, the room number, room name, description of room separation features (walls, floor/ceilings, openings) and pressure differential from surrounding spaces with doors closed - OR - Statement confirming that project includes no chemical use areas and that no hazardous cleaning materials are needed for building maintenance.		ARC MEC
			Final Design		If project includes chemical use areas: List of drawing and specification references that convey locations of chemical use areas, room separation features and exhaust system.		ARC MEC

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	LEED-NC v3 Submittals (OCT09)		Provide for Credit Audit Only		Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		FEATURE	DUE AT		REQUIRED DOCUMENTATION	DATE	REV
			Final Design		If project includes places where water and chemical concentrate mixing occurs: List of drawing and specification references that convey provisions for containment of hazardous liquid wastes OR - Statement confirming that project includes no places where water and chemical concentrate mixing occurs.		ARC MEC
			Closeout		If project includes chemical use areas: Spreadsheet indicating, for AHUs/mechanical ventilation equipment serving occupied areas, the manufacturer, model number, MERV rating, location installed, and if it was replaced immediately prior to occupancy (yes/no) - OR - Statement confirming that project does not use mechanical equipment for ventilation of occupied areas.		PE
EQ6.1		Controllability of Systems: Lighting	Final Design		Calculation indicating total number of individual workstations, number of workstations with individual lighting controls and the percentage of workstations with individual lighting controls.		ELEC
			Final Design		For each shared multi-occupant space, provide a brief description of lighting controls.		ELEC
			Final Design		Narrative describing lighting control strategy, including type and location of individual controls and type and location of controls in shared multi-occupant spaces.		ELEC
EQ6.2		Controllability of Systems: Thermal Comfort	Final Design		Calculation indicating total number of individual workstations, number of workstations with individual thermal comfort controls and the percentage of workstations with individual thermal comfort controls.		MEC
			Final Design		For each shared multi-occupant space, provide a brief description of thermal comfort controls.		MEC
			Final Design		Narrative describing thermal comfort control strategy, including type and location of individual and shared multi-occupant controls.		MEC
EQ7.1		Thermal Comfort: Design	Final Design		Design criteria spreadsheet indicating, for spring, summer, fall and winter, maximum indoor space design temperature, minimum indoor space design temperature and maximum indoor space design humidity.		MEC
			Final Design		Narrative describing method used to establish thermal comfort control conditions and how systems design addresses the design criteria, including compliance with the referenced standard.		MEC
EQ7.2		Thermal Comfort: Verification	Final Design		Narrative describing the scope of work for the thermal comfort survey, including corrective action plan development		MEC
			Final Design		List of drawing and specification references that convey permanent monitoring system.		MEC
EQ8.1		Daylight & Views: Daylight 75% of Spaces	Final Design		Option 2: Table indicating all regularly occupied spaces with space area and space area with compliant daylight zone. Sum of regularly occupied areas and regularly occupied areas withcompliant daylight zone. Percentage calculation of areas withcompliant daylight zone to total regularly occupied areas.		ARC
			Final Design		Option 1: Simulation model method, software and output data		ELEC
			Final Design		Option 1: Table indicating all regularly occupied spaces with space area, space area with minimum 25 footcandles daylighting illumination, and method of providing glare control. Sum of regularly occupied areas and regularly occupied areas with 25 fc daylighting. Percentage calculation of areas with 25 fc daylighting to total regularly occupied areas.		ELEC
			Final Design		For all occupied spaces excluded from the calculation, provide narrative indicating reasons for excluding the space.		ARC
			Final Design		List of drawing and specification references that convey exterior glazed opening head and sill heights, glazing performance properties and glare control/sunlight redirection devices.		ARC
			Closeout	X	Manufacturer published product data or certification confirming glazing Tvis in spreadsheet		PE
EQ8.2		Daylight & Views: Views for 90% of Spaces	Final Design		Table indicating all regularly occupied spaces with space area and space area with access to views. Sum of regularly occupied areas and regularly occupied areas with access to views. Percentage calculation of areas with views to total regularly occupied areas.		ARC
			Final Design		For all occupied spaces excluded from the calculation, provide narrative indicating reasons for excluding the space.		ARC
			Final Design		LEED Floor plan drawings showing line of sight diagramming of views areas in each regularly occupied space. List of drawing/specification references that convey exterior glazed opening head and sill heights.		ARC
INNOVATION & DESIGN PROCESS							

LEED Credit Paragraph	Contractor Check Here if Credit is Claimed	LEED-NC v3 Submittals (OCT09)		Provide for Credit Audit Only		Date Submitted (to be filled in by Contractor)	Government Reviewer's Use
PAR		FEATURE	DUE AT		REQUIRED DOCUMENTATION	DATE	REV
IDc1.1		Innovation in Design	Final Design		Narrative decribing intent, requirement for credit, project approach to the credit. List of drawings and specification references that convey implementation of credit. All other documentation that validates claimed credit.		
IDc1.2		Innovation in Design	Final Design				
IDc1.3		Innovation in Design	Final Design				
IDc1.4		Innovation in Design	Final Design				
IDc2		LEED Accredited Professional	Final Design		Narrative indicating name of LEED AP, company name of LEED AP, description of LEED AP's role and responsiblilities in the project.		ARC

<COS>ATTACHMENT F

Version 09-13-2012

BUILDING INFORMATION MODELING REQUIREMENTS

1.0 Section 1 - General

1.1. Definitions. See Section 7 for definitions of terms used in this document.

1.2. Submittal Format

1.2.1. The Model shall be developed using Building Information Modeling (“BIM”) supplemented with Computer Aided Design (“CAD”) content as necessary to produce a complete set of Construction Documents. Submitted drawings shall be halfsize size, suitable for half-size scaled reproduction.

1.2.2. BIM submittals shall conform to the requirements of Sections 3.0 and 4.0 below.

1.2.3. For each Center of Standardization (CoS) facility type included in this Project, all Models and associated Facility/Site Data shall be submitted in the BIM format and version as determined by the Customer, Geographic District BIM Manager, and the CoS District BIM Manager. For this project, the BIM submittal format will be Bentley BIM and InRoads [Not Supplied - SubmittalReqCADDSystem : BENTLEY_VERSION] . The submittals shall be fully operable, compatible, and editable within the native BIM tools.

2.0 Section 2 – BIM Requirements

2.1. Use of BIM. Contractor shall use BIM application(s) and software(s) to develop Projects consistent with the following requirements.

2.1.1. Baseline Model. The Contractor will not be provided a baseline multi-discipline BIM Project Model.

2.1.2. BIM Program Configuration Standards. The Bentley TriServices Workspace [Not Supplied - SubmittalReqCADDSystem : BENTLEY_VERSION] must be used and can be downloaded from the CAD/BIM Technology Center website, currently https://cadbim.usace.army.mil.

2.1.3. Reference. Refer to ERDC TR-06-10, “U.S. Army Corps of Engineers Building Information Modeling Road Map” from the CAD/BIM Technology Center website for more information on the USACE BIM implementation goals.

2.1.4. Industry Foundation Class (IFC) Support. The Contractor’s selected BIM application(s) and software(s) must be consistent with the current IFC property sets. Any deviations from or additions to the IFC property sets for any new spaces, systems, and equipment must be submitted for Government acceptance.

2.1.5. BIM Project Execution Plan.

2.1.5.1. Develop a BIM Project Execution Plan (“Plan” or “PxP”) documenting mandatory and Contractor-elected BIM Uses, analysis technologies and workflows.

2.1.5.2. Contractors shall use the USACE BIM PROJECT EXECUTION PLAN (PxP) Template located at https://cadbim.usace.army.mil to develop an acceptable Plan.

2.2. BIM Content.

2.2.1. Facility/Site Data. Develop the Facility/Site Data to include material definitions and attributes that are necessary for the Project facility design and construction as described in Section 4.0. Additional data in support of Section 6.0 Contractor Electives is encouraged to be added to the Model.

2.2.2. Model Content. The Model and Facility/Site Data shall include, at a minimum, the requirements of Section 4.0 below.

2.3. Output. Submitted Drawings (e.g., plans, elevations, sections, schedules, details, etc.) shall be derived (commonly known as extractions, views or sheets) from the Model and Facility/Site Data. Drawings derived from the Model shall remain connected to the Model for the life of the Project and documented in the PxP. Drawings not derived from the Model shall also be documented in the PxP.

2.3.1. Drawings derived from the Model shall be compliant with the A/E/C CAD Standard. Deliver electronic CAD files used for the creation of the Construction Documents per requirements in Section 01 33 16, the criteria of the USACE Fort Worth District, and as noted herein.

2.3.2. The CAD file format specified for drawings shall not dictate which application(s) are used for development and execution of the Model and Facility/Site Data. Application(s) used shall be documented in the PxP.

2.4. Quality Control Parameters. Implement quality control (“QC”) parameters for the Model, including:

2.4.1. Model Standards Checks. Provide QC checks demonstrating that the Project Facility/Site Data set has no undefined, incorrectly defined or duplicated elements. Identify and report non-compliant elements and submit a corrective action plan. Provide the Government with detailed justification and request Government acceptance for any non-compliant element that the Contractor proposes to be allowed to remain in the Model.

2.4.2. CAD Standards Checks. Provide QC checks demonstrating that the fonts, dimensions, line styles, levels and other construction document formatting issues are followed per requirements in Section 01 33 16. Identify and report non-compliant content and submit a corrective action plan.

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

2.5. Design and Construction Reviews. The Model and Facility/Site Data will be used to perform reviews at each submittal stage under Section 3.0 to test the Model, including Over-The-Shoulder Progress Reviews:

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

2.5.2. Interference Management Checks. Locate conflicting spatial data in the Model where two elements are occupying the same space. Log hard interferences (e.g., mechanical vs. structural, or mechanical vs. mechanical, overlaps in the same location) and soft interferences, (e.g., conflicts regarding equipment clearance, service access, fireproofing, insulation, code space requirements) in a written report and resolve.

2.5.3. 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.

2.6. Other Parameters. Develop other design and construction review parameters as the Contractor deems appropriate for the Project and provide to the Government for acceptance.

3.0 Section 3 – BIM Submittal Requirements

3.1. General Submittal Requirements.

3.1.1. Provide submittals in compliance with the PxP deliverables at stages as described below.

3.1.2. For each Submittal as set forth in Paragraphs 3.3 through 3.5, provide a Contractor-certified written report confirming that consistency checks as identified in Paragraphs 2.4 and 2.5 above have been completed. This report shall be discussed as part of the review process and shall address cross-discipline interferences, if any.

3.1.3. At each Submittal as set forth in Paragraphs 3.3 through 3.5, provide the Government with:

3.1.3.1. The Model, Facility/Site Data, Workspace and CAD Data files in the native BIM/CAD format.

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

3.1.3.3. A list of all submitted electronic files including a description, directory, and file name for each file submitted. For all CAD printed sheets, include a list of the sheet titles and sheet numbers. Identify which files have been produced from the Model and Facility/Site Data.

3.1.3.4. 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.

3.1.4. The Government shall confirm acceptability of all submittals identified in Section 3.0 in coordination with the USACE Geographic District BIM Manager.

3.2. Initial Design Conference Submittal.

3.2.1. Submit a digital copy of the PxP and M3 where, in addition to Paragraph 3.1.4, the USACE Geographic District BIM Manager will coordinate with the USACE CoS BIM Manager to confirm acceptability of the Plan or advise as to additional processes or activities necessary to be incorporated into the PxP.

3.2.2. Within thirty (30) days after the acceptance of the PxP and M3, conduct a demonstration to review the Plan for clarification, and to verify the functionality of planned Model technology workflow and processes. If modifications are required, the Contractor shall complete the modifications and resubmit the PxP performing a subsequent demonstration for Government acceptance. There will be no payment for design or construction until the PxP is completed and accepted by the Government. The Government may also withhold payment if there is design and construction for unacceptable performance in executing the accepted PxP.

3.3. Interim Design Submittals.

3.3.1. BIM and CAD Data. Submit the Model with Facility/Site Data per the requirements identified in Paragraphs 2.2 and 2.3 as applicable to the Interim Design package(s).

3.4. Final Design Submissions and Design Complete Submittals.

3.4.1. BIM and CAD Data. Submit the Model with Facility/Site Data per the requirements identified in Paragraphs 2.2 and 2.3. Acceptance according to Paragraph 3.1.4 is required before commencement of construction, as described in Paragraph 3.7.6 of Section 01 33 16.

3.5. Final As-Built BIM and CAD Data Submittal. Submit the final Model, Facility/Site Data, and CAD files reflecting as-built construction conditions for Government acceptance, as specified in Section 01 78 02.00 10, Closeout Submittals.

4.0 Section 4 – Minimum Modeling and Data Requirements

4.1. Minimum Modeling Matrix (M3)

4.1.1. Develop an M3 documenting elements included in the facility and site. The M3 describes the minimum modeling and data requirements by defining the Level of Development ("LOD") and Element Grade.

4.1.2. Contractors shall use the USACE Minimum Modeling Matrix (M3) Template located at https://cadbim.usace.army.mil and submitted as part of the PxP.

4.2. Additional Requirements.

4.2.1. Classification. All modeled elements shall include Facility/Site Data referencing one or more classification system(s).

4.2.2. Spatial Data. The Model shall include spatial data defining actual net square footage and net volume, and holding data to develop the room finish schedule including room names and numbers. Include program information to verify design space against programmed space, using this information to validate area quantities.

4.2.3. Schedules. Schedules shall be produced from the Facility/Site Data within the Model. Any exceptions should be documented in the PxP and submitted to the USACE for review.

4.2.4. Details and Enlarged Sections. All details and enlarged sections necessary for construction shall be derived from the Model when possible. For those details and enlarged sections not derived directly from the Model, Contractor must verify that geometry and data depicting the details and enlarged sections are consistent with Model elements. Details with significant drafted content such as 'standard' and 'typical' details shall not contradict the model and shall utilize the model as an underlay when possible for the purposes of verification and coordination. Three dimensional, isometric, and section isometric details derived from the model are preferred.

4.2.5. Legends. Model Elements shall be used to produce representations shown in the legends and shall match graphical representations shown in plans, sections, and elevations.

4.2.6. Drawing Indices. Where BIM authoring platform supports it, drawing indexes should be derived from a model-driven schedule.

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/Site Data developed for the Project in accordance with FAR Part 27, clauses incorporated in Section 00 72 00, Contract Clauses and Special Contract Requirement 1.14 GOVERNMENT RE-USE OF DESIGN (Section 00 73 00). The Government may make use of this data following any deliverable.

6.0 Section 6 – Contractor Electives

6.1. Applicable Criteria. If the Contractor elected to include one or more of the following features as an elective in its accepted contract proposal for additional credit, as described in the proposal submission requirements and evaluation criteria, the requirements of paragraphs 6.2 through 6.5 are as applicable for those elective feature(s) that will be included in the project.

6.2. COBIE Compliance. The Model and Facility/Site Data for the Project shall fulfill Construction Operations Building Information Exchange (COBIE) requirements on the Whole Building Design Guide website (www.wbdg.org) , including all requirements for the indexing and submission of Portable Document Format (PDF) and other appropriate records that would otherwise be printed and submitted in compliance with Project operations and maintenance handover requirements.

6.3. Project Scheduling using the Model. In the PxP and during the Initial Design Conference Submittal Demonstration, provide an overview of the use of BIM in the development and support of the Project construction schedule.

6.3.1. Submittal Requirements. During the Stages identified in Paragraphs 3.3 through 3.4, the Contractor shall deliver the construction schedule linked to the Model.

6.3.1.1. Construction Submittals – Over-The-Shoulder Progress Reviews. Periodic quality control meetings or construction progress review meetings shall include quality control reviews on the implementation and use of the Model for Project scheduling.

6.4. Cost Estimating. In the PxP and during the Initial Design Conference Submittal Demonstration, provide an overview of the use of BIM in the development and support of cost estimating, or other costing applications such as comparative cost analysis for proposed changes and estimate validation.

6.4.1. Submittal Requirements. During the Stages identified in Paragraphs 3.3 through 3.5, the Contractor shall deliver cost estimating information derived from the Model.

6.4.2. Project Completion. At Project completion, the Contractor shall provide an Micro Computer Aided Cost Estimating System Generation II (“MII”) Cost Estimate that follows the USACE Cost Engineering Military Work Breakdown System (“WBS”), a modified Uniformat, to at least the sub-systems level and uses quantity information supplied directly from Model output to the maximum extent possible, though other "gap" quantity information will be included by the contractor as necessary for a complete and accurate Cost Estimate. (See Paragraph 6.4.2.2).

6.4.2.1. Sub system level extracted quantities from the Model for use within the Estimate shall be provided according to how detailed line items or tasks should be installed/built so that accurate costs can be developed and/or reflected. When developing a Model, the contractor shall be cognizant of construction sequencing at the beginning stages of Model development, such as recognizing tasks performed on the first floor versus the same task on higher floors that will be more labor intensive and, therefore, need to have a separate quantity and be priced differently. Tasks and their extracted quantities from the Model shall be broken down by their location (proximity in the structure) as well as the complexity of installation.

6.4.2.2. At all design Stages it shall be acknowledged that BIM output will not generate all quantities that are necessary in order to develop a complete and accurate cost estimate of the Project based on the design alone. (An example of this would be plumbing that is less than 1.5" diameter and, therefore, not expected to be modeled due to permitted level of design granularity; this information is commonly referred to as “The Gap”. Quantities addressing “The Gap” and their associated costs shall be included in the final Project actual Cost Estimates as well even though not derived directly from the Model data).

6.5. Other Analyses and Reports. Structural, energy and efficiency, EPACT 2005 & EISA 2007, lighting design, daylighting, electrical power, psychrometric processing, shading, programming, LEED, fire protection, code compliance, Life Cycle Cost, acoustic, plumbing and other analyses that may be generated from the Model or reports summarizing the data compiled from these analyses shall be submitted in the form established by contractor in its accepted PxP.

7.0 Definitions

7.1. The following definitions apply specifically to the USACE BIM Requirements.

7.2. “Model”: A digital representation of physical and functional characteristics of a facility or a part thereof, comprised of “Model Elements” with “Facility/Site Data”.

7.3. “Model Element”: A self-contained element with a unique identification, whose behavior and properties are defined by Facility/Site Data and software processes. Model Elements can represent a physical entity, such as a pump or a concrete wall, and range from the simple to the complex.

7.4. “Facility/Site Data”: The non-graphical information attached to objects in the Model that defines various characteristics of the object. Facility/Site Data can include properties such as parametric values that drive physical sizes, material definitions and characteristics (e.g. wood, metal), manufacturer data, industry standards (e.g. AISC steel properties), and project identification numbers. Facility/Site Data can also define supplementary physical entities that are not shown graphically in the Model, such as insulation around a duct, hardware on a door, content of conduit, or transformer properties.

7.5. “Workspace”: A collection of content libraries and supporting files that define and embody a BIM standard. A workspace includes BIM libraries such as wall types, standard steel shapes, furniture, HVAC fittings, and sprinkler heads. It also contains sheet libraries such as print/plot configurations, font and text style libraries, and sheet borders and title blocks. The USACE has developed Workspaces specific to USACE BIM standards; these workspaces are dependent on specific versions of the BIM applications they serve. All USACE BIM Workspaces can be downloaded from the CAD/BIM Technology Center (https://cadbim.usace.army.mil). In some cases, there is a specific Workspace for a given CoS Facility Standard Design.

7.6. “IFC”: Industry Foundation Class, a standard and file format used for the exchange of BIM data; see www.iai-tech.org. Note: In the context of this attachment, IFC does not mean “Issued For Construction.”

ATTACHMENT G
DESIGN SUBMITTAL DIRECTORY AND SUBDIRECTORY FILE ARRANGEMENT

Organize electronic design submittal files in a subdirectory/file structure in accordance with the following table.

The Contractor may suggest a slightly different structure, subject to the discretion of the government.

Design Submittal Directory and Subdirectory File Arrangement.

Directory	Sub-Directory	Sub-Directory or Files	Files
Submittal/Package Name	Narratives	PDF file or files with updated design narrative for each applicable design discipline	
	Drawings	PDF (subdirectory)	Single PDF file with all applicable drawing sheets - bookmarked by sheet number and name
		BIM (subdirectory) See Attachment F.	BIM project folder (with files) per the USACE Workspace. Include an Excel drawing index file with each drawing sheet listed by sheet #, name and corresponding dgn file name (Final Design & Design Complete only)
	Design Analysis & Calculations	Individual PDF files containing design analysis and calculations for each discipline applicable to the submittal	
		PDF file with Fire Protection and Life Safety Code Review checklist	
	LEED	PDF file with updated Leed Check List	
		PDF file or files with LEED Templates for each point with applicable documentation included in each file.	
		LEED SUBMITTALS	
	Energy Analysis	PDF with baseline energy consumption analysis	
		PDF with actual building energy consumption analysis	
	Specifications	Single PDF file with table of contents and all applicable specifications sections.	
		Submittal Register (Final Design & Design Complete submittal only)	
	Design Quality Control	PDF file or files with DQC checklist(s) and/or statements	
	Building Rendering(s)	PDF file of rendering for each building type included in contract (Final Design & Design Complete).	

ATTACHMENT H
USACE BIM Project Execution Plan (PxP) Template Version 1.0

This template is a tool that is provided to assist in the development of a USACE BIM Project Execution Plan as required per contract. The template provides a standard format for organizations to establish their general means and methods for meeting the scope and deliverable requirements in Attachment F. It was adapted from the buildingSMART alliance™ (bSa) Project “BIM Project Execution Planning” as developed by The Computer Integrated Construction (CIC) Research Group of The Pennsylvania State University. The bSa project is sponsored by The Charles Pankow Foundation, Construction Industry Institute (CII), Penn State Office of Physical Plant (OPP), and The Partnership for Achieving Construction Excellence (PACE). The template can be found at the following link:

https://mrsi.usace.army.mil/rfp/Shared%20Documents/USACE_BIM_PXP_TEMPLATE_V1.0.pdf

Please note: Instructions and examples to assist with the completion of this template are currently in grey. The text can and should be modified to suit the needs of the organization filling out the template. If modified, the format of the text should be changed to match the rest of the document. This can be completed, in most cases, by selecting the normal style in the template styles.

SECTION 01 45 04.00 10
CONTRACTOR QUALITY CONTROL

1.0 GENERAL

1.1. REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Refer to the latest edition, as of the date of the contract solicitation.

- ASTM INTERNATIONAL (ASTM)
- ASTM D 3740 Minimum Requirements for Agencies

  Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
- ASTM E 329 Agencies Engaged in the Testing

  and/or Inspection of Materials Used in Construction
- U.S. ARMY CORPS OF ENGINEERS (USACE)

  ER 1110-1-12 Quality Management

1.2. PAYMENT

There will be no separate payment for providing and maintaining an effective Quality Control program. Include all costs associated therewith in the applicable unit prices or lump-sum prices contained in the Contract Line Item Schedule.

2.0 PRODUCTS (Not Applicable)

3.0 EXECUTION

3.1. GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause titled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product, which complies with the contract requirements. The system shall cover all design and construction operations, both onsite and offsite, and shall be keyed to the proposed design and construction sequence. The site project superintendent is responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager at the site, responsible for the overall site activities, including but not limited to quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise acceptable to the Contracting Officer, and shall be responsible for all construction and construction related activities at the site. Different contractors have different names for the on-site overall project supervisor. For clarification, the term “site project superintendent” refers to the Contractor’s senior site representative or “on-site manager”, or other similar title, as those terms are used in contract Clause 52.236-7, “Superintendence by the Contractor” and in the Division 00 Section(s) of the solicitation for this contract or task order,.or elsewhere in the contract. It does not refer to a construction superintendent, unless that person is also the Contractor’s permanently assigned senior site representative in charge of all on-site activities.

3.2. QUALITY CONTROL PLAN

Furnish for Government review, not later than 30 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, tests, records, and forms to be used. The Government will consider an interim plan for the first 30 days of operation. Design and construction may begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. The Government will not permit work outside of the features of work included in an accepted interim plan to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started. Where the applicable Code issued by the International Code Council calls for an inspection by the Building Official, the Contractor shall include the inspections in the Quality Control Plan and shall perform the inspections. The Designer of Record shall develop a program for any special inspections required by the applicable International Codes and the Contractor shall perform these inspections, using qualified inspectors. Include the special inspection plan in the QC Plan.

3.2.1. Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all design and construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents subcontractors, designers of record, consultants, architect/engineers (AE), fabricators, suppliers, and purchasing agents:

3.2.1.1. A description of the quality control organization. Include a chart showing lines of authority and an acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. A CQC System Manager shall report to the project superintendent or someone higher in the contractor's organization.

3.2.1.2. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function. Also include those responsible for performing and documenting the inspections required by the International Codes and the special inspection program developed by the designer of record.

3.2.1.3. A copy of the letter to the CQC System Manager, signed by an authorized official of the firm, which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Furnish copies of these letters.

3.2.1.4. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents subcontractors, designers of record, consultants, architect engineers (AE), offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

3.2.1.5. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. Use only Government approved Laboratory facilities.

3.2.1.6. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

3.2.1.7. Procedures for tracking design and construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

3.2.1.8. Reporting procedures, including proposed reporting formats.

3.2.1.9. A list of the definable features of work. A definable feature of work is a task, which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable feature under a particular section. This list will be agreed upon during the coordination meeting.

3.2.1.10. A list of all inspections required by the International Codes and the special inspection program required by the code and this contract.

3.2.2. Additional Requirements for Design Quality Control (DQC) Plan

The following additional requirements apply to the Design Quality Control (DQC) plan:

3.2.2.1. The Contractor's QCP Plan shall provide and maintain a Design Quality Control (DQC) Plan as an effective quality control program which will assure that all services required by this design-build contract are performed and provided in a manner that meets professional architectural and engineering quality standards. As a minimum, competent, independent reviewers identified in the DQC Plan shall review all documents. Use personnel who were not involved in the design effort to produce the design to perform the independent technical review (ITR). The ITR is intended as a quality control check of the design. Include, at least, but not necessarily limited to, a review of the contract requirements (the accepted contract or task order proposal and amended RFP), the basis of design, design calculations, the design configuration management documentation and check the design documents for errors, omissions, and for coordination and design integration. The ITR team is not required to examine, compare or comment concerning alternate design solutions but should concentrate on ensuring that the design meets the contract requirements. Correct errors and deficiencies in the design documents prior to submitting them to the Government.

3.2.2.2. Include in the DQC Plan the discipline-specific checklists to be used during the design and quality control of each submittal. Submit these completed checklists at each design phase as part of the project documentation.

3.2.2.3. A Design Quality Control Manager, who has the responsibility of being cognizant of and assuring that all documents on the project have been coordinated, shall implement the DQC Plan This individual shall be a person who has verifiable engineering or architectural design experience and is a registered professional engineer or architect. Notify the Government, in writing, of the name of the individual, and the name of an alternate person assigned to the position.

3.2.2.4. Develop and maintain effective, acceptable design configuration management (DCM) procedures to control and track all revisions to the design documents after the Interim Design Submission through submission of the As-Built documents. Include the DCM plan as a subset of the DQC Plan. See Section 'Design After Award'.

3.2.3. Acceptance of Plan

Government acceptance of the Contractor's plan is required prior to the start of design and construction. Acceptance is conditional and will be predicated on satisfactory performance during the design and construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.4. Notification of Changes

After acceptance of the CQC Plan, notify the Government in writing of any proposed change. Proposed changes are subject to Government acceptance.

3.3. COORDINATION MEETING

After the Postaward Conference, before start of design or construction, and prior to acceptance by the Government of the CQC Plan, the Contractor and the Government shall meet and discuss the Contractor's quality control system. Submit the CQC Plan for review a minimum of 7 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, design activities, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. The Government will prepare minutes of the meeting for signature by both parties. . The minutes shall become a part of the contract file. There may be occasions when either party will call for subsequent conferences to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

3.4. QUALITY CONTROL ORGANIZATION

3.4.1. Personnel Requirements

The requirements for the CQC organization are a CQC System Manager, a Design Quality Manager, and sufficient number of additional qualified personnel to ensure contract compliance. The CQC organization shall also include personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly. The Contractor's CQC staff shall maintain a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure contract compliance. The CQC staff shall be subject to acceptance by the Contracting Officer. Provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly furnish complete records of all letters, material submittals, shop drawing submittals, schedules and all other project documentation to the CQC organization. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.4.2. CQC System Manager

Identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, graduate architect, or a BA/BS graduate of an ACCE accredited construction management college program. The CQC system Manager may alternately be an engineering technician with at least 2 years of college and an ICC certification as a Commercial Building Inspector (Residential Building Inspector certification will be required for Military Family Housing projects). In addition, the CQC system manager shall have a minimum of 5 years construction experience on construction similar to this contract. The CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. Assign the CQC System Manager no other duties (except may also serve as Safety and Health Officer, if qualified and if allowed by Section 00 73 00, or by Section 00 73 10 if this is a task order). Identify an alternate for the CQC System Manager in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager but the alternate may have other duties in addition to serving in a temporary capacity as the acting QC manager.

3.4.3. CQC Personnel

3.4.3.1. In addition to CQC personnel specified elsewhere in the contract provide specialized CQC personnel to assist the CQC System Manager in accordance with paragraph titled Area Qualifications.

3.4.3.2. These individuals may be employees of the prime or subcontractor; be responsible to the CQC System Manager; **are not intended to be full time, but must be physically present at the construction site during work on their areas of responsibility**; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals may perform other duties but must be allowed sufficient time to perform their assigned quality control duties as described in the Quality Control Plan. **One person may cover more than one area, provided that they are qualified to perform QC activities for the designated areas below and provided that they have adequate time to perform their duties:**

3.4.4. Experience Matrix

3.4.4.1. Area Qualifications

3.4.4.1.1. Civil - Graduate Civil Engineer or (BA/BS) graduate in construction management with 4 years experience in the type of work being performed on this project or engineering technician with 5 yrs related experience.

3.4.4.1.2. Mechanical - Graduate Mechanical Engineer or (BA/BS) graduate in construction management with 4 yrs related experience or engineering technician with an ICC certification as a Commercial Mechanical Inspector with 5 yrs related experience.

3.4.4.1.3. Electrical - Graduate Electrical Engineer or (BA/BS) graduate in construction management with 4 yrs related experience or engineering technician with an ICC certification as a Commercial Electrical Inspector with 5 yrs related experience.

3.4.4.1.4. Structural - Graduate Structural Engineer or (BA/BS) graduate in construction management with 4 yrs related experience or person with an ICC certification as a Reinforced Concrete Special Inspector and Structural Steel and Bolting Special Inspector (as applicable to the type of construction involved) with 5 yrs related experience.

3.4.4.1.5. Plumbing - Graduate Mechanical Engineer or (BA/BS) graduate in construction management with 4 yrs related experience, or person with an ICC certification as a Commercial Plumbing Inspector with 5 yrs related experience.

3.4.4.1.6. Concrete, Pavements and Soils Materials Technician (present while performing tests) with 2 yrs experience for the appropriate area

3.4.4.1.7. Testing, Adjusting and Balancing Specialist must be a member (TAB) Personnel of AABC or an experienced technician of the firm certified by the NEBB (present while testing, adjusting, balancing).

3.4.4.1.8. Design Quality Control Manager Registered Architect or Professional Engineer (not required on the construction site)

3.4.4.1.9. Registered Fire Protection Engineer with 4 years related experience or engineering technician with 5 yrs related experience (but see requirements for Fire Protection Engineer of Record to witness final testing in Section 01 10 00, paragraph 5.10, Fire Protection).

3.4.4.1.10. QC personnel assigned to the installation of the telecommunication system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification. In lieu of BICSI certification, QC personnel shall have a minimum of 5 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. QC personnel shall witness and certify the testing of telecommunications cabling and equipment.

3.4.5. Additional Requirement

In addition to the above experience and/or education requirements the CQC System Manager shall have completed the course entitled "Construction Quality Management for Contractors". This course is periodically offered at http://www.swf.usace.army.mil/pubdata/CQM/index.asp. 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:

  U.S. Army Corps of Engineers

  Tom Hamilton

  Bldg 4229, 78th St

Fort Hood, TX 76544

- For other deliveries:

  [Not Supplied - ConstructionReqQC : LAB_NAME_OTHER]

  [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 02.12-1477
TEMPORARY CONSTRUCTION FACILITIES

1.0 OVERVIEW

1.1. GENERAL REQUIREMENTS

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

1.0 OVERVIEW

1.1. GENERAL REQUIREMENTS

1.1.1. This section contains requirements specifically applicable to this task order. The requirements of Base ID/IQ contract Section 01 50 02 apply to this task order, except as otherwise specified herein.

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

1.3.1. Bulletin Board (As Specified in Base contract)

1.3.2. Project and Safety Signs (Added to Stress standardization of signs, in the event that the Base ID/IQ Section 01 50 02 does not contain this information)

Erect a project sign and a site safety sign with informational details as provided by the Government at the Post award conference, within 15 days prior to any work activity on project site. Update the safety sign data daily, with light colored metallic or non-metallic numerals. Remove the signs from the site upon completion of the project. Engineer Pamphlet EP 310-1-6a contains the standardized layout and construction details for the signs. It can be found through a GOOGLE Search or try http://www.usace.army.mil/publications/eng-pamphlets/ep310-1-6a/s-16.pdf.

End of Section 01 50 02.12-1477

SECTION 01 57 23

TEMPORARY STORM WATER POLLUTION CONTROL
06/09

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 2009) 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 attached to that Section 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

b. 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 State of Texas 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 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 State of Texas 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 State of Texas 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 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;

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 and show on the SWPPP drawings. 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.

1.3.4 Sediment Basins

Trap sediment in temporary sediment basins. Select a basin size to accommodate the runoff of a local 0-1-year storm. Pump dry and remove the accumulated sediment, after each storm. Use a paved weir or vertical overflow pipe for overflow. Remove collected sediment from the site. Institute effluent quality monitoring programs. Install, inspect, and maintain best management practices (BMPs) as required by the general permit. Prepare BMP Inspection Reports as required by the general permit. If required by the permit, include those inspection reports.

1.3.5 Vegetation and Mulch

a. Provide temporary protection on sides and back slopes as soon as rough grading is completed or sufficient soil is exposed to require erosion protection. Protect slopes by accelerated growth of permanent vegetation, temporary vegetation, mulching, or netting. Stabilize slopes by hydroseeding, anchoring mulch in place, covering with anchored netting, sodding, or such combination of these and other methods necessary for effective erosion control.

b. Seeding: Provide new seeding where ground is disturbed. Include topsoil or nutriment during the seeding operation necessary to establish or reestablish a suitable stand of grass.

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.

2.2 COMPONENTS FOR STRAW BALES

The straw in the bales shall be stalks from oats, wheat, rye, barley, rice, or from grasses such as byhalia, bermuda, etc., furnished in air dry condition. Provide bales with a standard cross section of 14 by 18 inches. Wire-bound or string-tie all bales. Use either wooden stakes or steel posts to secure the straw bales to the ground. Wooden stakes utilized for this purpose, shall have a minimum dimensions of 2 by 2 inches in cross section and have a minimum length of 3 feet. Steel posts (standard "U" or "T" section) utilized for securing straw bales, shall have a minimum weight of 1.33 pounds/linear foot and a minimum length of 3 feet.

PART 3 EXECUTION

3.1 INSTALLATION OF SILT FENCES

Extend silt fences a minimum of 16 inches above the ground surface without exceeding 34 inches above the ground surface. Provide filter fabric from a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, splice together filter fabric at a support post, with a minimum 6 inch overlap, and securely sealed. Excavate trench approximately 4 inches wide and 4 inches deep on the upslope side of the location of the silt fence. The 4 by 4 inch trench shall be backfilled and the soil compacted over the filter fabric. Remove silt fences upon approval by the Contracting Officer.

3.2 INSTALLATION OF STRAW BALES

Place the straw bales in a single row, lengthwise on the contour, with ends of adjacent bales tightly abutting one another. Install straw bales so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings. Entrench and backfill the barrier. Excavate a trench the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. After the bales are staked and chinked (gaps filled by wedging with straw), backfill the excavated soil against the barrier. Conform the backfill soil with the ground level on the downhill side and build up to 4 inches against the uphill side of the barrier. Scatter loose straw over the area immediately uphill from a straw bale barrier to increase barrier efficiency. Securely anchor each bale by at least two stakes driven through the bale. Drive the first stake or steel post in each bale toward the previously laid bale to force the bales together. Drive stakes or steel pickets a minimum 18 inches deep into the ground to securely anchor the bales.

3.3 FIELD QUALITY CONTROL

Maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. Use the following procedures to maintain the protective measures.

3.3.1 Silt Fence Maintenance

Inspect the silt fences in accordance with paragraph, titled "Inspections," of this section. Any required repairs shall be made promptly. Pay close attention to the repair of damaged silt fence resulting from end runs and undercutting. Should the fabric on a silt fence decompose or become ineffective, and the barrier is still necessary, replace the fabric promptly. Remove sediment deposits when deposits reach one-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 or be seeded in accordance with UFGS Guide Specification 32 05 33 LANDSCAPE ESTABLISHMENT, except that the coverage requirements in paragraph, titled "Establishment" of this section do not apply.

3.4 INSPECTIONS

3.4.1 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.

3.4.2 Inspections Details

Inspect disturbed areas and areas used for material storage that are exposed to precipitation for evidence of, or the potential for, pollutants entering the drainage system. Observe erosion and sediment control measures to ensure that they are operating correctly. Inspect discharge locations or points to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Inspect locations where vehicles exit the site for evidence of offsite sediment tracking.

3.4.3 Inspection Reports

For each inspection conducted, prepare a report summarizing the scope of the inspection, name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, 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.

3.4.4 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 --

FORT HOOD, TEXAS

MODIFIED RECORD FIRE RANGE (FY13)

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

SEPTEMBER 2011

FORT HOOD, TEXAS
MODIFIED RECORD FIRE RANGE (FY13)

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 a new Modified Record Fire Range (MRFR) (FY13) at Fort Hood, Texas. The final design and construction of this facility will be accomplished under a Design-Build contract. The descriptions of the project facilities presented herein are based upon information available at the time of the report (including the Project Definition Report, dated January 2011). The bidders should refer to the Design-Build Request for Proposal (RFP) document for specific facility descriptions.

Based upon information available at the time of this report, the project is subdivided into a Range Operations Control Area (ROCA) and the Range Area. Buildings located at the project ROCA include an 800 GSF Classroom building, an 800 GSF Operations/Storage building, both of which are anticipated to be single-story, pre-engineered metal buildings with a standing seam metal roof. The Cantonment Area also will include a new 800 GSF Covered Mess and a Bleacher Enclosure (anticipated to be approximately 586 GSF) which also will be single-story, pre-engineered metal buildings with a standing seam metal roof, and a 185 GSF Ammo Breakdown building, which will be a partially enclosed metal structure with a standing seam metal roof. The project will also include a new Range Operations Control (ROC) Tower. Types of vehicles anticipated to utilize the facility include light- to medium-duty trucks, as well as some larger support trucks; large and heavy pneumatic tire vehicles and track-laying vehicles are not anticipated to utilize the site. Pavement features for the new facility are anticipated to include aggregate-surfaced range service roads and parking areas. Site improvements include new utilities.

The new Modified Record Fire Range (FY13) will be constructed in the southern part of the Fort Hood Range. More specifically, the project is located immediately north of the Fort Hood main cantonment, at a location approximately 2,000 feet west of the intersection of South Range Road and 53rd Street (on the north side of South Range Road). The developable area of the project site is approximately 30 acres. The site is relatively flat with minimal vegetation.

A site-specific topographic survey was not available for review at the time of this report. Finish floor elevations for the proposed new facilities were not known at the time of this report.

2. **Subsurface Investigation.** A total of fourteen (14) borings were drilled in general accordance with a drilling and sampling scope of work prepared by the U.S. Army Corps of Engineers, Fort Worth District, during March 2011 by Raba-Kistner Consultants, Inc. under a subcontract through K.M. Ng and Associates. Borings 8A4C-MRFR-1 through 10A-MRFR-14 were drilled to determine subsurface conditions and to obtain representative soil and rock samples for laboratory testing. Test hole advancement and sampling was performed by the drilling subcontractor, GEDCO Drilling, using a 4 ½-inch (O.D.) diameter hollow stem continuous flight auger, a 3 ¼-inch solid stem continuous flight auger, a nominal 3-inch diameter shelby tube sampler, and a nominal 2-inch diameter split-spoon sampler (used to recover soil samples). Borings were drilled to depths ranging from 10.0 feet to 22.0 feet below existing grade. Samples recovered from the borings were sealed in airtight containers and delivered to the laboratory of TEAM Consultants, Incorporated (Arlington, Texas) for testing.

The field investigation was performed using a Gardner Denver truck-mounted drilling rig and conventional drilling implements. Results of the field investigation are shown on Sheet B101 (Boring Locations) and Sheets B201 through B203 (Logs of Borings), Appendix A.

a. Groundwater Conditions. Groundwater conditions were monitored immediately upon completion of the test holes and after a 24-hour observation period. All borings were dry during these observation periods. However, it should be noted that groundwater conditions are relative to the time of drilling, annual precipitation, and drainage conditions at the site. Groundwater has previously been encountered at shallow depths within the Fort Hood range area.

b. Dynamic Cone Penetrometer Testing. Dynamic Cone Penetrometer testing (DCP) was performed at the Modified Record Fire Range (FY13) site for pavement design considerations in borings 10A-MRFR-7, 10A-MRFR-9, 10A-MRFR-11, 10A-MRFR-12, and

10A-MRFR-13. Dynamic Cone Penetrometer testing was performed at the Dining Facility site for pavement design considerations in borings 8A4C-5749, 8A4C-5750, 8A4C-5751, and 8A4C-5752. Results of DCP testing are presented in Appendix D and discussed in Sections 4 and 5.

c. Soil Resistivity Testing. Based on information provided by the field investigation subcontractor, soil resistivity testing was performed at approximately the location of the Classroom Facility (approximately the location of boring 8A4C-MRFR-2). Testing was performed at seven depths (diode spacings) each in both a north-south alignment and an east-west alignment. Specifically, the seven tests were performed at diode spacings of 2.5, 5.0, 10.0, 15.0, 20.0, 30.0, and 50.0 feet. The resistivity values measured in the field in a north-south direction are 4,787 ohm-cm for a diode spacing of 2.5 feet, 3,350 ohm-cm for a diode spacing of 5.0 feet, 2,150 ohm-cm for a diode spacing of 10.0 feet, 1,867 ohm-cm for a diode spacing of 15.0 feet, 1,785 ohm-cm for a diode spacing of 20.0 feet, 1,930 ohm-cm for a diode spacing of 30.0 feet, and 2,145 ohm-cm for a diode spacing of 50.0 feet. The resistivity values measured in the field in an east-west direction are 5,074 ohm-cm for a diode spacing of 2.5 feet, 2,964 ohm-cm for a diode spacing of 5.0 feet, 2,306 ohm-cm for a diode spacing of 10.0 feet, 2,074 ohm-cm for a diode spacing of 15.0 feet, 1,884 ohm-cm for a diode spacing of 20.0 feet, 1,896 ohm-cm for a diode spacing of 30.0 feet, and 2,135 ohm-cm for a diode spacing of 50.0 feet.

3. Subsurface Conditions.

a. General Geology. Fort Hood lies within the Central Texas Section of the Great Plains physiographic province. The topographic features of the area are those of a dissected plateau characterized by buttes and mesas. Approximately 30 miles southeast of Fort Hood, the dissected plateau topography gives way to the moderate or rolling relief of the Gulf Coastal Plain. The Balcones fault zone is, roughly, the dividing line of the two physiographic provinces. The uppermost primary stratum underlying Fort Hood is the Walnut Formation of the Comanche Series, Cretaceous age. The Walnut Formation is composed of gray-black, calcareous clay shales alternating with beds of chalky, nodular limestone and shell conglomerates. The entire Walnut Formation was not penetrated by borings drilled at the site.

Overburden soils within the area vary from a knife edge to greater than 30 feet in thickness, and consist of clays of low to high plasticity, clayey gravels and/or clay choked limestone nodules. The overburden soils are residual soils derived from the underlying parent material.

b. <u>Site Conditions.</u> Based on available information, the ROCA of the Modified Record Fire Range (FY13) site has been previously developed; this limited development includes multiple small buildings, parking areas, and roads and trails. These features are anticipated to require demolition to accommodate the new construction. The site is relatively flat with minimal vegetation. A site-specific topographic survey was not available for review at the time of this report. Finish floor elevations for the project buildings were not known at the time of this report.

Presented below are descriptions of the subsurface conditions encountered at the Modified Record Fire Range (FY13) project site. <u>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 respective geotechnical field investigations).</u>

Stratigraphically, the Modified Record Fire Range (FY13) site is characterized by typically high plasticity clay (CH) overburden strata, underlain by strata of weathered interbedded marl/shale and limestone, and by a deeper formation of unweathered interbedded marl/shale and limestone primary. It should be noted that the descriptions provided herein are based on an interpretation of the logs of borings prepared by Raba-Kistner during the geotechnical field investigation, the results of laboratory testing, as well as subsurface/stratigraphic information for the area from the previous (and subsequent) geotechnical field investigations performed at Fort Hood by the U.S. Army Corps of Engineers, Fort Worth District, and engineering knowledge and experience.

Based on these considerations, the overburden soils at the Modified Record Fire Range (FY13) project site consist typically of high plasticity clays (CH). The overburden soils range in color from brown to dark brown to red brown, and are typically hard, damp, with gravel (likely either extremely weathered limestone either in situ or mixed with the overburden clay during drilling). It should be noted that the residual soil typically developed from the interbedded limestone and yellow brown marl/shale primary is a brown to very dark brown, soft to firm, high plasticity clay. This overburden soil is underlain by the highly weathered primary, which, when drilled through with a flight auger, may mix these materials and recover cuttings that are similar in character to the materials described on the logs of borings as clay. Consequently, some of the overburden materials may, in actuality, be ground and mixed primary materials, and the contact between the overburden and primary may occur at a shallower depth than indicated on the logs of borings. These observations are based on engineering experience with the overburden and primary materials present in this area of Fort Hood, and evaluation of the drilling methods used during the geotechnical field investigation. The overburden soils at the site vary from less than 1 foot to approximately 5 feet in thickness (although the marl/clay shale primary appears to outcrop at the surface across most of the site). Atterberg limits testing on the high plasticity clay overburden soils present at the site indicates that these materials possess liquid limits ranging from 53 to 84 percent, plastic limits varying from 22 to 30 percent (with plasticity indices ranging from 30 to 62 percent), and in situ moisture contents varying from about 12 to 27 percent.

Weathered interbedded marl/clay shale and limestone primary is present below the overburden soils or outcropping at the surface across the site. Due to the apparent drilling and sampling techniques used, collected specimens of the highly weathered to weathered marl/clay shale were commonly given a sandy low to medium plasticity clay (CL) USCS classification in the laboratory; this classifications is most likely a function of the proportion of limestone (sand/gravel), ground up by drilling action, present in the sample. The weathered marl/clay shale primary is typically yellow brown to gray, damp, has a characteristic blocky structure and iron oxide staining, is jointed and fractured, includes scattered shell fossils, and is interbedded with limestone seams. The weathered limestone primary is yellow brown to light gray to white, moderately fractured, fossiliferous, and interbedded with marl/clay shale seams and layers. Based on previous engineering studies in the area, the marl/clay shale primary is very soft to soft (Rock Classification) and the weathered limestone primary is typically hard (Rock Classification). Based on an interpretation of the information provided on the logs of borings and the results of laboratory testing, the dark gray unweathered limestone and marl/clay shale primary is present at approximate depths of 19 and 11.5 feet at the locations of borings 8A4C-MRFR-2 and 8A4C-MRFR-3, respectively. Based on previous engineering studies in the area, the unweathered marl/clay shale primary is soft (Rock Classification) and the unweathered limestone primary is typically hard (Rock Classification) and unfractured. Specimens of the weathered marl/clay shale primary and lenses of weathered marl/shale interbedded with weathered limestone primary subjected to Atterberg limits testing were found to have liquid limits ranging from 25 to 48 percent, plastic limits ranging from 14 to 24 percent (with plasticity indices ranging from 11 to 32 percent), and in situ moisture contents varying from about 4 to 16 percent. Specimens of the unweathered marl/clay shale primary and lenses of unweathered weathered marl/shale interbedded with unweathered limestone primary subjected to Atterberg limits testing were found to have liquid limits ranging from 34 to 52 percent, plastic limits ranging from 13 to 19 percent (with plasticity indices ranging from 21 to 33 percent), and in situ moisture contents varying from about 5 to 12 percent. It should be noted that some specimens of the marl/clay shale primary collected (both weathered and unweathered) **NOTE: REGARDLESS OF THE STATE OF WEATHERING, EXCAVATIONS MADE INTO THE MARL/CLAY SHALE PRIMARY SHOULD BE CONSIDERED "ROCK EXCAVATION".**

Based on the geotechnical field investigation, the Modified Record Fire Range project site is assigned International Building Code (IBC) ***Site Class D***.

Subsurface conditions representative of the Modified Record Fire Range project site are shown on the boring logs, Sheets B201 through B203 (Appendix A). The legend on the individual boring logs show overburden materials as classified in the laboratory using procedures presented in ASTM D 2488 and classified in the field using procedures presented in ASTM D 2487. It should be noted that the actual interface between material types might 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 site 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, and strength. The accumulative test results are tabulated and presented in Appendix C. Results of identification and moisture content testing are shown on the boring log, Appendix A.

Results of laboratory testing performed on samples obtained from the Modified Record Fire Range (FY13) 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 marl/shale and limestone primary are shown with respect to depth on Plate 5.

(1) Shear Strength Testing. Shear strength characteristics of the marl/shale and limestone (LS) primary were analyzed in the laboratory using one-point unconsolidated-

undrained triaxial compression testing, confining the specimen to overburden pressure and then loading to failure, or using unconfined compression (UC) testing. Tabulated below are the ultimate compressive strengths and respective dry densities. Shear strength test results are presented in Appendix C at the end of this report.

Boring	Depth, feet	γ_d, pcf	Q_u, tsf	Material Type
8A4C-MRFR-1	4.0	119.7	4.95	Weathered Marl/Shale
8A4C-MRFR-1	8.4	125.0	2.15	Weath. Marl/Shale w/ LS Seams
8A4C-MRFR-1	10.3	137.4	30.30	Weathered LS w/ Marl/Shale Seams
8A4C-MRFR-1	17.4	137.4	20.44	Weathered LS w/ Marl/Shale Seams
8A4C-MRFR-2	9.4	120.7	7.66	Weath. Marl/Shale w/ LS Seams
8A4C-MRFR-2	14.3	127.4	4.19	Weath. Marl/Shale w/ LS Seams
8A4C-MRFR-2	19.0	143.1	82.89	Unweath. LS w/ Marl/Shale Seams
8A4C-MRFR-3	12.4	126.1	16.45	Unweath. LS w/ Marl/Shale Seams
8A4C-MRFR-3	17.4	136.3	30.47	Unweath. LS w/ Marl/Shale Seams
8A4C-MRFR-3	23.9	139.4	36.81	Unweath. LS w/ Marl/Shale Seams
8A4C-MRFR-3	26.7	139.1	19.69	Unweath. LS w/ Marl/Shale Seams
8A4C-MRFR-3	33.0	138.1	65.78	Unweath. LS w/ Marl/Shale Seams

b. Field Testing. Dynamic Cone Penetrometer testing (DCP) was performed at the Modified Record Fire Range (FY13) site for pavement design considerations in borings 10A-MRFR-7, 10A-MRFR-9, 10A-MRFR-11, 10A-MRFR-12, and 10A-MRFR-13. 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 17.6-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	5 - 48	133 - 383
6 – 12	3 - 29	100 - 305
>12	3 - 31	97 - 304

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 Modified Record Fire Range (FY13) 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 Hood. The Design-Build Contractor shall heed the information provided in this report and comply with the requirements and recommendations presented herein when developing his/her 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 presented herein as the sole basis to formulate his/her foundation and pavement designs, or, at his/her option, the Design-Build Contractor may supplement the information provided herein by his/her own geotechnical field investigation and laboratory testing program. **<u>Supplemental geotechnical field investigations conducted by the Design-Build Contractor shall be ONLY for the purpose of supplementing the data regarding the subsurface conditions provided by the Government geotechnical field investigation</u>**. These supplemental efforts shall include conducting testing on soil and rock specimens as described in Section 4 (Testing). Additional test holes for the foundation design shall each be drilled to a minimum depth of 20.0 feet below existing grade. Additional test holes for the pavement design shall each be drilled to a minimum depth of 10.0 feet below existing grade. 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 in any supplemental geotechnical field investigations; 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 weathered marl/shale and limestone 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 (for marl/shale core specimens) (ASTM D 2435 and ASTM D 4546 (Method C)), and strength (ASTM D 2464 for marl/shale core specimens; ASTM D 2938 for limestone core specimens).

Development of the final foundation designs (and pavement designs if required) 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 IS NOT PERMITTED TO UTILIZE FINAL FOUNDATION AND PAVEMENT DESIGNS THAT ARE LESS RIGOROUS AND STRINGENT THAN THE MINIMUM DESIGNS SPECIFIED HEREIN (I.E., THAT DO NOT MEET OR EXCEED THE MINIMUM REQUIREMENTS SPECIFIED HEREIN). IF THE DESIGN-BUILD CONTRACTOR'S ADDITIONAL SOILS INVESTIGATIONS, LABORATORY TESTING, AND ENGINEERING ANALYSES SHOW THAT A MORE STRINGENT AND RIGOROUS DESIGN IS REQUIRED ABOVE THE MINIMUM FOUNDATION AND PAVEMENT DESIGN REQUIREMENTS SPECIFIED HEREIN, IT IS

THE RESPONSIBILITY OF THE DESIGN-BUILD CONTRACTOR TO ENSURE THEIR FINAL DESIGNS MEET THE MORE STRINGENT REQUIREMENT.

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. Subsurface conditions in the area of building construction consist typically of medium to high plasticity clay overburden and weathered marl/clay shale primary. Based on laboratory test results, the clayey soils and weathered marl/clay shale primary materials are moisture deficient throughout the total depth investigated (35.0 feet), and therefore will be susceptible to volumetric changes during periods of seasonal moisture variations. In this zone, liquid limits range from 25 to 84 percent, plastic limits vary from 13 to 30 percent (with plasticity indices ranging from 11 to 62 percent), and natural moisture contents vary from 4 to 27 percent. Based on the plasticity characteristics of the clayey overburden soils and the marl/clay shale primary encountered during the field investigation at the Modified Record Fire Range (FY13) project site, and upon the results of controlled expansion-consolidation (CEC) testing on similar subsurface materials at Fort Hood, the in situ overburden and primary materials have a moderate to high expansion potential and a moderate consolidation potential. Special foundation and subgrade preparation requirements for Modified Record Fire Range (FY13) facilities are provided herein to ensure the structure(s) withstand the effects of the high shrink-swell subsurface conditions. Within the area of new building construction, the soils within the upper 2 feet have the highest shrink-swell potential, below which, the soils' activity levels appear generally to decrease. Therefore, it is recommended that the overburden clays should be removed to a minimum depth of 2 feet, or to the top of intact limestone primary, whichever occurs first, and replaced with compacted nonexpansive backfill material to the base of floor slabs placed on-grade.

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.

All new building structures included in this project are relatively small, lightly loaded single-story facilities. A deep drilled pier foundation system is not considered necessary or appropriate for these facilities. Instead, a shallow foundation system is considered better suited to these structures. The best shallow foundation performance by similar structures in the expansive subsurface material conditions present at Fort Hood 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.

Therefore, the foundation system used for the proposed Modified Record Fire Range (FY13) structures shall be limited to those specified herein, specifically a shallow foundation system consisting of 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 CRITERIA AND MINIMUM REQUIREMENTS SPECIFIED HEREIN.***

c. Pavement Design Considerations. The pavement designs presented in this report are based on criteria contained in *UFC 3-250-01FA, UFC 3-250-09FA, UFC 3-250-18FA,* and engineering judgment.

(1) Traffic Types and Conditions. There are two (2) pavement structures proposed for this project. New aggregate-surfaced pavement structures include range parking areas and range service roads.

It is anticipated that the vehicles which will utilize the site pavement structures primarily will be M998 HMMWV and other light- to medium-duty vehicles (Category II Traffic). However, support vehicles consisting of heavier two-, three-, and four-axle trucks (Category IVA Traffic) with or without trailers are also anticipated to utilize the pavement structures. It is anticipated that during peak operational periods, the pavement structures may experience at least 25 but less than 250 passes per hour of Category II Traffic vehicles (constituting a Class E Street and a corresponding Design Index equal to 2), while the number of heavier multi-axle Category IVA Traffic vehicles is anticipated to be limited to less than 25 vehicular passes per hour (constituting a Class F Street and a corresponding Design Index equal to 4). Large and heavy pneumatic tire vehicles and track-laying vehicles are not anticipated to utilize the site.

Based on the aforementioned Unified Facilities Criteria, the anticipated traffic conditions were assigned:

	Pavement Structure	Traffic Category	Street Class	Design Index
Ag-Surf	Range Service Roads & Pkg. Areas			
	* Light- to Medium-Duty Vehicles	II	E	2
	* Medium- to Heavy-Duty Vehicles	IVA	F	4

Note: The Road Class and Design Index for the aggregate-surfaced pavement structures were determined in accordance with criteria contained in UFC 3-250-09FA.

(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 Modified Record Fire Range (FY13) site range from approximately 3 to 48 percent, and below this depth, CBR values range from 3 to 31 percent. Modulus of subgrade reaction values measured within the upper 12 inches of soils tested range from 100 to 383 pci, and below this depth, modulus of subgrade reaction values range from 97 to 304 pci. In the past, the clayey subgrade at Fort Hood has been assigned CBR values ranging from 4 to 6 percent 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 100 pci to 150 pci can be assigned to the in situ soils when compacted to 90 percent of laboratory maximum density. The higher CBR and subgrade modulus values measured at this site are believed to be attributable to the occurrence of the weathered marl/clay shale at or near the surface at the DCP test locations, and to the presence of clasts or seams of weathered limestone within the depth of DCP testing. 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 when compacted to 90 percent of laboratory maximum density (ASTM D 1557).

(3) Material Sources. Material sources in central Texas 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 are based on the results of the field investigation, laboratory testing, engineering studies.

As previously stated, the Design-Build Contractor is not permitted to utilize final foundation and pavement designs that are less rigorous and stringent than the minimum designs specified herein (i.e., that do not meet or exceed the minimum requirements specified herein). If the design-build contractor’s additional soils investigations and laboratory testing (if performed), and engineering analyses show that a more stringent and rigorous design is required above the minimum foundation and pavement design requirements specified herein, it is the responsibility of the design-build contractor to ensure their final designs meet the more stringent requirement.

a. Foundation Design Recommendations and Requirements.

(1) Foundation System. Only the following foundation systems shall be allowed for the proposed Modified Record Fire Range (FY13) structures: 1) a reinforced concrete ribbed mat slab, or 2) a reinforced concrete flat mat slab. All foundation systems shall be designed in accordance with the criteria and minimum requirements specified hererin. **NO OTHER FOUNDATION SYSTEMS SHALL BE ALLOWED.** ***THE FOLLOWING FOUNDATION SYSTEMS ARE SPECIFICALLY PROHIBITED: SPOT AND/OR CONTINUOUS SPREAD FOOTINGS, REINFORCED CONCRETE DRILLED AND UNDERREAMED PIERS, AND AUGER CAST PILES.***

(a) Reinforced Concrete Ribbed Mat or Flat Mat Slab. The proposed Modified Record Fire Range (FY13) structures 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 20 feet center-to-center, and diagonal stiffener ribs shall be placed at each corner of the mat slab. Additional stiffness may be needed for irregular slab geometries. 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 shall 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 minimum 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 a minimum 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 2.0 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.

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 1.5 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 18 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.

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.

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 shall be placed beneath the mat slab. The following requirements concerning demolition of existing building foundations and slabs shall apply for areas of new mat slab or slab-on-grade construction.

As previously discussed, the new construction may be in areas that will require the demolition of some existing facilities and their structural elements. **If the existing buildings/structures are determined to have a reinforced concrete drilled pier foundation:** ***existing piers shall be abandoned in-place – extraction of these piers SHALL NOT be allowed.*** Abandoned piers shall be cut off AT LEAST 3 FEET below the top of the base of the excavation (cut) for the new building construction (per requirements for existing soil removal and replacement with compacted nonexpansive fill specified herein). **Compacted select clay**

material shall be used to backfill excavations to cut off abandoned piers. Select clay backfill for used for this purpose shall be compacted to at least 92 percent of laboratory maximum density as determined in accordance with ASTM D 1557. **<u>If the existing buildings/structures are determined to have a shallow foundation system:</u>** t***he existing shallow foundation system within the proposed building footprint shall be removed in its entirety, and the excavation backfilled with compacted nonexpansive fill in accordance with the requirements specified herein for compacted nonexpansive fill placed below mat floor slab and foundations.***

(b) <u>Range Operations Control (ROC) Tower.</u> A drilled and underreamed pier foundation shall not be used for Tower due to the lightly loaded nature of the structure, and potential heave due to the expansive clay overburden and weathered clay shale primary, which could result in torsional strain on the structure. Instead, Tower shall be supported on a square footing (base) foundation. The footing shall be founded at a depth of at least 5.0 feet below existing grade at the Tower location. An allowable bearing capacity of 2.0 ksf shall be assigned to (and shall not be exceeded for) the clay or marl/clay shale subgrade at the Tower location. The footing sahll have a minimum thickness of 30 inches and sahll be reinforced with at least 1.5 percent steel. A cover of at least 30 inches of satisfactory fill shall be placed above the footing to act against wind loads. The fill shall be placed in controlled lifts not to exceed 8 inches in loose thickness and compacted to at least 92 percent of laboratory maximum density (ASTM D 1557). Sufficient burial and mass of the footing shall be obtained to resist lateral wind loadings.

(c) <u>Small Support-type Structures.</u> Small support-type structures ($\leq$500 GSF), if applicable, can be supported on a reinforced concrete slab-on-grade with turned-down edge beam foundation. The turned-down edge beam shall extend a minimum of 12 inches below outside finished grade, and shall be sized for a safe bearing pressure of 2,000 psf (net). Subgrade preparation shall be in accordance with the requirements specified below for floor slabs founded on-grade.

(2) Ground-Level Floor Slab System(s). The mat slab systems will, by design, be supported on-grade.

(3) Subgrade Preparation and Fill Requirements. The existing soils within ribbed and flat mat slab building footprints, shall be removed to a minimum depth of 2.0 feet below existing grade, or to the top of intact limestone primary, whichever occurs first, and replaced with compacted nonexpansive backfill, which should limit the magnitude of predicted movement to approximately 1 inch or less. However, ensure requirements for minimum founding depths below outside finish grade are met for ribbed mat slabs and slabs with turned down edge beams, as specified in Paragraphs 6.a.(1)(a) and 6.a.(1)(c), respectively. 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). A polyethylene vapor barrier (10-mil minimum thickness) and a minimum 6-inch capillary water barrier shall be provided beneath floor slabs supported on-grade. NOTE: The vapor barrier and capillary water barrier are not required for exterior mat slabs-on-grade that are open/exposed to the elements (e.g. mechanical equipment pads) and not connected to the building.

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. The following minimum testing frequencies should be included in the contract specifications:

- In-place density of the subgrade, fills, and backfills shall be performed for every 2,000 square feet per lift in accordance with ASTM D 1556 or ASTM D 6938.
- Optimum Moisture and Laboratory Maximum Density of nonexpansive fill and backfill shall be performed for every 500 cubic yards or when any change in material occurs.

(5) Below-Grade Structures (Including Retaining Walls) (If Applicable). The following information is provided for the design of all below-grade structures, if applicable. An at-rest lateral earth pressure coefficient (k_o) of 0.7, an angle of internal friction (ϕ) of 28^o, a cohesion value (c) of 100 psf, and an allowable bearing capacity of 2,000 psf shall be used. The backfill material shall be assumed to have a moist unit weight of 125 lb/ft^3 and all backfill shall be nonexpansive or select material, as specified herein. The retaining wall analyses and designs shall also account for surcharge loadings (e.g., due to vehicular traffic) where applicable.

(6) Berms (if used). Earthfill berms, if used, shall be constructed of Satisfactory Materials (per the definition in this report). The materials used to construct the berms should have the following plasticity index (PI) characteristics: $15 \leq PI \leq 30$. The earthfill for the berms shall be placed in controlled lifts not exceeding 8 inches in loose thickness and compacted to at least 92 percent of maximum laboratory density as determined in

accordance with ASTM D 1557. Additionally, 6 inches of the existing subgrade material beneath the base of the berms should be scarified, moistened, aerated, and recompacted to at least 90 percent of maximum laboratory density as determined in accordance with ASTM D 1557.

(7) Drainage Conditions. Proper site drainage is imperative to ensure satisfactory long-term foundation performance. Exterior grading adjacent to the buildings shall be sloped away from the structures 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.

(8) 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 foundations is unacceptable at any time.** In addition, site excavations to include utility trenching, grading, and retention basins shall be constructed so as not to supply water directly or indirectly to the building or underlying active clayey soils and marl/shale. Such exposure of the underlying active clayey soils and marl/shale to surface runoff during construction could extend the active zone (via fractures) to much greater depths within the marl/shale. This would activate these highly expansive materials and result in expansion pressures on the foundation elements that could create distress on the structural systems of the facilities. ***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 structures.

(9) Mechanical Connections. All exterior mechanical connections shall be of the flexible type. Flexible connections shall be capable of resisting a minimum of 1 inch 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 1 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 footprint. 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 marl/shale materials within the building footprint.

(10) Backfill Adjacent to Exterior Grade Beam Excavation. Use ***Select Clay backfill*** adjacent to exterior grade beam excavation to minimize water penetration to expansive subsoils.

(11) 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 shall 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 the above material definitions, subgrade preparation procedures, and material testing requirements.

b. Pavement Design Recommendations and Requirements. The pavement sections presented below are based on criteria contained in *UFC 3-250-01FA*, *UFC 3-250-09FA*, *UFC 3-250-18FA*, and engineering judgment. The Design-Build Contractor is responsible for developing the final pavement designs for any new pavement structures (or pavement repairs/reconstructions due to impacts of their construction activities) which may be required under their contract. The Design-Build Contractor shall use the subsurface conditions and laboratory and in situ testing data provided in this report, as well as any supplemental subsurface investigations and testing performed by them or their associates, 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) Aggregate-Surfaced Pavements. The following pavement sections are recommended for parking areas and range service roads for light- to medium-duty and medium- to heavy-duty pneumatic tire vehicles. The aggregate-surfaced pavement designs consider a CBR value of 4 for the raw subgrade when compacted to 90 percent of maximum laboratory.

(a) Parking Areas and Range Service Roads for Medium- to Heavy-Duty Pneumatic Tire Vehicles. The design is based on Category IVA Traffic making no more than 25 passes per hour (Class F Street and a Design Index = 4, per UFC 3-250-09FA).

6” Aggregate-Surface Course compacted to at least 100 percent of maximum laboratory density (ASTM D 1557)

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) Parking Areas and Range Service Roads for Light- to Medium-Duty Duty Pneumatic Tire Vehicles. The design is based on Category II Traffic making at least 25 passes per hour but less than 250 passes per hour (Class E Street and a Design Index = 2, per UFC 3-250-09FA). Any pavement structures which may be subjected to heavier than Category II Traffic loading shall utilize the minimum pavement section (or more robust) provided in Paragraph 6.b.(1)(a), above.

4” Aggregate-Surface Course compacted to at least 100 percent of maximum laboratory density (ASTM D 1557)

4” 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)

The following notes should be incorporated as part of the pavement details shown on the construction drawings.

1. "The moisture content shall be at least 1 percent above optimum during compaction of the raw subgrade."

2. "A minimum 4-inch layer of Aggregate Base Course shall be provided below rigid pavement sections when limestone is exposed at the surface."

(2) Pavement Material Definitions.

(a) Aggregate Surface Courses. The material shall conform to the following requirements. The table below shows the permissible gradations for granular material used in aggregate surface roads. Gradation requirements specified below shall apply to the completed aggregate surface. Aggregate gradation shall be made in conformance with ***ASTM C 117***, ***ASTM C 136***, and ***ASTM D 422***. Sieves shall conform to ***ASTM E 11***. It shall be the responsibility of the Contractor to obtain materials that will meet the gradation requirements after mixing, placing, compacting, and other operations.

Sieve Designation	No. 1	No. 2
1 in.	100	100
3/8 in.	50-85	60-100
No. 4	35-65	50-85
No. 10	25-50	40-70
No. 40	15-30	24-45
No. 200	8-15	8-15

The portion of the completed aggregate surface course passing the No. 40 sieve shall have a maximum liquid limit of 35 and a plasticity index of 4 to 9 (***ASTM D 4318***). Sampling for material gradation, liquid limit, and plastic limit tests shall be taken in conformance with ***ASTM D 75***. When deemed necessary, the sampling will be observed by the Contracting Officer.

The material retained on the No. 4 sieve shall be known as coarse aggregate. Coarse aggregates shall be reasonably uniform in density and quality. The coarse aggregate shall have a percentage of wear not to exceed 50 percent after 500 revolutions as determined by ***ASTM C 131***. The amount of flat and/or elongated particles shall not exceed 20 percent. A flat particle is one having a ratio of width to thickness greater than three; an elongated particle is one having a ratio of length to width greater than three. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the requirements set forth herein. The material passing the No. 4 sieve shall be known as fine aggregate. Fine aggregate shall consist of screenings, sand, soil, or other finely divided mineral matter that is processed or naturally combined with the coarse aggregate.

The aggregate material shall be placed on the underlying course in layers of uniform thickness. When a compacted layer of 6 inches or less is specified, the material may be placed in a single layer; when a compacted thickness of more than 6 inches is required, no layer shall exceed 6 inches nor be less than 3 inches when compacted.

(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 shall 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 surface course, and aggregate base course 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, aggregate surface course, and aggregate base course shall be performed, at a minimum, every 500 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, aggregate surface course, and aggregate base course.

- Before starting work, at least one sample of aggregate surface course and 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 5,000 square yards of aggregate surface course and 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 for every 5,000 square yards of aggregate surface and base course material. A minimum of one test per aggregate surface course and aggregate base course material source shall be run.

- Thickness of the aggregate surface course and aggregate base course shall be measured for each 600 square yards of material placed. Compacted thickness of the aggregate surface course and aggregate base course shall be as presented in this report and the completed section shall be within 3/8-inch of the thickness presented.

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.

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 IS NOT PERMITTED TO UTILIZE FINAL FOUNDATION AND PAVEMENT DESIGNS THAT ARE LESS RIGOROUS AND STRINGENT THAN THE MINIMUM DESIGNS SPECIFIED HEREIN (I.E., THAT DO NOT MEET OR EXCEED THE MINIMUM REQUIREMENTS SPECIFIED HEREIN). IF THE DESIGN-BUILD CONTRACTOR'S ADDITIONAL SOILS INVESTIGATIONS AND LABORATORY TESTING PROGRAM (IF PERFORMED), AND ENGINEERING ANALYSES SHOW THAT A MORE STRINGENT AND RIGOROUS DESIGN IS REQUIRED ABOVE THE MINIMUM FOUNDATION AND PAVEMENT DESIGN REQUIREMENTS SPECIFIED HEREIN, IT IS THE RESPONSIBILITY OF THE DESIGN-BUILD CONTRACTOR TO ENSURE THEIR FINAL DESIGNS MEET THE MORE STRINGENT REQUIREMENT.

(1) **Foundation System.** ***The foundation system used for the proposed project building structures shall be limited to a shallow foundation system consisting of either a monolithic reinforced concrete ribbed mat or flat mat slab. The selected foundation system(s) shall be designed and constructed 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. 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. ***Compaction of pavement course layers and natural subgrade below the surface course layer shall be in accordance with the modified Proctor method (ASTM D 1557).***

(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);

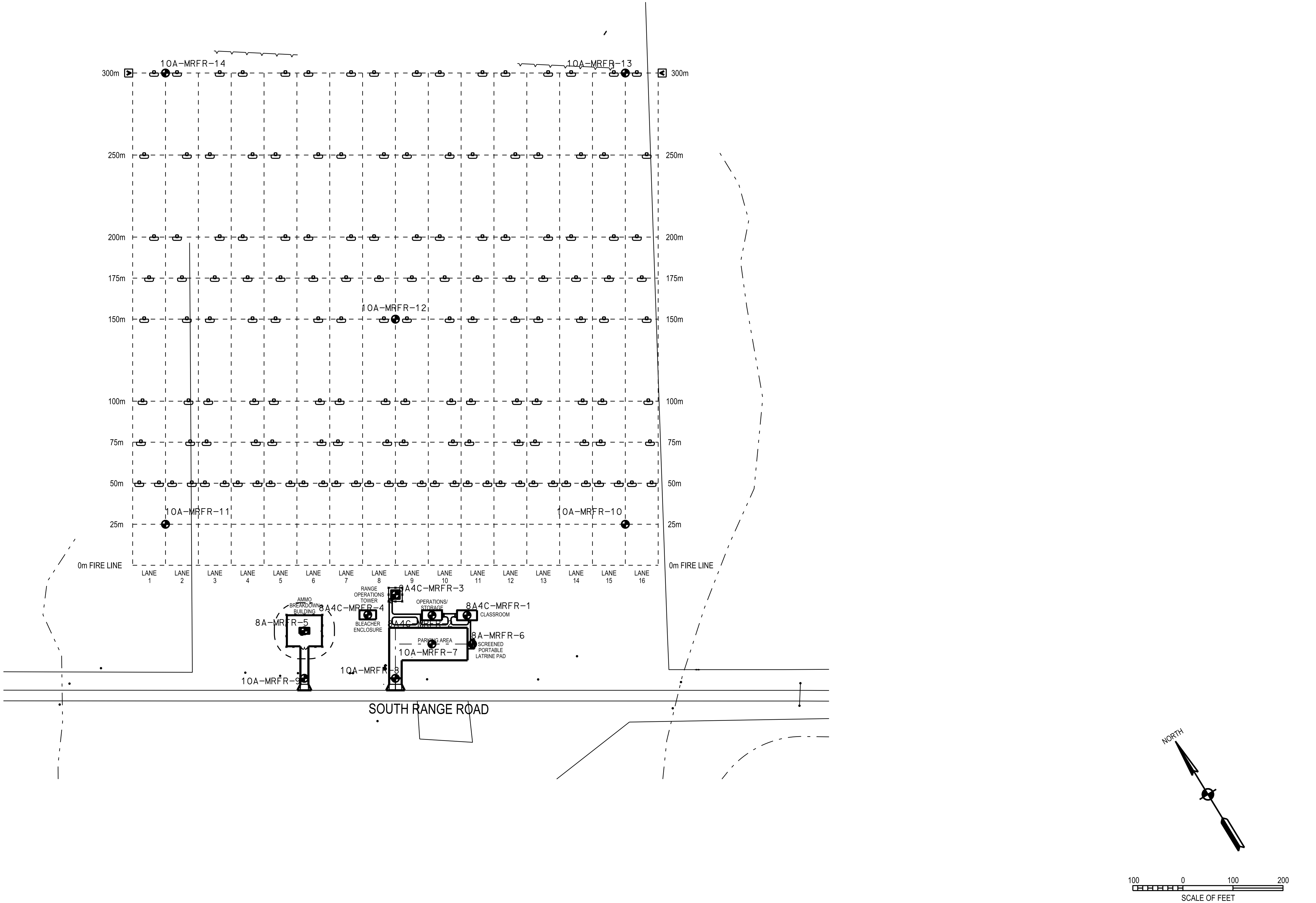
- Strength Tests Results versus Depth (Chart);
- Tabulation of Laboratory Test Results (to include Boring Number, Sample Number, Depth, Laboratory Classification, Visual Descriptions, Grain Size Analysis (%Gravel, %Sand, %Fines), LL, PL, PI, MC, Unit Weight, and Strength Test Data;
- Consolidation-Expansion Tests/Swell Pressure Tests (if applicable).

References:

- TEAM Consultants, Incorporated Report No. 112025
- 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 3-250-09FA – Aggregate Surfaced Roads and Airfield Areas
- UFC 3-250-18FA – General Provisions and Geometric Design For Roads, Streets, Walks, and Open Storage Areas
- 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
- Texas Department of Transportation - Standard Specifications For Construction of Highways, Streets and Bridges
- SWD-AEIM Architectural-Engineering Manual
- UFGS Guide Specifications For Construction

APPENDIX A

BORING LOCATIONS & LOGS OF BORINGS



NOTE: USE THIS SHEET FOR BORING LOCATIONS ONLY.

US Army Corps of Engineers
Fort Worth District

Designed by: JOSH PICKERING
Dwn by: JOSH PICKERING
Reviewed by: KEN McCLESKEY
Submitted by: KEN McCLESKEY, P.G. CHIEF, GEOTECHNICAL SECTION

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION ENGINEERING BRANCH

FORT HOOD, TEXAS
MODIFIED RECORD FIRE RANGE (FY13)
PN: 067020

BORING LOCATION PLAN

Sheet reference number:
B-101

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Section:

DRILLING LOG — Hole No. 8A4C-MRFR-1

DIVISION	SWD
INSTALLATION	Ft. Worth District
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft. Hood Modified Record Firing Range
2. LOCATION (Coordinates or Station)	See Figure 1
3. DRILLING AGENCY	Gedco Drilling
4. HOLE NO. (As shown on drawing title and file number)	8A4C-MRFR-1
5. NAME OF DRILLER	Eddie Garcia
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (ft)	10"
8. DEPTH DRILLED INTO ROCK (ft)	19' 2"
9. TOTAL DEPTH OF HOLE (ft)	20
10. SIZE AND TYPE OF BIT	4"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	Gardner Denver
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 4, UNDISTURBED 1
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER (ft)	N/A
16. DATE HOLE	STARTED 22-Mar-11, COMPLETED 22-Mar-11
17. ELEVATION TOP OF HOLE	N/A
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. GEOLOGIST	Brent Foshee

DEPTH (ft) a	LEGEND b	CLASSIFICATION OF MATERIALS (Description) c	BLOW COUNT d	% RECOVERY e	SAMPLE INTERVAL f	MOISTURE % g	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) h
0.8		CLAY (CL), Dark Brown, Damp, with organics and gravels			0.0 0.8		Sample 1 taken from 0-10"
		MARL, Chalky, Tan, with Fe stains and interbedded clay and limestone layers throughout			3.0 5.0		Sample 2 taken from 3-5'
					5.0 10.0		Core run from 5-10' REC: 70% RQD 37%
					10.0 15.0		Core run from 10-15' REC: 47% RQD 0%
17.0					15.0 20.0		Core run from 15-20' REC 88% RQD 33%
20.0		LIMESTONE, Gray, Hard, Moderately Weathered, Moderately Fractured, with abundant marine fossils					
		NOTES: 1. Groundwater was not encountered during drilling operations or at 24 hour reading. 2. Hole was backfilled with grout.					Groundwater was not encountered

ENG FORM 1836 MAR 71 REVISED JUNE 2008 | PROJECT Ft. Hood Modified Record Firing Range | HOLE NO. 8A4C-MRFR-1 | FIGURE

DRILLING LOG — Hole No. 8A4C-MRFR-2

DIVISION	SWD
INSTALLATION	Ft. Worth District
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft. Hood Modified Record Firing Range
2. LOCATION (Coordinates or Station)	See Figure 1
3. DRILLING AGENCY	Gedco Drilling
4. HOLE NO. (As shown on drawing title and file number)	8A4C-MRFR-2
5. NAME OF DRILLER	Eddie Garcia
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (ft)	8"
8. DEPTH DRILLED INTO ROCK (ft)	19' 4"
9. TOTAL DEPTH OF HOLE (ft)	20
10. SIZE AND TYPE OF BIT	4"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	Gardner Denver
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 6, UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER (ft)	N/A
16. DATE HOLE	STARTED 23-Mar-11, COMPLETED 23-Mar-11
17. ELEVATION TOP OF HOLE	N/A
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. GEOLOGIST	Brent Foshee

DEPTH (ft) a	LEGEND b	CLASSIFICATION OF MATERIALS (Description) c	BLOW COUNT d	% RECOVERY e	SAMPLE INTERVAL f	MOISTURE % g	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) h
0.7		CLAY (CL), Dark Brown, Damp, with organics and gravels			0.0 0.7		Sample 1 taken from 0-8" Sample 2 taken from 8"-5'
		MARL, Chalky, Tan, with Fe stains and interbedded clay and limestone layers throughout			0.7 5.0		
			67		3.5 5.0		SPT from 3.5-5'
					5.0 10.0		Core run from 5-10' REC: 90% RQD 30%
					10.0 15.0		Core run from 10-15' REC: 95% RQD 80%
16.7					15.0 20.0		Core run from 15-20' REC: 97% RQD 68%
20.0		LIMESTONE, Gray, Hard, Moderately Weathered, Moderately Fractured, with abundant marine fossils					
		NOTES: 1. Groundwater was not encountered during drilling operations or at 24 hour reading. 2. Hole was backfilled with grout.					Groundwater was not encountered

ENG FORM 1836 MAR 71 REVISED JUNE 2008 | PROJECT Ft. Hood Modified Record Firing Range | HOLE NO. 8A4C-MRFR-2 | FIGURE

DRILLING LOG — Hole No. 8A4C-MRFR-3

DIVISION	SWD
INSTALLATION	Ft. Worth District
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft. Hood Modified Record Firing Range
2. LOCATION (Coordinates or Station)	See Figure 1
3. DRILLING AGENCY	Gedco Drilling
4. HOLE NO. (As shown on drawing title and file number)	8A4C-MRFR-3
5. NAME OF DRILLER	Eddie Garcia
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (ft)	3"
8. DEPTH DRILLED INTO ROCK (ft)	34' 9"
9. TOTAL DEPTH OF HOLE (ft)	35
10. SIZE AND TYPE OF BIT	4"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	Gardner Denver
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 10, UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER (ft)	N/A
16. DATE HOLE	STARTED 21-Mar-11, COMPLETED 22-Mar-11
17. ELEVATION TOP OF HOLE	N/A
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. GEOLOGIST	Brent Foshee

DEPTH (ft) a	LEGEND b	CLASSIFICATION OF MATERIALS (Description) c	BLOW COUNT d	% RECOVERY e	SAMPLE INTERVAL f	MOISTURE % g	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) h
0.3		FILL, Base			0.0 5.0		Sample 1 taken from 0-5'
		MARL, Chalky, Tan, with Fe stains and interbedded clay and limestone layers throughout	ref/5"		3.5 5.0		
					7.0 10.0		Sample 2 taken from 7-10'
			75/10.5"		8.5 10.0		
12.0					10.0 12.0		Sample 3 taken from 10-12'
		LIMESTONE with Shale Layers, Gray, Hard, Moderately Weathered, Moderately Fractured, with abundant marine fossils			12.0 15.0		Core run from 12-15 REC: 83% RQD: 69%
					15.0 20.0		Core run from 15-20 REC: 93% RQD: 67%
					20.0 25.0		Core run from 20-25 REC: 100% RQD: 70%
30.0					25.0 30.0		Core run from 25-30 REC: 100% RQD: 65%
35.0		LIMESTONE, Gray, Hard, Fresh, Unfractured, with abundant marine fossils			30.0 35.0		Core run from 30-35 REC: 96% RQD: 88%
		NOTES: 1. Groundwater was not encountered during drilling operations or at 24 hour reading. 2. Hole was backfilled with grout.					Groundwater was not encountered

ENG FORM 1836 MAR 71 REVISED JUNE 2008 | PROJECT Ft. Hood Modified Record Firing Range | HOLE NO. 8A4C-MRFR-3 | FIGURE

DRILLING LOG — Hole No. 8A4C-MRFR-4

DIVISION	SWD
INSTALLATION	Ft. Worth District
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft. Hood Modified Record Firing Range
2. LOCATION (Coordinates or Station)	See Figure 1
3. DRILLING AGENCY	Gedco Drilling
4. HOLE NO. (As shown on drawing title and file number)	8A4C-MRFR-4
5. NAME OF DRILLER	Eddie Garcia
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (ft)	1'
8. DEPTH DRILLED INTO ROCK (ft)	19'
9. TOTAL DEPTH OF HOLE (ft)	20
10. SIZE AND TYPE OF BIT	4"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	Gardner Denver
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 5, UNDISTURBED 1
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER (ft)	N/A
16. DATE HOLE	STARTED 23-Mar-11, COMPLETED 23-Mar-11
17. ELEVATION TOP OF HOLE	N/A
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. GEOLOGIST	Brent Foshee

DEPTH (ft) a	LEGEND b	CLASSIFICATION OF MATERIALS (Description) c	BLOW COUNT d	% RECOVERY e	SAMPLE INTERVAL f	MOISTURE % g	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) h
0.1		CLAY (CL), Dark Brown, Damp, with organics and gravels			0.0 0.1		Sample 1 taken from 0-1" Sample 2 taken from 1"-5'
		MARL, Chalky, Tan, with Fe stains and interbedded clay and limestone layers throughout			0.1 5.0		
			50/4.5"		3.5 5.0		SPT taken at 3.5-5'
					6.0 8.0		Shelby Tube from 6-8'
					10.0 15.0		Core run from 10-15' REC: 93% RQD 52%
17.5					15.0 20.0		Core run from 15-20' REC: 88% RQD 52%
20.0		LIMESTONE, Gray, Hard, Moderately Weathered, Moderately Fractured, with abundant marine fossils					
		NOTES: 1. Groundwater was not encountered during drilling operations or at 24 hour reading. 2. Hole was backfilled with grout.					Groundwater was not encountered during drilling

ENG FORM 1836 MAR 71 REVISED JUNE 2008 | PROJECT Ft. Hood Modified Record Firing Range | HOLE NO. 8A4C-MRFR-4 | FIGURE

DRILLING LOG — Hole No. 8A4C-MRFR-5

DIVISION	SWD
INSTALLATION	Ft. Worth District
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft. Hood Modified Record Firing Range
2. LOCATION (Coordinates or Station)	See Figure 1
3. DRILLING AGENCY	Gedco Drilling
4. HOLE NO. (As shown on drawing title and file number)	8A4C-MRFR-5
5. NAME OF DRILLER	Eddie Garcia
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (ft)	4"
8. DEPTH DRILLED INTO ROCK (ft)	9' 8"
9. TOTAL DEPTH OF HOLE (ft)	10
10. SIZE AND TYPE OF BIT	4"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	Gardner Denver
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 5, UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER (ft)	N/A
16. DATE HOLE	STARTED 22-Mar-11, COMPLETED 22-Mar-11
17. ELEVATION TOP OF HOLE	N/A
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. GEOLOGIST	Brent Foshee

DEPTH (ft) a	LEGEND b	CLASSIFICATION OF MATERIALS (Description) c	BLOW COUNT d	% RECOVERY e	SAMPLE INTERVAL f	MOISTURE % g	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) h
0.3		CLAY (CL), Dark Brown, Damp, with organics and gravels			0.0 0.3		
		MARL, Chalky, Tan, with Fe stains and interbedded clay and limestone layers throughout			0.3 3.5		
4.0		Limestone Layer	ref/5"		3.5 5.0		
6.7		Limestone Layer			6.0 8.5		
8.3		Limestone Layer	52		8.5 10.0		
10.0							
		NOTES: 1. Groundwater was not encountered during drilling operations or at 24 hour reading. 2. Hole was backfilled with grout.					

ENG FORM 1836 MAR 71 REVISED JUNE 2008 | PROJECT Ft. Hood Modified Record Firing Range | HOLE NO. 8A4C-MRFR-5 | FIGURE

DRILLING LOG — Hole No. 8A4C-MRFR-6

DIVISION	SWD
INSTALLATION	Ft. Worth District
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft. Hood Modified Record Firing Range
2. LOCATION (Coordinates or Station)	See Figure 1
3. DRILLING AGENCY	Gedco Drilling
4. HOLE NO. (As shown on drawing title and file number)	8A4C-MRFR-6
5. NAME OF DRILLER	Eddie Garcia
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (ft)	1'
8. DEPTH DRILLED INTO ROCK (ft)	9'
9. TOTAL DEPTH OF HOLE (ft)	10
10. SIZE AND TYPE OF BIT	4"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	Gardner Denver
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 4, UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER (ft)	N/A
16. DATE HOLE	STARTED 22-Mar-11, COMPLETED 22-Mar-11
17. ELEVATION TOP OF HOLE	N/A
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. GEOLOGIST	Brent Foshee

DEPTH (ft) a	LEGEND b	CLASSIFICATION OF MATERIALS (Description) c	BLOW COUNT d	% RECOVERY e	SAMPLE INTERVAL f	MOISTURE % g	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) h
1.0		CLAY, Dark Brown, Damp, with organics and gravels					
		MARL, Chalky, Tan, with Fe stains and interbedded clay and limestone layers throughout			1.0 3.5		
			50		3.5 5.0		
					5.0 8.5		
10.0			27		8.5 10.0		
		NOTES: 1. Groundwater was not encountered during drilling operations or at 24 hour reading. 2. Hole was backfilled with grout.					

ENG FORM 1836 MAR 71 REVISED JUNE 2008 | PROJECT Ft. Hood Modified Record Firing Range | HOLE NO. 8A4C-MRFR-6 | FIGURE

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: JOSH PICKERING	Date:	Rev.	
Dwn by: JOSH PICKERING	Sol No.		
Reviewed by: KEN McCLESKEY	Contr No.		
Submitted by: KEN McCLESKEY, P.G. CHIEF, GEOTECHNICAL SECTION	File name: FH_MRFR-B201.dgn Plot date: 9/28/2011 Plot scale:		

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION ENGINEERING BRANCH

FORT HOOD, TEXAS
MODIFIED RECORD FIRE RANGE (FY13)
PN: 067020
LOGS OF BORINGS - 1 OF 3

Sheet reference number: B-201

Contr No.

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Section:

DRILLING LOG — Hole No. 10A-MRFR-7

Field	Entry
DIVISION	SWD
INSTALLATION	Ft. Worth District
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft. Hood Modified Record Firing Range
2. LOCATION (Coordinates or Station)	See Figure 1
3. DRILLING AGENCY	Gedco Drilling
4. HOLE NO. (As shown on drawing title and file number)	10A-MRFR-7
5. NAME OF DRILLER	Eddie Garcia
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (ft)	8"
8. DEPTH DRILLED INTO ROCK (ft)	9' 4"
9. TOTAL DEPTH OF HOLE (ft)	10
10. SIZE AND TYPE OF BIT	4"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	Gardner Denver
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 4 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER (ft)	N/A
16. DATE HOLE	STARTED 22-Mar-11 / COMPLETED 22-Mar-11
17. ELEVATION TOP OF HOLE	N/A
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. GEOLOGIST	Brent Foshee

DEPTH (ft) a	LEGEND b	CLASSIFICATION OF MATERIALS (Description) c	BLOW COUNT d	% RECOVERY e	SAMPLE INTERVAL f	MOISTURE % g	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) h
0.7		CLAY, Dark Brown, Damp, with organics and gravels			0.0 0.7		
		MARL, Chalky, Tan, with Fe stains and interbedded clay and limestone layers throughout	54		3.5 5.0		
					5.0 8.5		
10.0		Limestone Layer	ref/50/1"		8.5 10.0		

NOTES:
1. Groundwater was not encountered during drilling operations or at 24 hour reading.
2. Hole was backfilled with grout.

ENG FORM 1836 MAR 71 REVISED JUNE 2008 | PROJECT Ft. Hood Modified Record Firing Range | HOLE NO 10A-MRFR-7 | FIGURE

DRILLING LOG — Hole No. 10A-MRFR-8

Field	Entry
DIVISION	SWD
INSTALLATION	Ft. Worth District
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft. Hood Modified Record Firing Range
2. LOCATION (Coordinates or Station)	See Figure 1
3. DRILLING AGENCY	Gedco Drilling
4. HOLE NO. (As shown on drawing title and file number)	10A-MRFR-8
5. NAME OF DRILLER	Eddie Garcia
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (ft)	10"
8. DEPTH DRILLED INTO ROCK (ft)	9' 2"
9. TOTAL DEPTH OF HOLE (ft)	10
10. SIZE AND TYPE OF BIT	4"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	Gardner Denver
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 4 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER (ft)	N/A
16. DATE HOLE	STARTED 22-Mar-11 / COMPLETED 22-Mar-11
17. ELEVATION TOP OF HOLE	N/A
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. GEOLOGIST	Brent Foshee

DEPTH (ft) a	LEGEND b	CLASSIFICATION OF MATERIALS (Description) c	BLOW COUNT d	% RECOVERY e	SAMPLE INTERVAL f	MOISTURE % g	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) h
0.8		CLAY, Dark Brown, Damp, with organics and gravels			0.0 3.5		
		MARL, Chalky, Tan, with Fe stains and interbedded clay and limestone layers throughout	68		3.5 5.0		
					6.0 8.5		
7.3		Limestone Layer					
10.0			35		8.5 10.0		

NOTES:
1. Groundwater was not encountered during drilling operations or at 24 hour reading.
2. Hole was backfilled with grout.

ENG FORM 1836 MAR 71 REVISED JUNE 2008 | PROJECT Ft. Hood Modified Record Firing Range | HOLE NO 10A-MRFR-8 | FIGURE

DRILLING LOG — Hole No. 10A-MRFR-9

Field	Entry
DIVISION	SWD
INSTALLATION	Ft. Worth District
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft. Hood Modified Record Firing Range
2. LOCATION (Coordinates or Station)	See Figure 1
3. DRILLING AGENCY	Gedco Drilling
4. HOLE NO. (As shown on drawing title and file number)	10A-MRFR-9
5. NAME OF DRILLER	Eddie Garcia
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (ft)	4"
8. DEPTH DRILLED INTO ROCK (ft)	9' 8"
9. TOTAL DEPTH OF HOLE (ft)	10
10. SIZE AND TYPE OF BIT	4"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	Gardner Denver
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 5 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER (ft)	N/A
16. DATE HOLE	STARTED 22-Mar-11 / COMPLETED 22-Mar-11
17. ELEVATION TOP OF HOLE	N/A
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. GEOLOGIST	Brent Foshee

DEPTH (ft) a	LEGEND b	CLASSIFICATION OF MATERIALS (Description) c	BLOW COUNT d	% RECOVERY e	SAMPLE INTERVAL f	MOISTURE % g	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) h
0.3		CLAY, Dark Brown, Damp, with organics and gravels			0.0 0.3		
		MARL, Chalky, Tan, with Fe stains and interbedded clay and limestone layers throughout			0.3 3.5		
			56		3.5 5.0		
					5.0 8.5		
7.8		Limestone Layer					
9.8			68/9"		8.5 10.0		
10.0		Limestone Layer					

NOTES:
1. Groundwater was not encountered during drilling operations or at 24 hour reading.
2. Hole was backfilled with grout.

ENG FORM 1836 MAR 71 REVISED JUNE 2008 | PROJECT Ft. Hood Modified Record Firing Range | HOLE NO 10A-MRFR-9 | FIGURE

DRILLING LOG — Hole No. 10A-MRFR-10

Field	Entry
DIVISION	SWD
INSTALLATION	Ft. Worth District
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft. Hood Modified Record Firing Range
2. LOCATION (Coordinates or Station)	See Figure 1
3. DRILLING AGENCY	Gedco Drilling
4. HOLE NO. (As shown on drawing title and file number)	10A-MRFR-10
5. NAME OF DRILLER	Eddie Garcia
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (ft)	6"
8. DEPTH DRILLED INTO ROCK (ft)	9'6"
9. TOTAL DEPTH OF HOLE (ft)	10
10. SIZE AND TYPE OF BIT	4"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	Gardner Denver
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 5 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER (ft)	N/A
16. DATE HOLE	STARTED 21-Mar-11 / COMPLETED 21-Mar-11
17. ELEVATION TOP OF HOLE	N/A
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. GEOLOGIST	Brent Foshee

DEPTH (ft) a	LEGEND b	CLASSIFICATION OF MATERIALS (Description) c	BLOW COUNT d	% RECOVERY e	SAMPLE INTERVAL f	MOISTURE % g	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) h
0.5		CLAY (CH), Dark Brown, Damp, with organics and gravels			0.0 0.5		
		MARL, Chalky, Tan, with Fe stains and interbedded clay and limestone layers throughout			0.5 3.5		
			88/9.75"		3.5 5.0		
					5.0 8.5		
		Limestone Layer					
10.0			ref/6"		8.5 10.0		

NOTES:
1. Groundwater was not encountered during drilling operations or at 24 hour reading.
2. Hole was backfilled with grout.

ENG FORM 1836 MAR 71 REVISED JUNE 2008 | PROJECT Ft. Hood Modified Record Firing Range | HOLE NO 10A-MRFR-10 | FIGURE

DRILLING LOG — Hole No. 10A-MRFR-11

Field	Entry
DIVISION	SWD
INSTALLATION	Ft. Worth District
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft. Hood Modified Record Firing Range
2. LOCATION (Coordinates or Station)	See Figure 1
3. DRILLING AGENCY	Gedco Drilling
4. HOLE NO. (As shown on drawing title and file number)	10A-MRFR-11
5. NAME OF DRILLER	Eddie Garcia
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (ft)	2' 6"
8. DEPTH DRILLED INTO ROCK (ft)	7' 6"
9. TOTAL DEPTH OF HOLE (ft)	10
10. SIZE AND TYPE OF BIT	4"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	Gardner Denver
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 5 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER (ft)	N/A
16. DATE HOLE	STARTED 21-Mar-11 / COMPLETED 21-Mar-11
17. ELEVATION TOP OF HOLE	N/A
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. GEOLOGIST	Brent Foshee

DEPTH (ft) a	LEGEND b	CLASSIFICATION OF MATERIALS (Description) c	BLOW COUNT d	% RECOVERY e	SAMPLE INTERVAL f	MOISTURE % g	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) h
0.0		CLAY (CH), Dark Brown, Damp, with organics and gravels			0.0 2.5		
2.5		MARL, Chalky, Tan, with Fe stains and interbedded clay and limestone layers throughout			2.5 3.5		
			64		3.5 5.0		
					5.0 8.5		
10.0			50/2.5"		8.5 10.0		

NOTES:
1. Groundwater was not encountered during drilling operations or at 24 hour reading.
2. Hole was backfilled with grout.

ENG FORM 1836 MAR 71 REVISED JUNE 2008 | PROJECT Ft. Hood Modified Record Firing Range | HOLE NO 10A-MRFR-11 | FIGURE

DRILLING LOG — Hole No. 10A-MRFR-12

Field	Entry
DIVISION	SWD
INSTALLATION	Ft. Worth District
SHEET	1 OF 1 SHEETS
1. PROJECT	Ft. Hood Modified Record Firing Range
2. LOCATION (Coordinates or Station)	See Figure 1
3. DRILLING AGENCY	Gedco Drilling
4. HOLE NO. (As shown on drawing title and file number)	10A-MRFR-12
5. NAME OF DRILLER	Eddie Garcia
6. DIRECTION OF HOLE	☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN (ft)	4' 6"
8. DEPTH DRILLED INTO ROCK (ft)	5' 6"
9. TOTAL DEPTH OF HOLE (ft)	10
10. SIZE AND TYPE OF BIT	4"
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURER'S DESIGNATION OF DRILL	Gardner Denver
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 4 / UNDISTURBED 0
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER (ft)	N/A
16. DATE HOLE	STARTED 21-Mar-11 / COMPLETED 21-Mar-11
17. ELEVATION TOP OF HOLE	N/A
18. TOTAL CORE RECOVERY FOR BORING	N/A %
19. GEOLOGIST	Brent Foshee

DEPTH (ft) a	LEGEND b	CLASSIFICATION OF MATERIALS (Description) c	BLOW COUNT d	% RECOVERY e	SAMPLE INTERVAL f	MOISTURE % g	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) h
0.0		CLAY (CH), Dark Brown, Damp, with organics and gravels			0.0 3.5		
			76		3.5 5.0		
4.5		MARL, Chalky, Tan, with Fe stains and interbedded clay and limestone layers throughout			5.0 8.5		
8.8		Limestone Layer	ref/2.5"		8.5 10.0		
10.0							

NOTES:
1. Groundwater was not encountered during drilling operations or at 24 hour reading.
2. Hole was backfilled with grout.

ENG FORM 1836 MAR 71 REVISED JUNE 2008 | PROJECT Ft. Hood Modified Record Firing Range | HOLE NO 10A-MRFR-12 | FIGURE

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: JOSH PICKERING	Date:	Rev.
Dwn by: JOSH PICKERING	Sol No.	
Reviewed by: KEN McCLESKEY	Contr No.	
Submitted by: KEN McCLESKEY, P.G. CHIEF, GEOTECHNICAL SECTION	File name: FH_MRFR-B202.dgn Plot date: 9/28/2011 Plot scale:	

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION ENGINEERING BRANCH

FORT HOOD, TEXAS
MODIFIED RECORD FIRE RANGE (FY13)
PN: 067020
LOGS OF BORINGS - 2 OF 3

Sheet reference number: B-202

Contr No.

REFERENCE FILES:
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K:\GEOTECHNICAL SECTION\McClesky_K\Military Jobs\FDAs - Backup Copy\F & P DAs\Army\Fort Hood\MRFR (FY13)\CADD\FH_MRFR-G-bs.DGN

FH_MRFR-B203.dgn 9/28/2011 6:01:39 PM

Hole No. 10A-MRFR-13

DRILLING LOG	DIVISION SWD	INSTALLATION Ft. Worth District	SHEET 1 OF 1 SHEETS
1. PROJECT Ft. Hood Modified Record Firing Range		10. SIZE AND TYPE OF BIT 4"	
2. LOCATION (Coordinates or Station) See Figure 1		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY Gedco Drilling		12. MANUFACTURER'S DESIGNATION OF DRILL Gardner Denver	
4. HOLE NO. (As shown on drawing title and file number)	10A-MRFR-13	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 4 / UNDISTURBED 0
5. NAME OF DRILLER Eddie Garcia		14. TOTAL NUMBER CORE BOXES	N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.		15. ELEVATION GROUND WATER (ft)	N/A
		16. DATE HOLE	STARTED 21-Mar-11 / COMPLETED 21-Mar-11
7. THICKNESS OF OVERBURDEN (ft)	3'	17. ELEVATION TOP OF HOLE	N/A
8. DEPTH DRILLED INTO ROCK (ft)	7'	18. TOTAL CORE RECOVERY FOR BORING	N/A %
9. TOTAL DEPTH OF HOLE (ft)	10	19. GEOLOGIST	Brent Foshee

DEPTH (ft) a	LEGEND b	CLASSIFICATION OF MATERIALS (Description) c	BLOW COUNT d	% RECOVERY e	SAMPLE INTERVAL f	MOISTURE % g	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) h
0.0 – 3.0		CLAY (CH), Dark Brown, Damp, with organics and gravels			0.0 3.5		
3.0 – 10.0		MARL, Chalky, Tan, with Fe stains and interbedded clay and limestone layers throughout	50/4"		3.5 5.0		
					5.0 8.5		
			ref/4"		8.5 10.0		

NOTES:
1. Groundwater was not encountered during drilling operations or at 24 hour reading.
2. Hole was backfilled with grout.

ENG FORM 1836 MAR 71 REVISED JUNE 2008 | PROJECT Ft. Hood Modified Record Firing Range | HOLE NO. 10A-MRFR-13 | FIGURE

Hole No. 10A-MRFR-14

DRILLING LOG	DIVISION SWD	INSTALLATION Ft. Worth District	SHEET 1 OF 1 SHEETS
1. PROJECT Ft. Hood Modified Record Firing Range		10. SIZE AND TYPE OF BIT 4"	
2. LOCATION (Coordinates or Station) See Figure 1		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL	
3. DRILLING AGENCY Gedco Drilling		12. MANUFACTURER'S DESIGNATION OF DRILL Gardner Denver	
4. HOLE NO. (As shown on drawing title and file number)	10A-MRFR-14	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	DISTURBED 4 / UNDISTURBED 0
5. NAME OF DRILLER Eddie Garcia		14. TOTAL NUMBER CORE BOXES	N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED --- DEG. FROM VERT.		15. ELEVATION GROUND WATER (ft)	N/A
		16. DATE HOLE	STARTED 21-Mar-11 / COMPLETED 21-Mar-11
7. THICKNESS OF OVERBURDEN (ft)	5'	17. ELEVATION TOP OF HOLE	N/A
8. DEPTH DRILLED INTO ROCK (ft)	5'	18. TOTAL CORE RECOVERY FOR BORING	N/A %
9. TOTAL DEPTH OF HOLE (ft)	10	19. GEOLOGIST	Brent Foshee

DEPTH (ft) a	LEGEND b	CLASSIFICATION OF MATERIALS (Description) c	BLOW COUNT d	% RECOVERY e	SAMPLE INTERVAL f	MOISTURE % g	REMARKS (Drilling time, water loss, depth weathering, etc., if significant) h
0.0 – 5.0		CLAY (CH), Reddish Brown, Damp, with organics and gravels			0.0 3.5		
			25		3.5 5.0		
5.0 – 10.0		MARL, Chalky, Tan, with Fe stains and interbedded clay and limestone layers throughout			5.0 8.5		
			6		8.5 10.0		

NOTES:
1. Groundwater was not encountered during drilling operations or at 24 hour reading.
2. Hole was backfilled with grout.

ENG FORM 1836 MAR 71 REVISED JUNE 2008 | PROJECT Ft. Hood Modified Record Firing Range | HOLE NO. 10A-MRFR-14 | FIGURE

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: JOSH PICKERING | Date: | Rev.
Dwn by: JOSH PICKERING | Sol No.
Reviewed by: KEN McCLESKEY | Contr No.
Submitted by: KEN McCLESKEY, P.G. CHIEF, GEOTECHNICAL SECTION | File name: FH_MRFR-B203.dgn Plot date: 9/28/2011 Plot scale:

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION ENGINEERING BRANCH

FORT HOOD, TEXAS
MODIFIED RECORD FIRE RANGE (FY13)
PN: 067020

LOGS OF BORINGS - 3 OF 3

Sheet reference number:

B-203

APPENDIX B

LABORATORY TESTING DATA PLOTS

MODIFIED RECORD FIRE RANGE (FY13)
PLASTICITY CHART

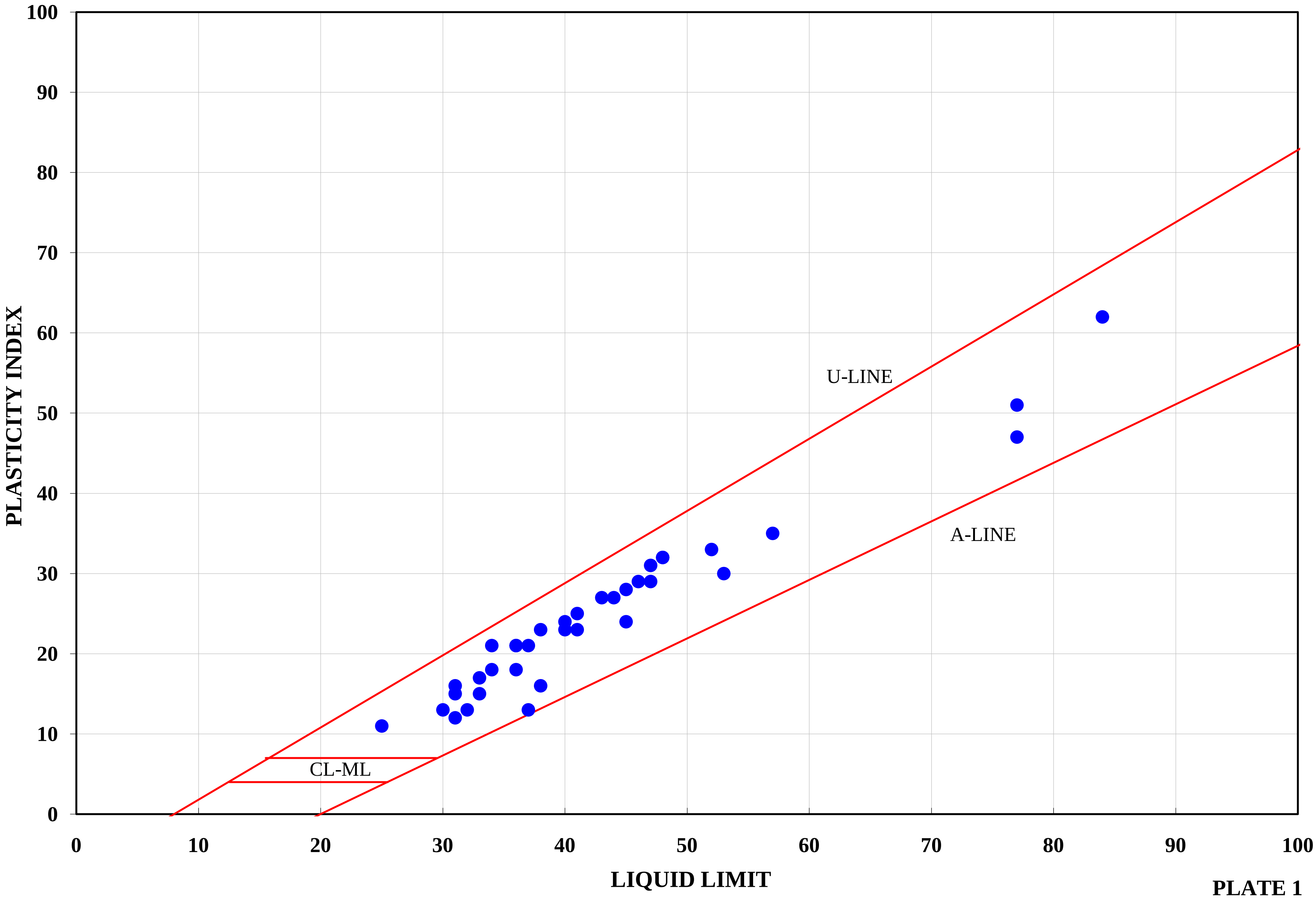


PLATE 1

MODIFIED RECORD FIRE RANGE (FY13)
MOISTURE CONTENT VS DEPTH

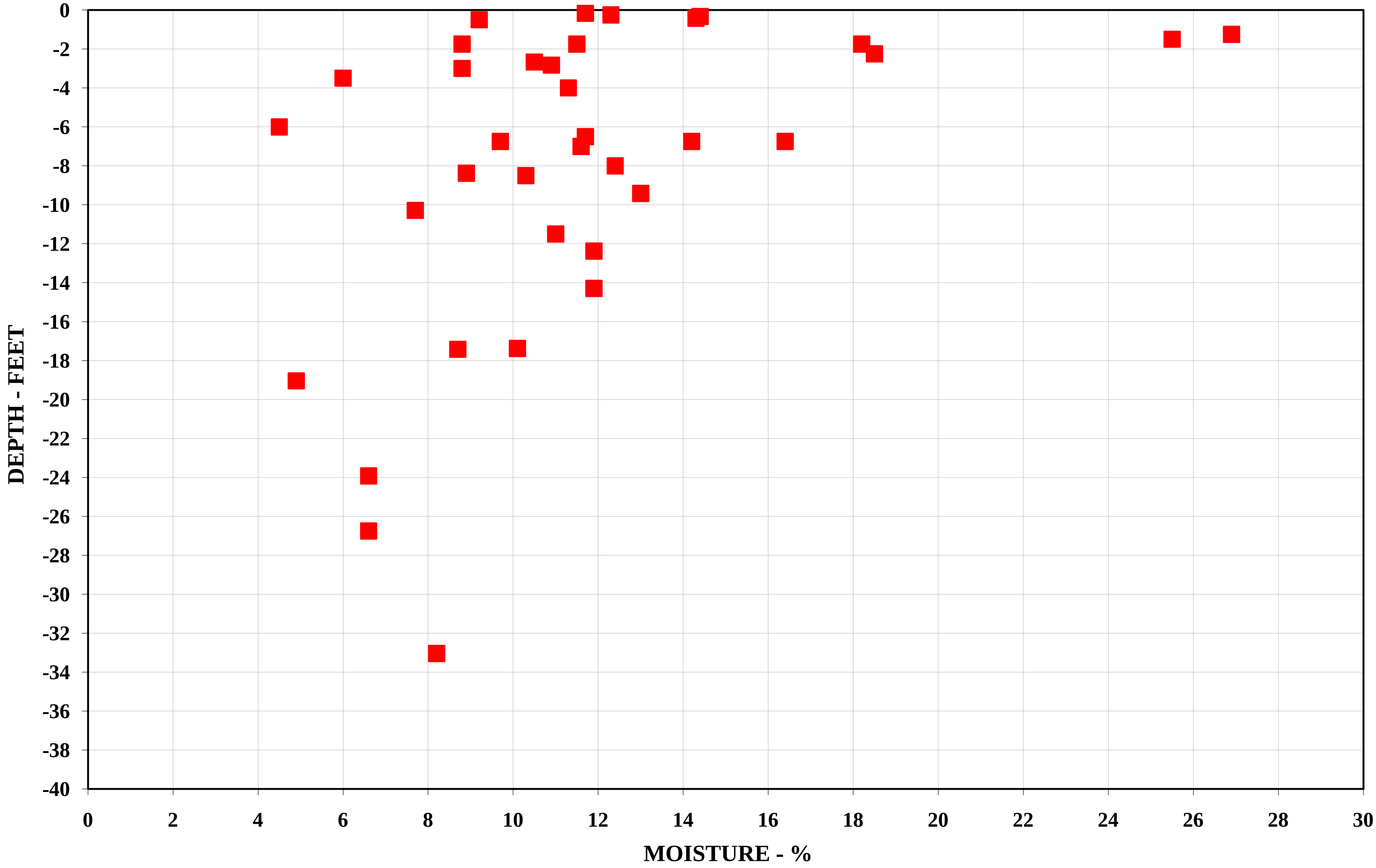


PLATE 2

MODIFIED RECORD FIRE RANGE (FY13)
ATTERBERG LIMITS VS DEPTH

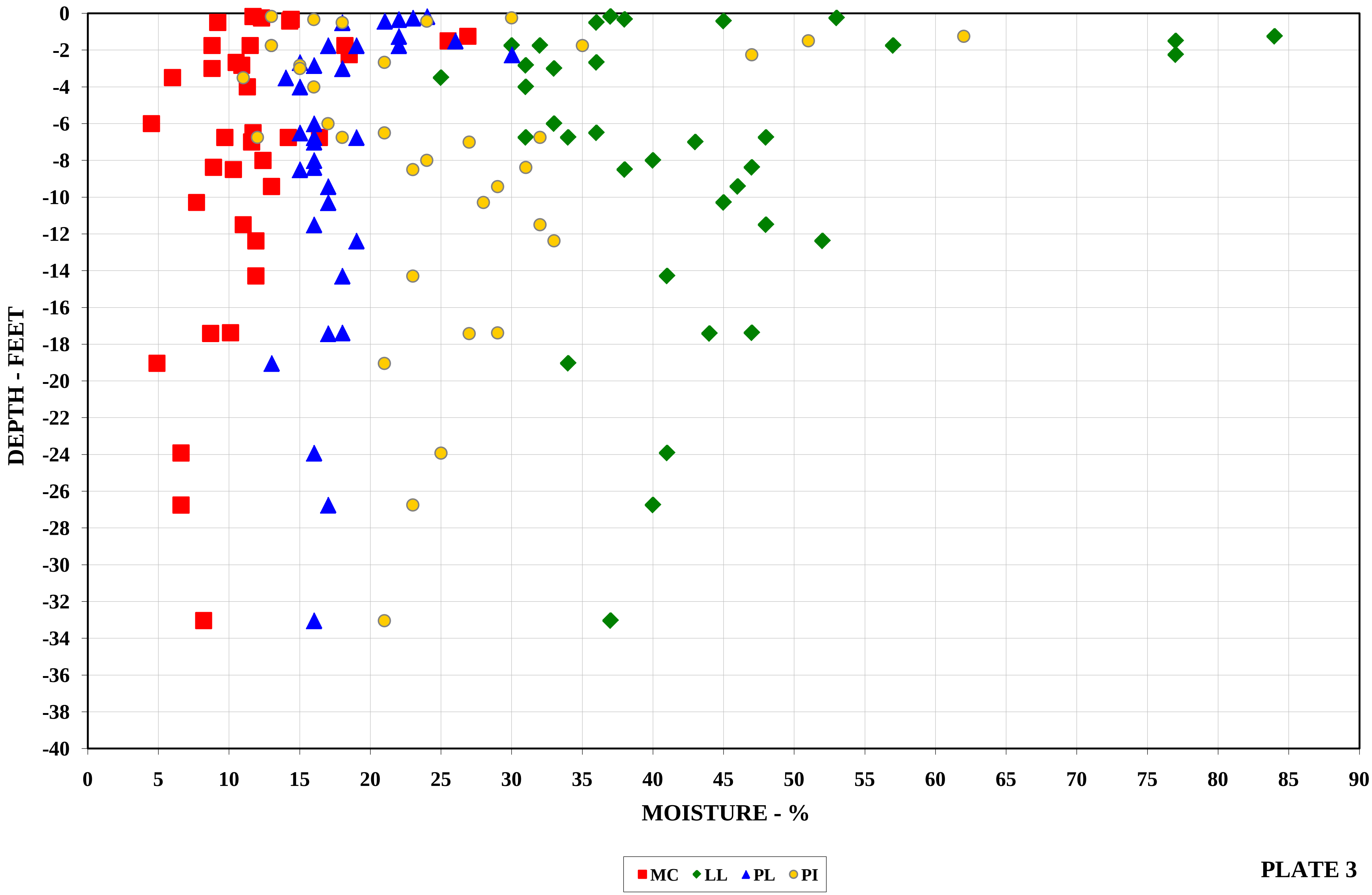


PLATE 3

MODIFIED RECORD FIRE RANGE (FY13)
MOISTURE CONTENT - DRY DENSITY VS DEPTH

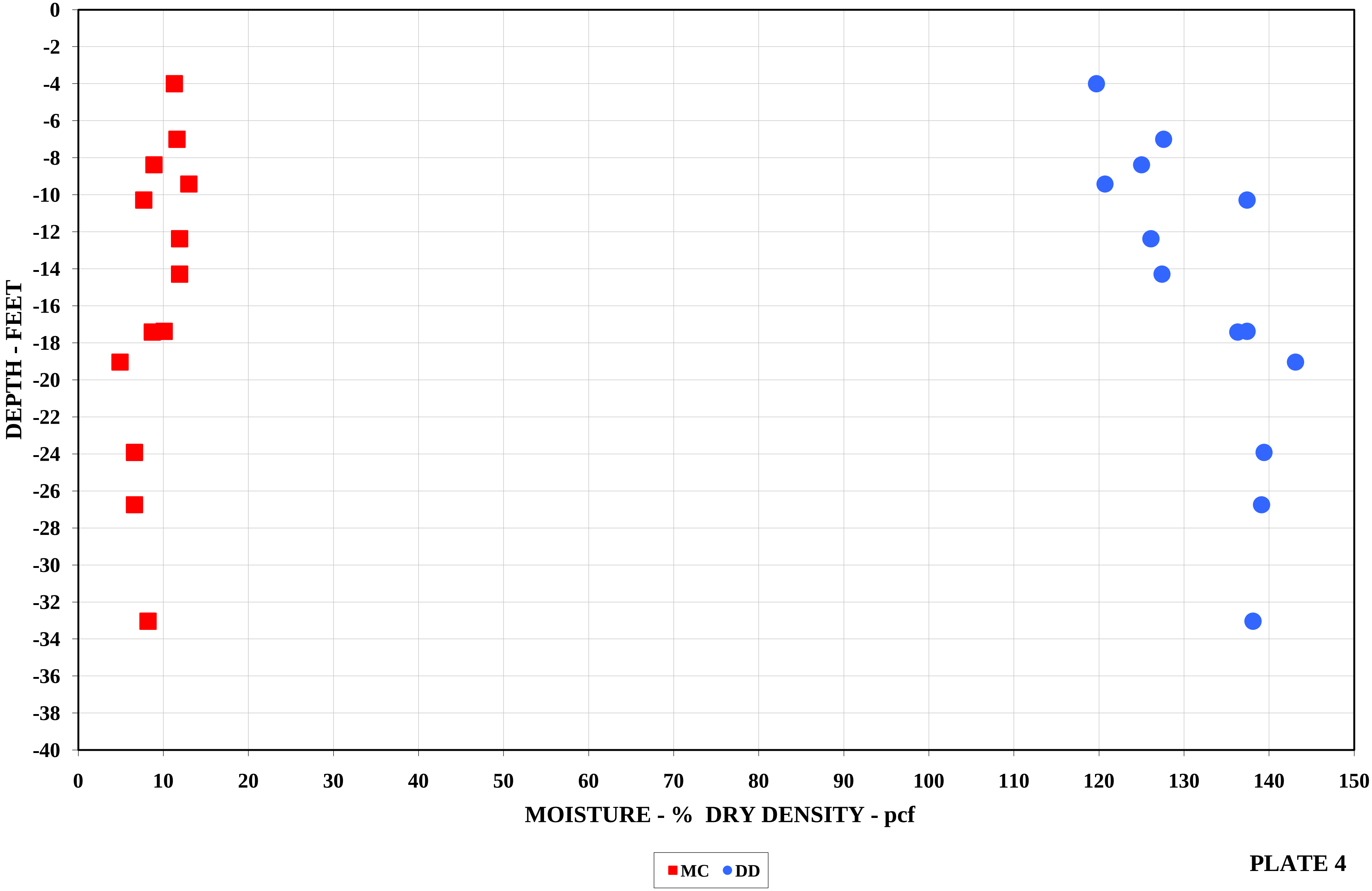


PLATE 4

MODIFIED RECORD FIRE RANGE (FY13)
ULTIMATE COMPRESSIVE STRENGTH VS DEPTH

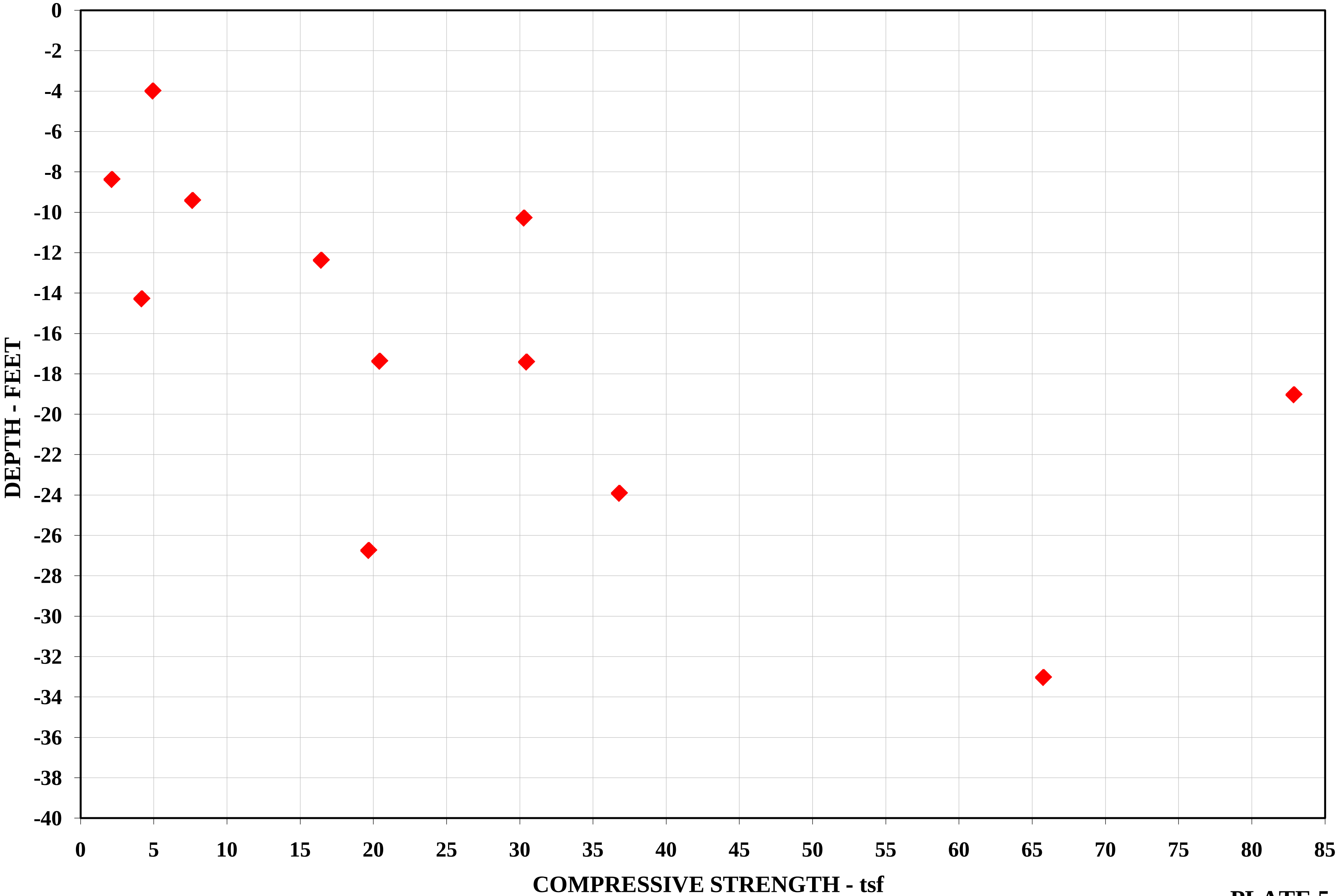


PLATE 5

APPENDIX C

LABORATORY TESTING DATA

SUMMARY OF LABORATORY TEST RESULTS

LABORATORY TESTING SERVICES
MODIFIED RECORD FIRE RANGE (MRFR)(FY13)
FORT HOOD, TEXAS

Boring No.	Sample No.	Sample Depth (ft.)	Visual Description & Unified Soil Classification (ASTM D-2487)		Percent Passing Sieve #4	#10	#20	#40	#60	#80	#100	#200
8A4C-MRFR-1	S-1	0-10"	Dark brown and tan clay with sand	CL	92.4	85.8	81.5	79.5	77.9	76.4	75.7	72.3
	S-2	3-5'	Tan and light gray shaley clay	CL	---	---	---	---	---	---	---	---
	C-1	8'-8'9"	Light gray and tan shaley clay with limestone seams	CL	---	---	---	---	---	---	---	---
	C-2	10'-10'7"	Light gray and tan limestone with shaley clay lenses	N/A	---	---	---	---	---	---	---	---
	C-3	17'-17'9"	Brown and tan limestone with shaley clay lenses	N/A	---	---	---	---	---	---	---	---
8A4C-MRFR-2	S-1	0-8"	Dark brown and tan sandy clay	CL	94.9	84.4	78.5	75.6	73.6	71.7	70.8	66.6
	S-2	8"-5'	Tan and light gray shaley clay	CL	---	---	---	---	---	---	---	---
	C-1	9'2"-9'8"	Light gray and tan shaley clay with limestone seams	CL	---	---	---	---	---	---	---	---
	C-2	13'10"-14'9"	Light gray and tan shaley clay with limestone seams	CL	---	---	---	---	---	---	---	---
	C-3	18'7"-19'6"	Gray fossiliferous limestone with some shale inclusions	N/A	---	---	---	---	---	---	---	---
8A4C-MRFR-3	S-1	0-3.5'	Light gray shaley clay with limestone fragments	CL	87.9	81.8	79.3	78.0	76.9	75.7	75.1	71.4
	S-2	7-10'	Light gray shaley clay with limestone fragments	CL	---	---	---	---	---	---	---	---
	S-3	11-12'	Gray shaley clay with limestone fragments	CL	---	---	---	---	---	---	---	---
	C-1	12'-12'9"	Gray limestone with shaley clay lenses	N/A	---	---	---	---	---	---	---	---
	C-2	17'1"-17'9"	Gray limestone with shaley clay lenses	N/A	---	---	---	---	---	---	---	---
	C-3	23'7"-24'3"	Gray fossiliferous limestone with shale inclusions	N/A	---	---	---	---	---	---	---	---
	C-4	26'4"-27'2"	Gray limestone with shale inclusions	N/A	---	---	---	---	---	---	---	---
	C-5	32'8"-33'5"	Gray fossiliferous limestone with some shale inclusions	N/A	---	---	---	---	---	---	---	---
8A4C-MRFR-4	S-1	0-1'	Tan and light brown clay with sand	CL	97.3	93.2	89.2	86.2	84.0	81.7	80.2	75.6
	S-2	1-5'	Tan and light brown sandy clay	CL	---	---	---	---	---	---	---	---
	S-3	6-8'	Tan and light gray clay with limestone fragments	CL	---	---	---	---	---	---	---	---
8A4C-MRFR-5	S-1	0-4"	Dark brown and tan clay with sand	CL	91.4	84.7	80.5	78.4	76.8	75.3	74.6	70.5
	S-2	4"-5'	Tan shaley clay with limestone fragments	CL	---	---	---	---	---	---	---	---
	S-3	6-10'	Tan and light gray shaley clay with limestone fragments	CL	---	---	---	---	---	---	---	---
10A-MRFR-10	S-1	0-6"	Dark brown sandy clay with gravel	CH	82.0	79.9	77.6	75.4	73.8	72.2	71.5	68.4
	S-2	6"-3'	Tan sandy clay with gravel	CL	---	---	---	---	---	---	---	---
	S-3	4.5-8.5'	Tan shaley clay with limestone fragments	CL	---	---	---	---	---	---	---	---
10A-MRFR-11	S-1	0-2.5'	Dark brown clay	CH	99.4	97.6	96.2	95.3	94.8	94.4	94.2	93.4
	S-2	2.5-4.5'	Tan sandy clay with limestone fragments	CL	---	---	---	---	---	---	---	---
	S-3	5-8.5'	Gray and tan shaley clay with limestone fragments	CL	---	---	---	---	---	---	---	---
10A-MRFR-12	S-1	0-4.5'	Dark brown clay with sand	CH	87.0	85.7	84.5	83.7	83.2	82.7	82.5	81.5
	S-2	5-8.5'	Gray and tan shaley clay with limestone fragments	CL	---	---	---	---	---	---	---	---
10A-MRFR-13	S-1	0-3'	Dark brown clay	CH	99.4	98.1	96.5	95.5	95.0	94.6	94.4	93.7
	S-2	3.5-8.5'	Tan and light gray shaley clay with limestone fragments	CL	---	---	---	---	---	---	---	---
10A-MRFR-14	S-1	0-3.5'	Reddish brown clay	CH	98.7	95.5	92.6	91.2	90.3	89.6	89.3	87.8
	S-2	5-8.5'	Tan and light gray shaley clay with limestone fragments	CL	---	---	---	---	---	---	---	---

SUMMARY OF LABORATORY TEST RESULTS

LABORATORY TESTING SERVICES
MODIFIED RECORD FIRE RANGE (MRFR)(FY13)
FORT HOOD, TEXAS

Boring No.	Sample No.	Sample Depth (ft.)	Visual Description & Unified Soil Classification (ASTM D-2487)		Moisture Content (%)	Unit Dry Weight (pcf)	Atterberg Limits LL	PL	PI	Notes
8A4C-MRFR-1	S-1	0-10"	Dark brown and tan clay with sand	CL	14.3	---	45	21	24	
	S-2	3-5'	Tan and light gray shaley clay	CL	11.3	119.7	31	15	16	
	C-1	8'-8'9"	Light gray and tan shaley clay with limestone seams	CL	8.9	125.0	47	16	31	
	C-2	10'-10'7"	Light gray and tan limestone with shaley clay lenses	N/A	7.7	137.4	45	17	28	
	C-3	17'-17'9"	Brown and tan limestone with shaley clay lenses	N/A	10.1	137.4	47	18	29	
8A4C-MRFR-2	S-1	0-8"	Dark brown and tan sandy clay	CL	14.4	---	38	22	16	
	S-2	8"-5'	Tan and light gray shaley clay	CL	10.9	---	31	16	15	
	C-1	9'2"-9'8"	Light gray and tan shaley clay with limestone seams	CL	13.0	120.7	46	17	29	
	C-2	13'10"-14'9"	Light gray and tan shaley clay with limestone seams	CL	11.9	127.4	41	18	23	
	C-3	18'7"-19'6"	Gray fossiliferous limestone with some shale inclusions	N/A	4.9	143.1	34	13	21	
8A4C-MRFR-3	S-1	0-3.5'	Light gray shaley clay with limestone fragments	CL	8.8	---	30	17	13	
	S-2	7-10'	Light gray shaley clay with limestone fragments	CL	10.3	---	38	15	23	
	S-3	11-12'	Gray shaley clay with limestone fragments	CL	11.0	---	48	16	32	
	C-1	12'-12'9"	Gray limestone with shaley clay lenses	N/A	11.9	126.1	52	19	33	
	C-2	17'1"-17'9"	Gray limestone with shaley clay lenses	N/A	8.7	136.3	44	17	27	
	C-3	23'7"-24'3"	Gray fossiliferous limestone with shale inclusions	N/A	6.6	139.4	41	16	25	
	C-4	26'4"-27'2"	Gray limestone with shale inclusions	N/A	6.6	139.1	40	17	23	
	C-5	32'8"-33'5"	Gray fossiliferous limestone with some shale inclusions	N/A	8.2	138.1	37	16	21	
8A4C-MRFR-4	S-1	0-1'	Tan and light brown clay with sand	CL	9.2	---	36	18	18	
	S-2	1-5'	Tan and light brown sandy clay	CL	8.8	---	33	18	15	
	S-3	6-8'	Tan and light gray clay with limestone fragments	CL	11.6	127.6	43	16	27	
8A4C-MRFR-5	S-1	0-4"	Dark brown and tan clay with sand	CL	11.7	---	37	24	13	
	S-2	4"-5'	Tan shaley clay with limestone fragments	CL	10.5	---	36	15	21	
	S-3	6-10'	Tan and light gray shaley clay with limestone fragments	CL	12.4	---	40	16	24	
10A-MRFR-10	S-1	0-6"	Dark brown sandy clay with gravel	CH	12.3	---	53	23	30	
	S-2	6"-3'	Tan sandy clay with gravel	CL	11.5	---	32	19	13	
	S-3	4.5-8.5'	Tan shaley clay with limestone fragments	CL	11.7	---	36	15	21	
10A-MRFR-11	S-1	0-2.5'	Dark brown clay	CH	26.9	---	84	22	62	
	S-2	2.5-4.5'	Tan sandy clay with limestone fragments	CL	6.0	---	25	14	11	
	S-3	5-8.5'	Gray and tan shaley clay with limestone fragments	CL	14.2	---	48	16	32	
10A-MRFR-12	S-1	0-4.5'	Dark brown clay with sand	CH	18.5	---	77	30	47	
	S-2	5-8.5'	Gray and tan shaley clay with limestone fragments	CL	9.7	---	34	16	18	
10A-MRFR-13	S-1	0-3'	Dark brown clay	CH	25.5	---	77	26	51	
	S-2	3.5-8.5'	Tan and light gray shaley clay with limestone fragments	CL	4.5	---	33	16	17	
10A-MRFR-14	S-1	0-3.5'	Reddish brown clay	CH	18.2	---	57	22	35	
	S-2	5-8.5'	Tan and light gray shaley clay with limestone fragments	CL	16.4	---	31	19	12	

SUMMARY OF LABORATORY TEST RESULTS

LABORATORY TESTING SERVICES
MODIFIED RECORD FIRE RANGE (MRFR)(FY13)
FORT HOOD, TEXAS

Boring No.	Sample No.	Sample Depth (ft.)	Visual Description & Unified Soil Classification (ASTM D-2487)		Moisture Content (%)	Unit Dry Weight (pcf)	Confining Pressure (tsf)	Q (tsf)	Strain @ Failure (%)	Type Failure
8A4C-MRFR-1	S-1	0-10"	Dark brown and tan clay with sand	CL	14.3	---	---	---	---	
	S-2	3-5'	Tan and light gray shaley clay	CL	11.3	119.7	0.250	4.95	5.6	Internal
	C-1	8'-8'9"	Light gray and tan shaley clay with limestone seams	CL	8.9	125.0	0.523	2.15	2.1	Vertical
	C-2	10'-10'7"	Light gray and tan limestone with shaley clay lenses	N/A	7.7	137.4	0.643	30.3	1.4	Vertical
	C-3	17'-17'9"	Brown and tan limestone with shaley clay lenses	N/A	10.1	137.4	1.086	20.4	1.4	Vertical
8A4C-MRFR-2	S-1	0-8"	Dark brown and tan sandy clay	CL	14.4	---	---	---	---	
	S-2	8"-5'	Tan and light gray shaley clay	CL	10.9	---	---	---	---	
	C-1	9'2"-9'8"	Light gray and tan shaley clay with limestone seams	CL	13.0	120.7	0.589	7.66	5.3	Vertical
	C-2	13'10"-14'9"	Light gray and tan shaley clay with limestone seams	CL	11.9	127.4	0.799	4.19	6.3	Angular (40°)
	C-3	18'7"-19'6"	Gray fossiliferous limestone with some shale inclusions	N/A	4.9	143.1	0	82.9	**	Vertical
8A4C-MRFR-3	S-1	0-3.5'	Light gray shaley clay with limestone fragments	CL	8.8	---	---	---	---	
	S-2	7-10'	Light gray shaley clay with limestone fragments	CL	10.3	---	---	---	---	
	S-3	11-12'	Gray shaley clay with limestone fragments	CL	11.0	---	---	---	---	
	C-1	12'-12'9"	Gray limestone with shaley clay lenses	N/A	11.9	126.1	0.430	16.45	1.7	Vertical
	C-2	17'1"-17'9"	Gray limestone with shaley clay lenses	N/A	8.7	136.3	1.089	30.5	1.0	Angular (70°)
	C-3	23'7"-24'3"	Gray fossiliferous limestone with shale inclusions	N/A	6.6	139.4	1.495	36.8	1.1	Vertical
	C-4	26'4"-27'2"	Gray limestone with shale inclusions	N/A	6.6	139.1	1.672	19.69	1.6	Vertical
	C-5	32'8"-33'5"	Gray fossiliferous limestone with some shale inclusions	N/A	8.2	138.1	0	65.8	**	Vertical
8A4C-MRFR-4	S-1	0-1'	Tan and light brown clay with sand	CL	9.2	---	---	---	---	
	S-2	1-5'	Tan and light brown sandy clay	CL	8.8	---	---	---	---	
	S-3	6-8'	Tan and light gray clay with limestone fragments	CL	11.6	127.6	*	*	*	
8A4C-MRFR-5	S-1	0-4"	Dark brown and tan clay with sand	CL	11.7	---	---	---	---	
	S-2	4"-5'	Tan shaley clay with limestone fragments	CL	10.5	---	---	---	---	
	S-3	6-10'	Tan and light gray shaley clay with limestone fragments	CL	12.4	---	---	---	---	
10A-MRFR-10	S-1	0-6"	Dark brown sandy clay with gravel	CH	12.3	---	---	---	---	
	S-2	6"-3'	Tan sandy clay with gravel	CL	11.5	---	---	---	---	
	S-3	4.5-8.5'	Tan shaley clay with limestone fragments	CL	11.7	---	---	---	---	
10A-MRFR-11	S-1	0-2.5'	Dark brown clay	CH	26.9	---	---	---	---	
	S-2	2.5-4.5'	Tan sandy clay with limestone fragments	CL	6.0	---	---	---	---	
	S-3	5-8.5'	Gray and tan shaley clay with limestone fragments	CL	14.2	---	---	---	---	
10A-MRFR-12	S-1	0-4.5'	Dark brown clay with sand	CH	18.5	---	---	---	---	
	S-2	5-8.5'	Gray and tan shaley clay with limestone fragments	CL	9.7	---	---	---	---	
10A-MRFR-13	S-1	0-3'	Dark brown clay	CH	25.5	---	---	---	---	
	S-2	3.5-8.5'	Tan and light gray shaley clay with limestone fragments	CL	4.5	---	---	---	---	
10A-MRFR-14	S-1	0-3.5'	Reddish brown clay	CH	18.2	---	---	---	---	
	S-2	5-8.5'	Tan and light gray shaley clay with limestone fragments	CL	16.4	---	---	---	---	

* Insufficient sample recovery from Shelby Tube Sampler to complete the requested strength testing.
** Tested in accordance with ASTM D-2938, Unconfined Compression of Intact Rock Core Specimens.

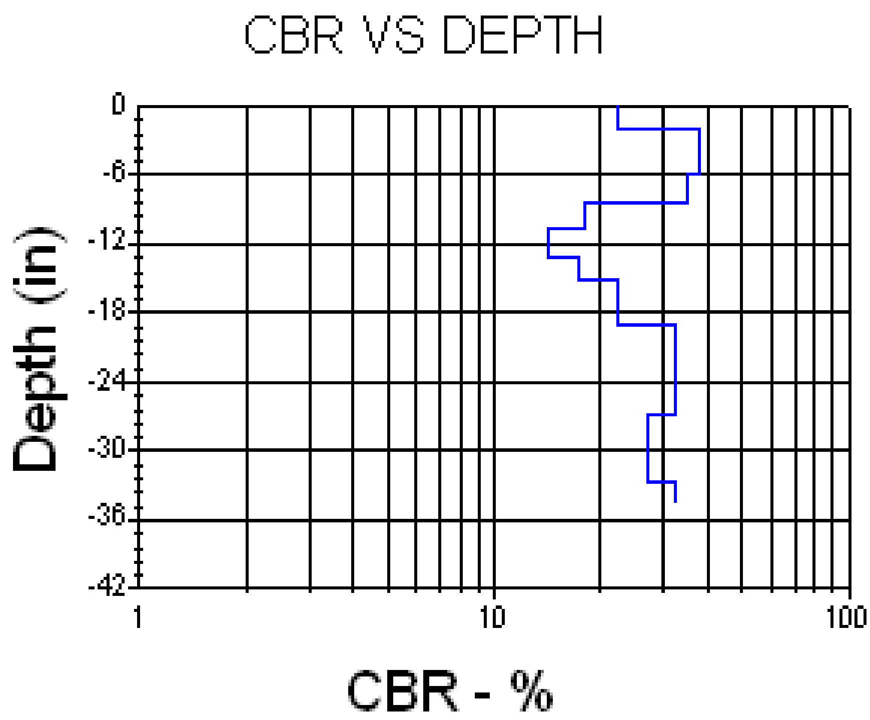
APPENDIX D

DYNAMIC CONE PENETROMETER (DCP) TESTING DATA PLOTS

DCP TEST DATA

Project: Modified Record Fire Range (FY13) Date: 23 March 2011

Feature: 10A-MRFR-07 Station: 10A-MRFR-07



TEST PROFILE

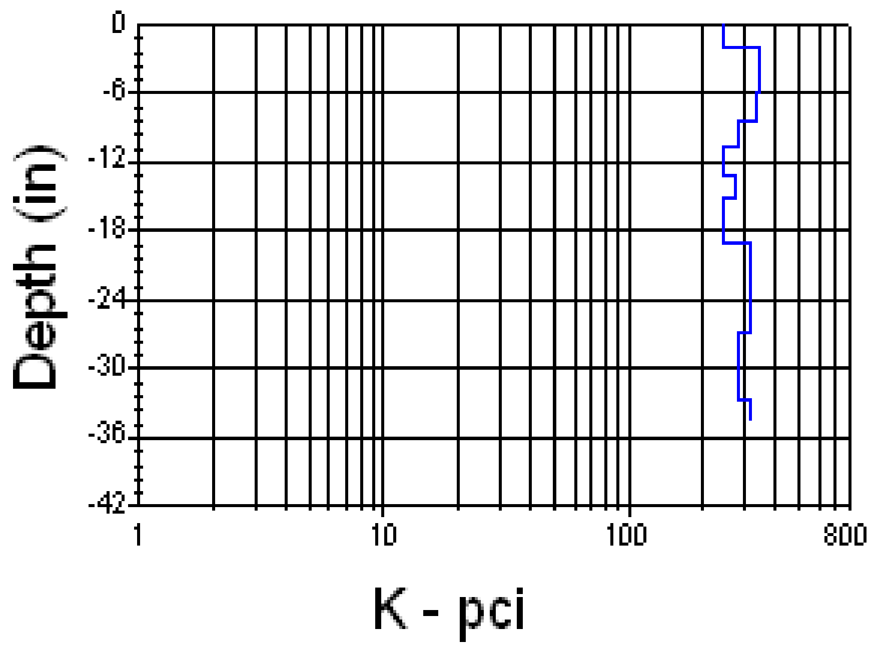
(MM)	TEST PROFILE	(IN)
0	SUBGRADE 6.00" CBR 33	0
127		5
254	UNASSIGNED 6.00" CBR 21	10
381	UNASSIGNED 6.00" CBR 19	15
508	UNASSIGNED 6.00" CBR 31	20
635		25
762	UNASSIGNED 10.75" CBR 30	30
889		35
1016		40
1143		45
1270		50

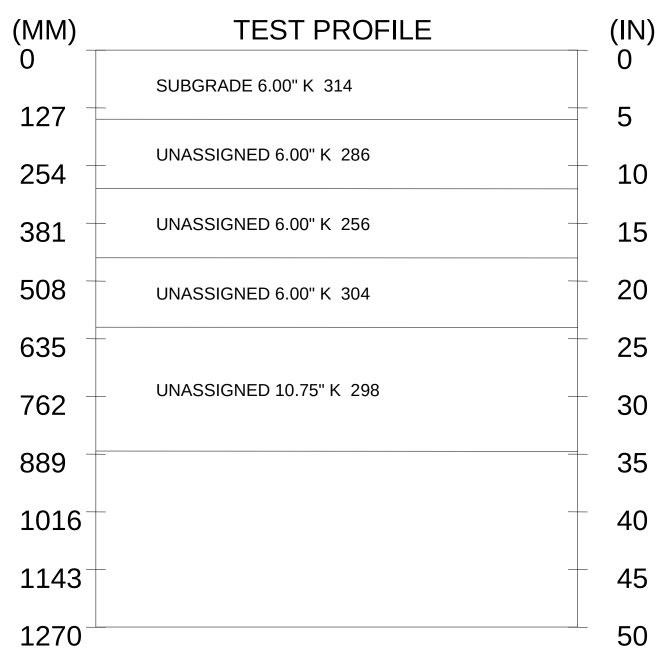
DCP TEST DATA

Project: Modified Record Fire Range (FY13) Date: 23 March 2011

Feature: 10A-MRFR-07 Station: 10A-MRFR-07

SUBGRADE MODULUS VS DEPTH

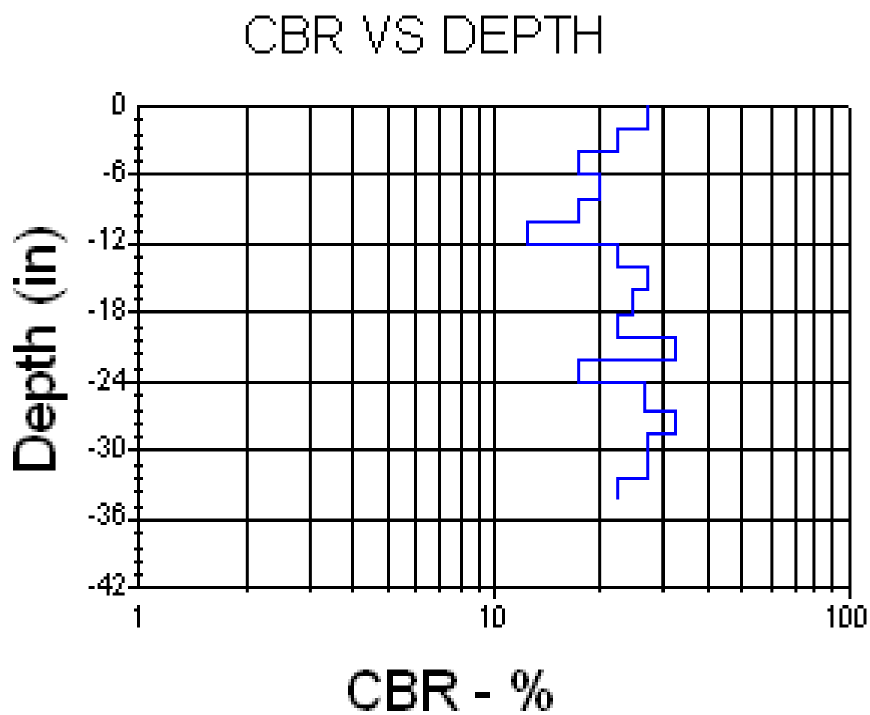




DCP TEST DATA

Project: Modified Record Fire Range (FY13) Date: 23 March 2011

Feature: 10A-MRFR-09 Station: 10A-MRFR-09



(MM)	TEST PROFILE	(IN)
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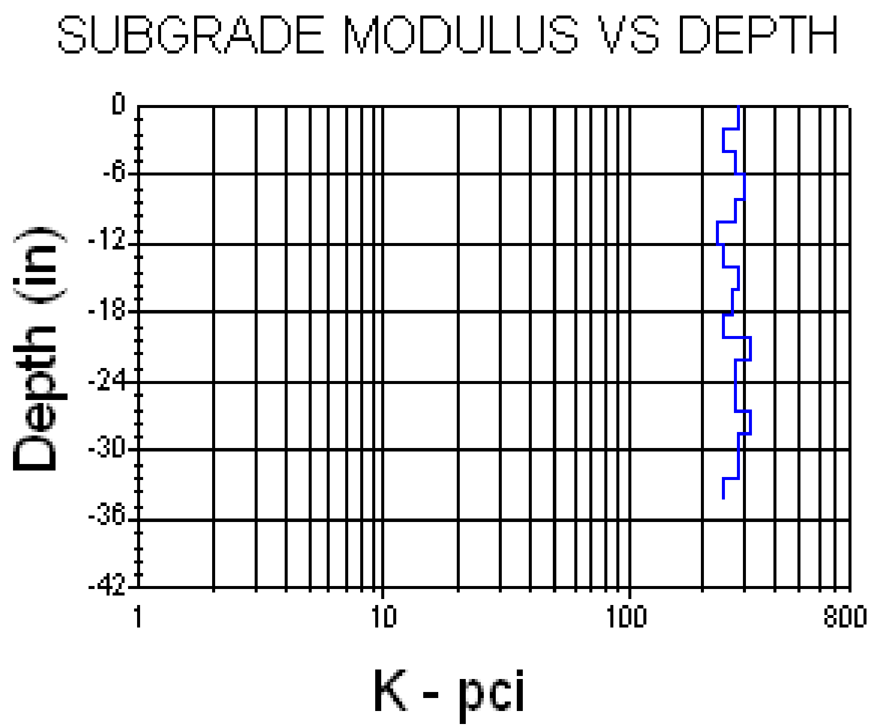
127		5
254	UNASSIGNED 6.00" CBR 17	10
381	UNASSIGNED 6.00" CBR 23	15
508	UNASSIGNED 6.00" CBR 25	20
635		25
762	UNASSIGNED 10.25" CBR 27	30
889		35
1016		40
1143		45
1270		50

DCP TEST DATA

Project: Modified Record Fire Range (FY13) Date: 23 March 2011

Feature: 10A-MRFR-09 Station: 10A-MRFR-09



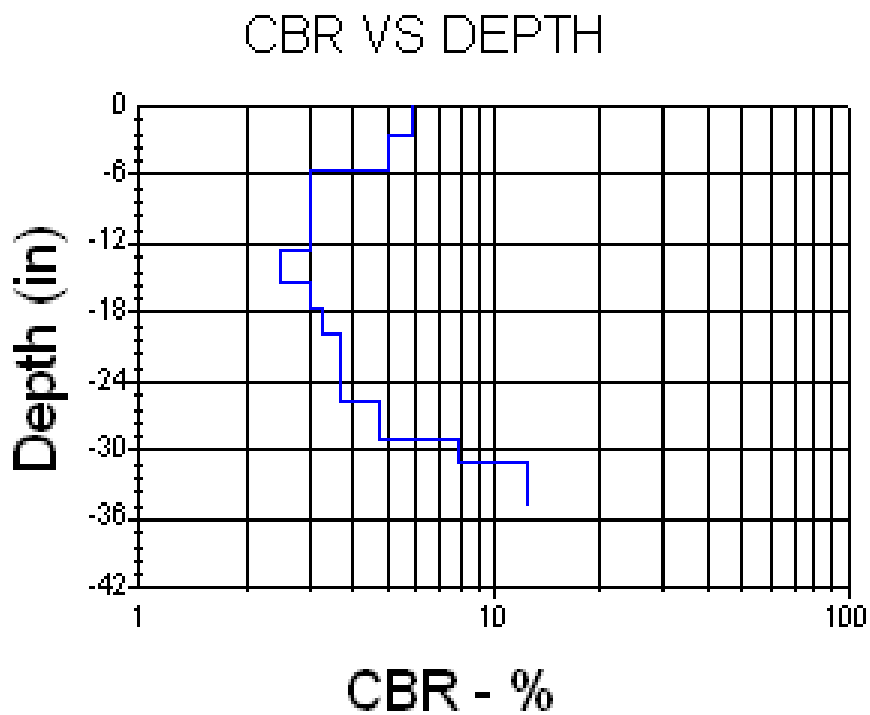
TEST PROFILE

(MM)	TEST PROFILE	(IN)
0	SUBGRADE 6.00" K 273	0
127		5
254	UNASSIGNED 6.00" K 271	10
381	UNASSIGNED 6.00" K 258	15
508	UNASSIGNED 6.00" K 277	20
635		25
762	UNASSIGNED 10.25" K 284	30
889		35
1016		40
1143		45
1270		50

DCP TEST DATA

Project: Modified Record Fire Range (FY13) Date: 23 March 2011

Feature: 10A-MRFR-11 Station: 10A-MRFR-11



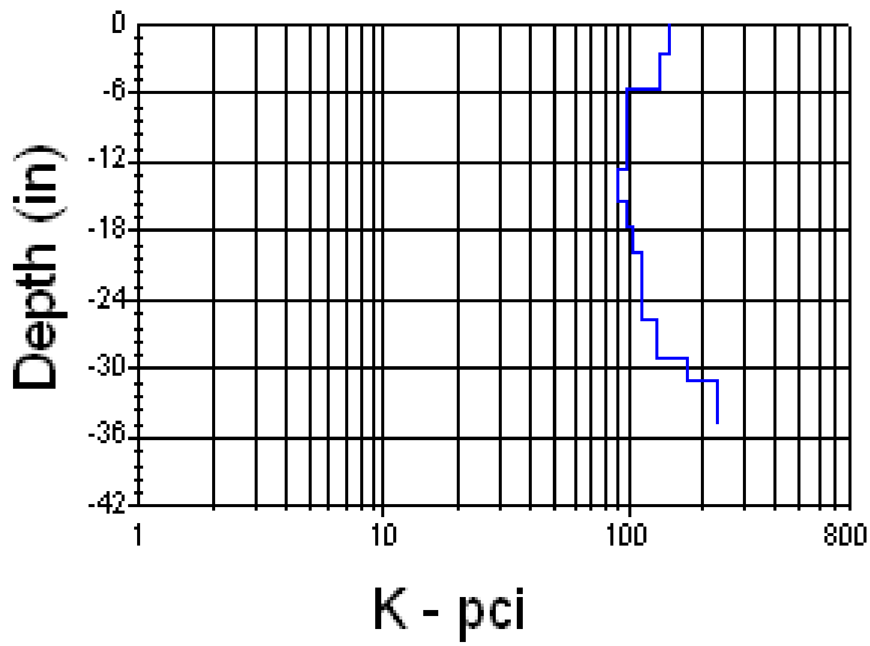
(MM)	TEST PROFILE	(IN)
0		0
127	SUBGRADE 6.00" CBR 5	5
254	UNASSIGNED 6.00" CBR 3	10
381	UNASSIGNED 6.00" CBR 3	15
508	UNASSIGNED 6.00" CBR 4	20
635		25
762	UNASSIGNED 11.00" CBR 9	30
889		35
1016		40
1143		45
1270		50

DCP TEST DATA

Project: Modified Record Fire Range (FY13) Date: 23 March 2011

Feature: 10A-MRFR-11 Station: 10A-MRFR-11

SUBGRADE MODULUS VS DEPTH

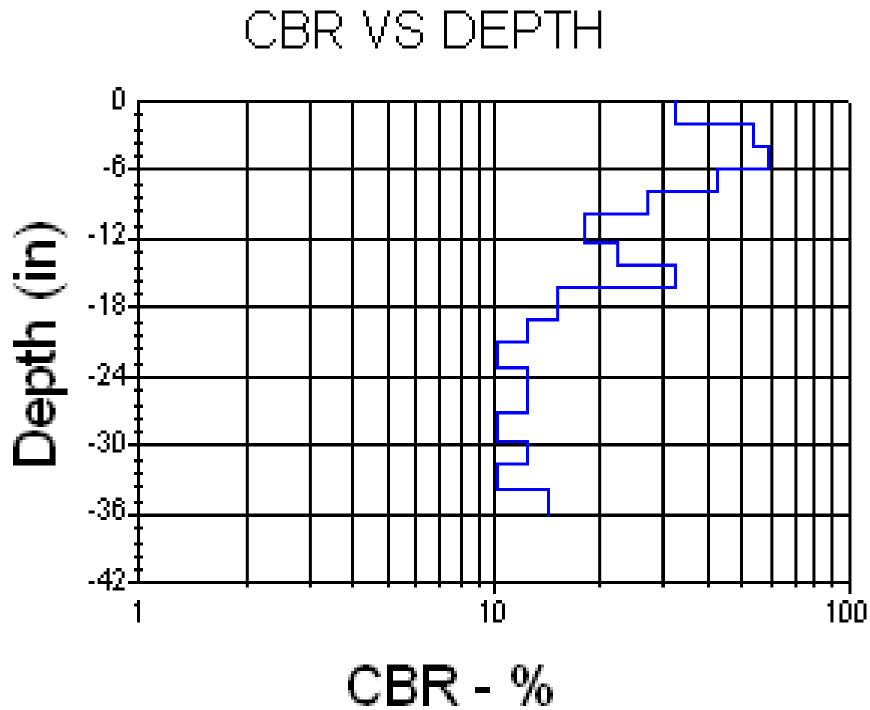


(MM)	TEST PROFILE	(IN)
0		0
	SUBGRADE 6.00" K 133	
127		5
	UNASSIGNED 6.00" K 100	
254		10
	UNASSIGNED 6.00" K 97	
381		15
	UNASSIGNED 6.00" K 111	
508		20
635		25
	UNASSIGNED 11.00" K 182	
762		30
889		35
1016		40
1143		45
1270		50

DCP TEST DATA

Project: Modified Record Fire Range (FY13)   Date: 23 March 2011

Feature: 10A-MRFR-12   Station: 10A-MRFR-12



(MM)	TEST PROFILE	(IN)
0		0
	SUBGRADE 6.00" CBR 48	
127		5
	UNASSIGNED 6.00" CBR 29	
254		10
381	UNASSIGNED 6.00" CBR 24	15
508	UNASSIGNED 6.00" CBR 12	20
635		25
762	UNASSIGNED 12.25" CBR 12	30
889		35
1016		40
1143		45
1270		50

DCP TEST DATA

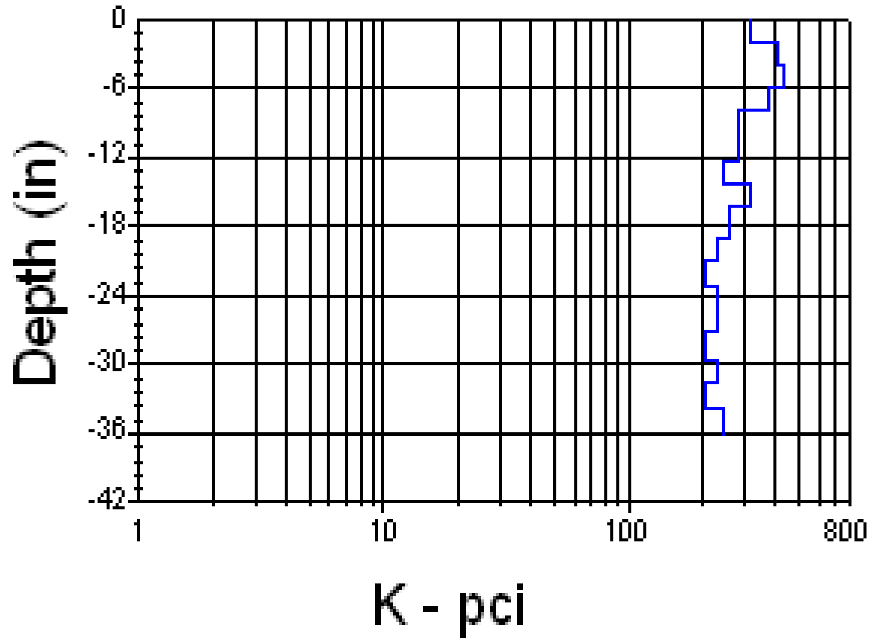
Project: Modified Record Fire Range (FY13)

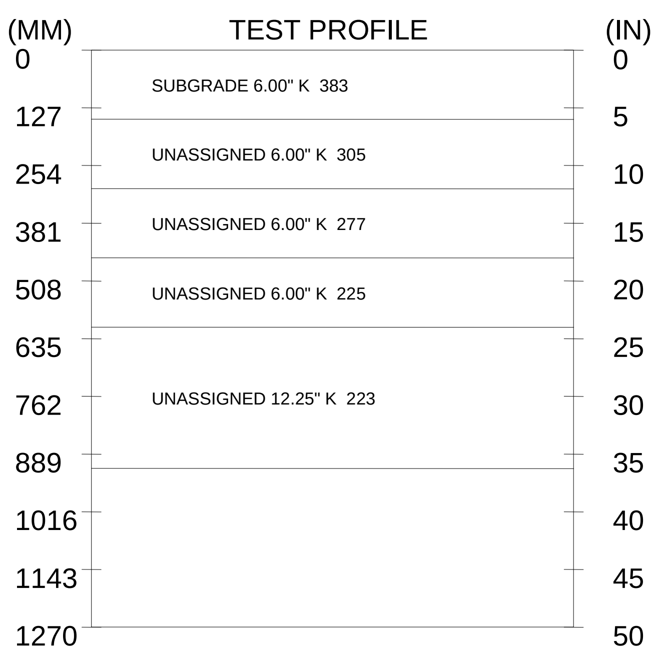
Date: 23 March 2011

Feature: 10A-MRFR-12

Station: 10A-MRFR-12

SUBGRADE MODULUS VS DEPTH

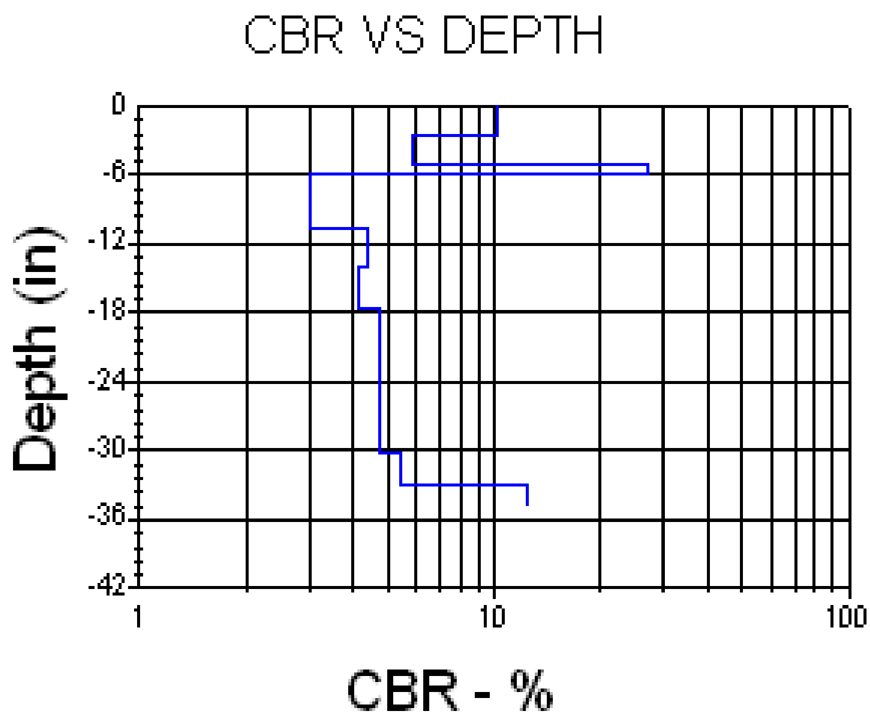




DCP TEST DATA

Project: Modified Record Fire Range (FY13) Date: 23 March 2011

Feature: 10A-MRFR-13 Station: 10A-MRFR-13



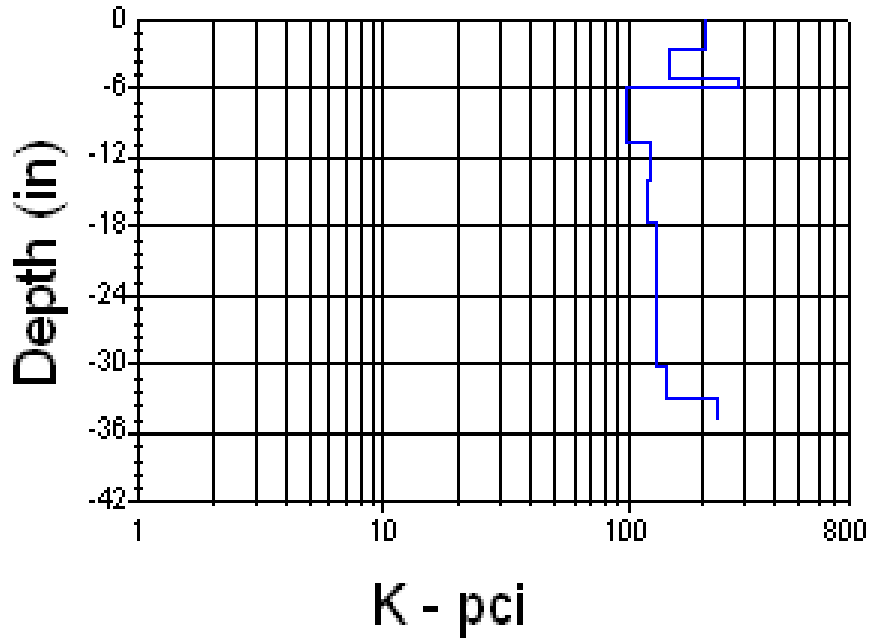
(MM)	TEST PROFILE	(IN)
0		0
	SUBGRADE 6.00" CBR 13	
127		5
	UNASSIGNED 6.00" CBR 4	
254		10
	UNASSIGNED 6.00" CBR 4	
381		15
	UNASSIGNED 6.00" CBR 5	
508		20
635		25
	UNASSIGNED 11.00" CBR 7	
762		30
889		35
1016		40
1143		45
1270		50

DCP TEST DATA

Project: Modified Record Fire Range (FY13) Date: 23 March 2011

Feature: 10A-MRFR-13 Station: 10A-MRFR-13

SUBGRADE MODULUS VS DEPTH



(MM)	TEST PROFILE	(IN)
0	SUBGRADE 6.00" K 196	0
127		5
254	UNASSIGNED 6.00" K 112	10
381	UNASSIGNED 6.00" K 123	15
508	UNASSIGNED 6.00" K 130	20
635		25
762	UNASSIGNED 11.00" K 161	30
889		35
1016		40
1143		45
1270		50

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 1989

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 Jolu

Encl

for 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

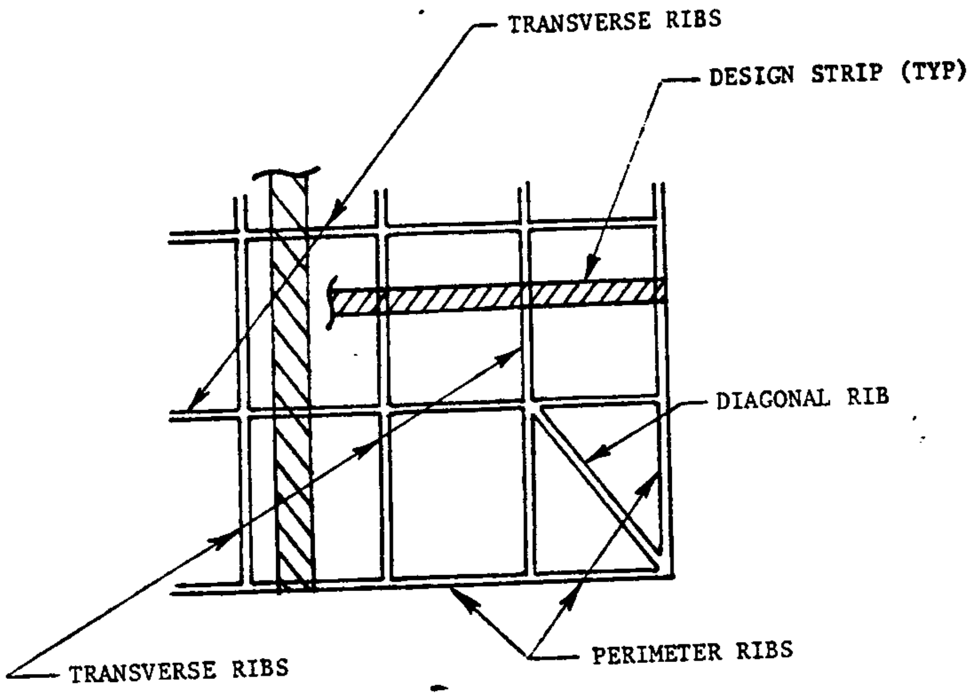
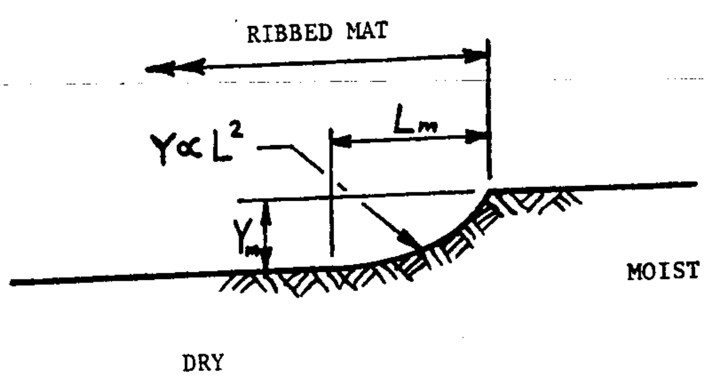


FIGURE 2 - SOIL EDGE PROFILE



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

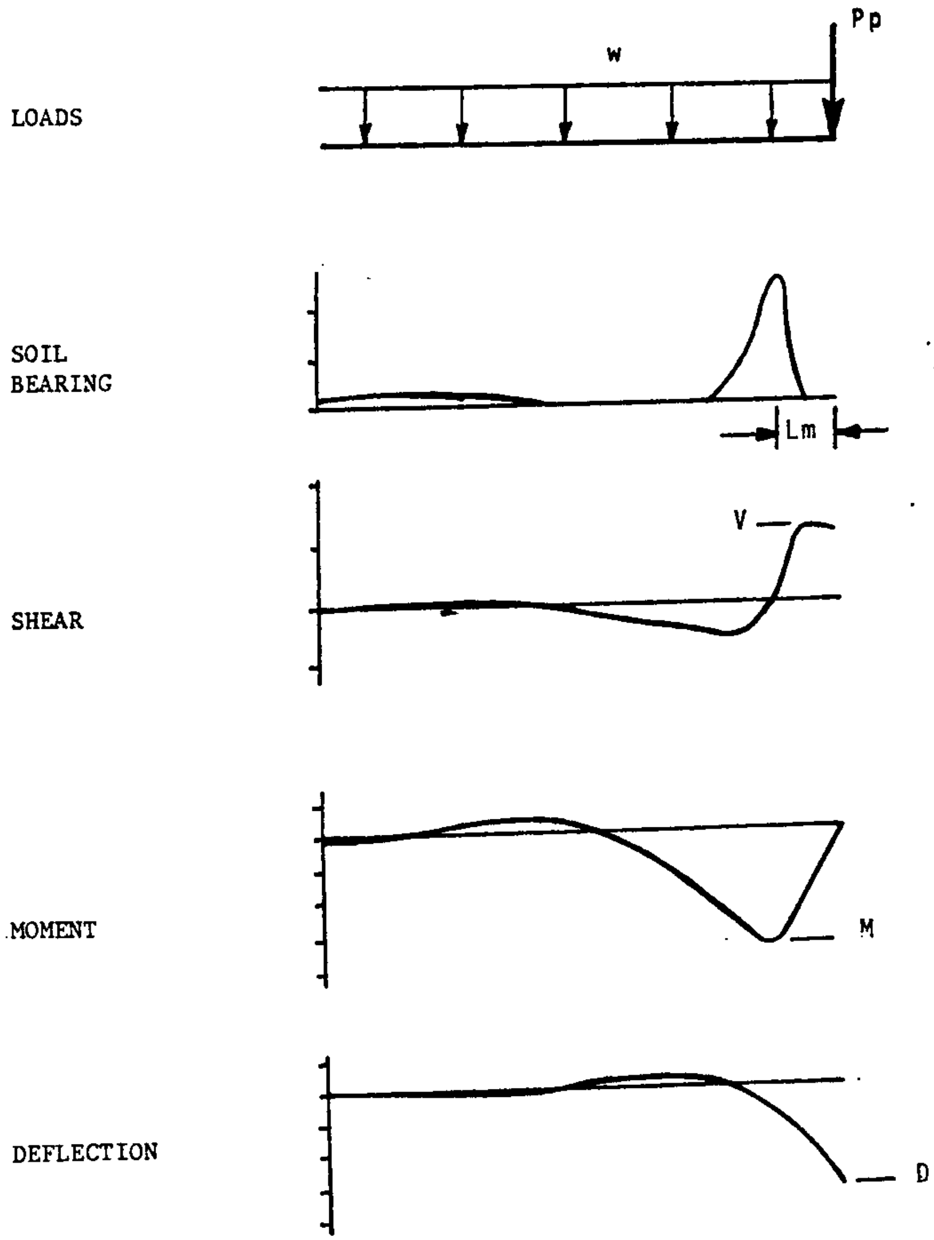
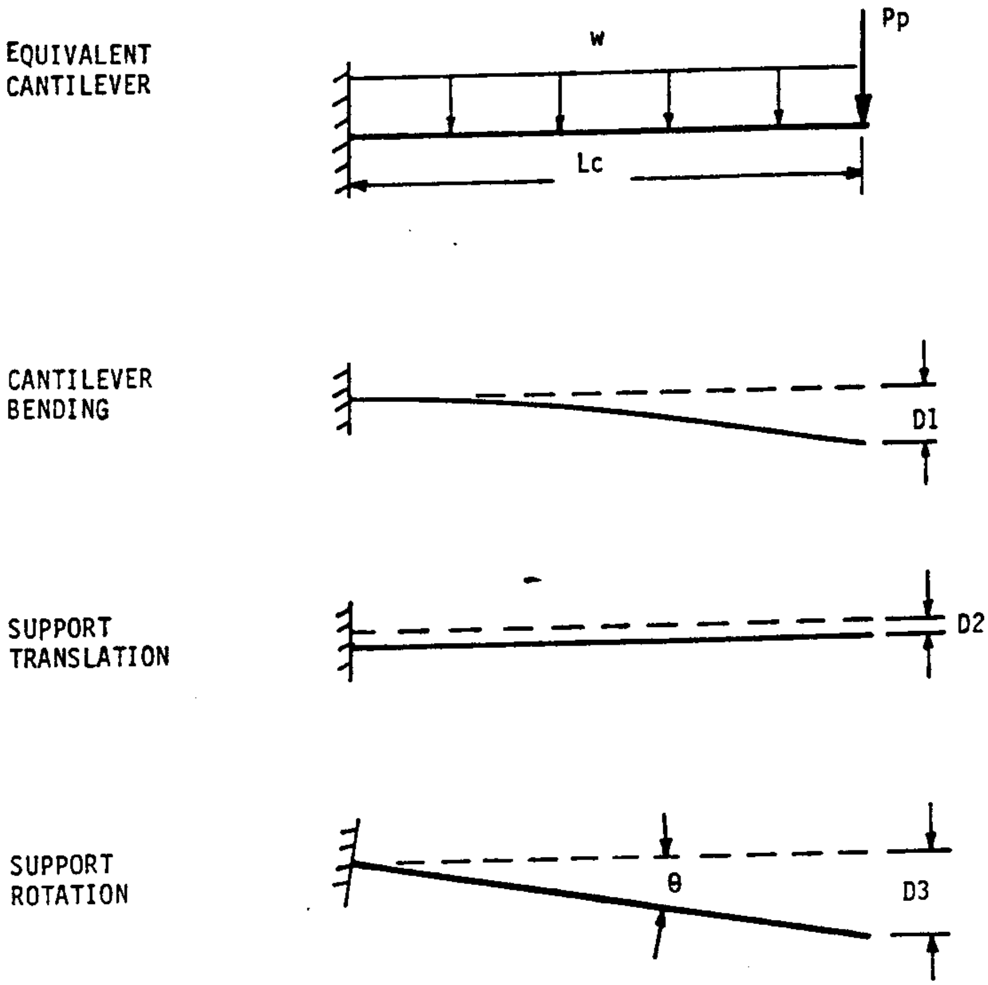


FIGURE A2 - CENTER LIFT DEFLECTION



$$D = D1 + D2 + D3$$

$$D1 + D2 = .11$$

$$D3 = 12\ Lc\ \theta$$

FIGURE A3 - EDGE LIFT BEHAVIOR

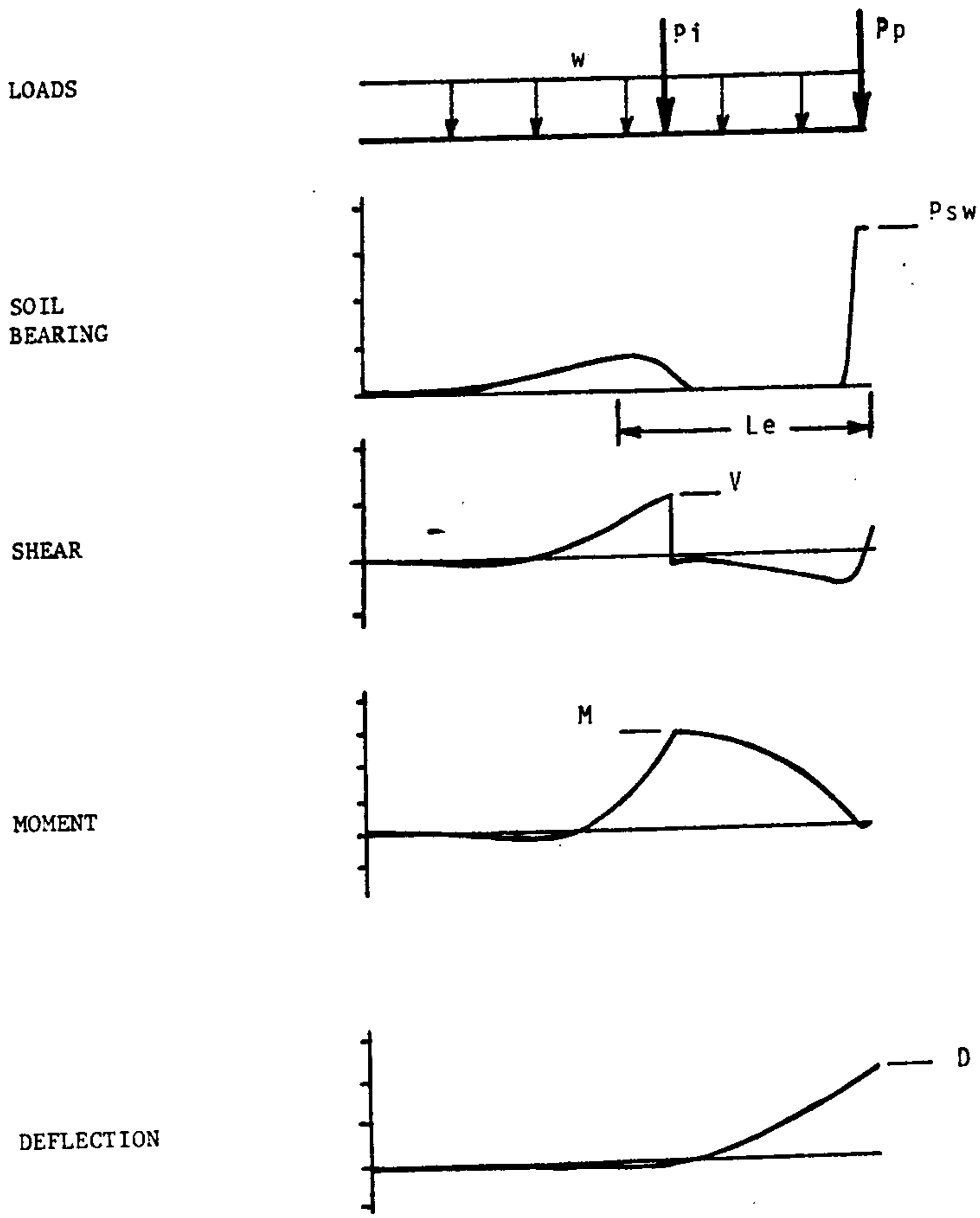
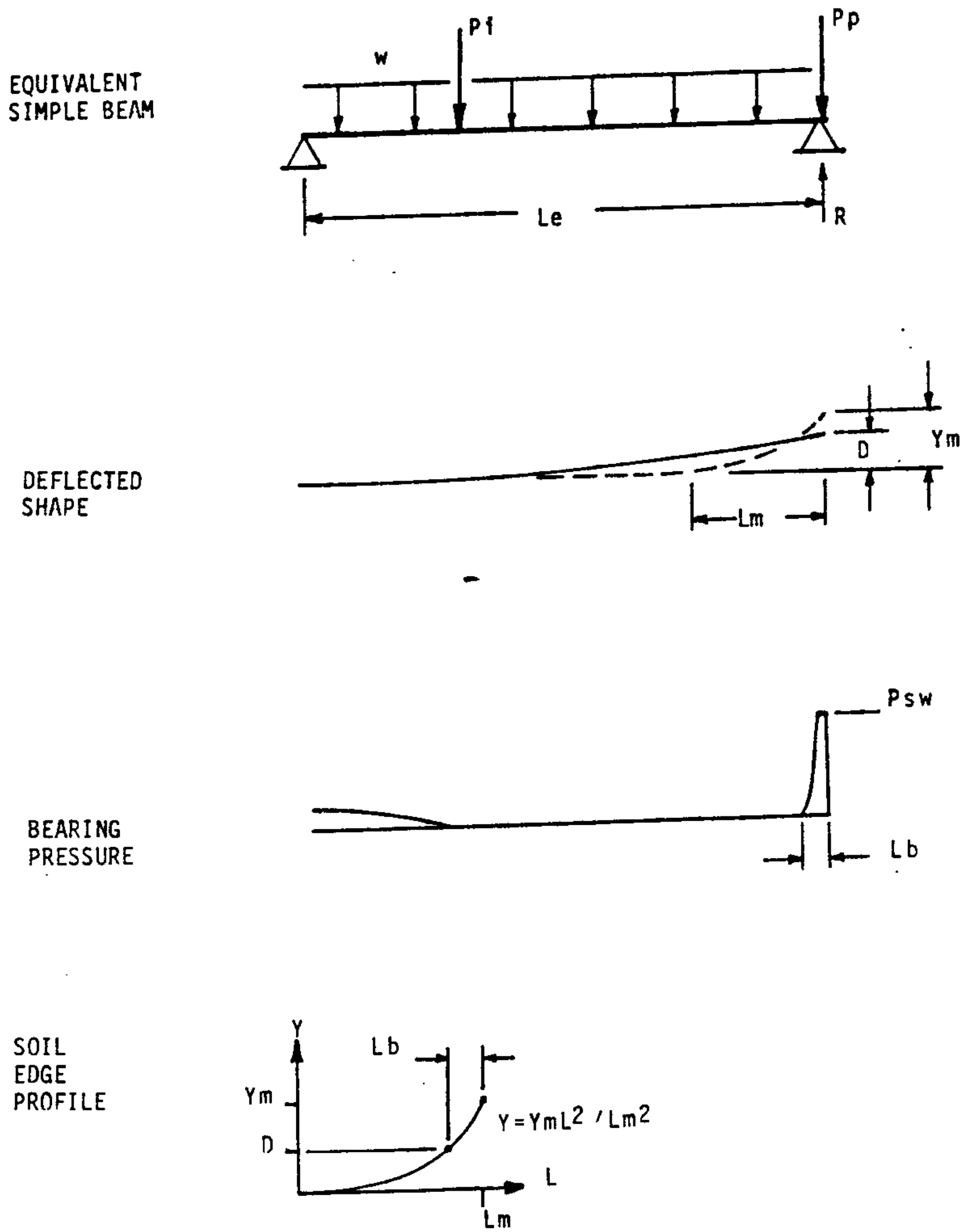


FIGURE A4 - EDGE LIFT DEFLECTION



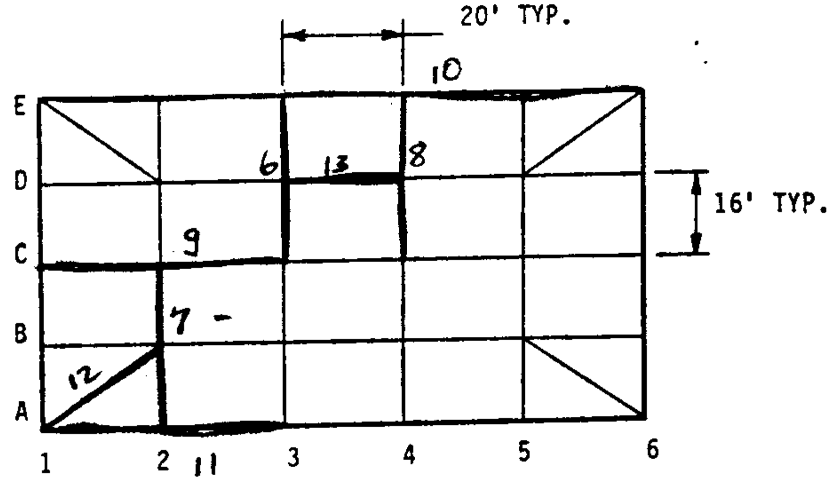
APPENDIX B - DESIGN EXAMPLE

(RIBBED MAT DESIGN IN EXPANSIVE SOIL)

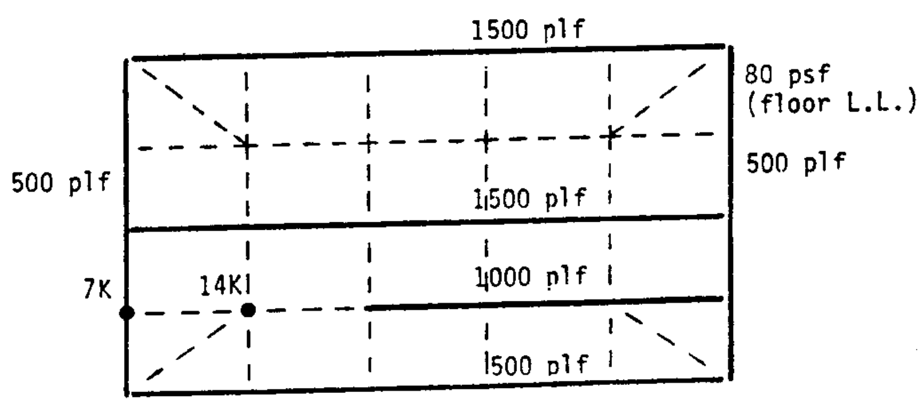
1. SOIL DATA (ref. Part I - 3.3)

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

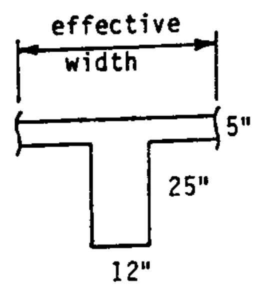
Width $\geq$ P/qa = 1500/2000 = .75 ft

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

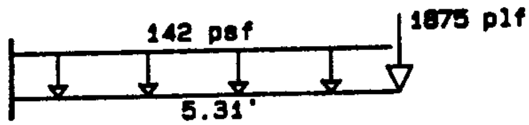
6.2 Equivalent cantilever (ref. Part II - 3.1)

$Lo = 2.3 + .4\ Lm = 2.3 + (.4 \times 6) = 4.7$ 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



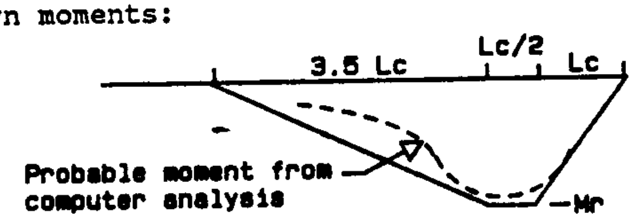
6.3 Moment (ref. Part II - 3.1.2)

$M = Pp\ Lc + 1/2\ w\ Lc^2$

$M = 1875 \times 5.31 + 1/2 \times 142 \times 5.31^2 = 12{,}000$ ft-lb/ft

$Mr = M \times S = 12000 \times 20 = 240{,}000$ ft-lb/rib

Design moments:

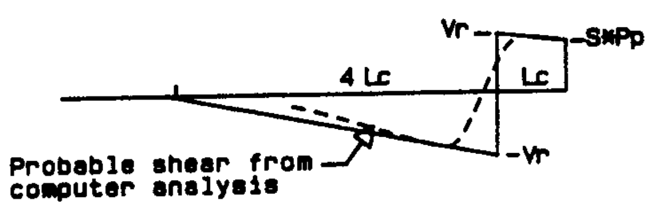


6.4 Shear (ref. Part II - 3.1.3)

$V = Pp + w\ Lc = 1875 + 142 \times 5.31 = 2630$ 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)

$\theta = M^{1.4} / 9800\ I\ k^{.5}$

$\theta = 12000^{1.4} / (9800 \times 1800 \times 100^{.5})$ = .0029 radians .00221

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

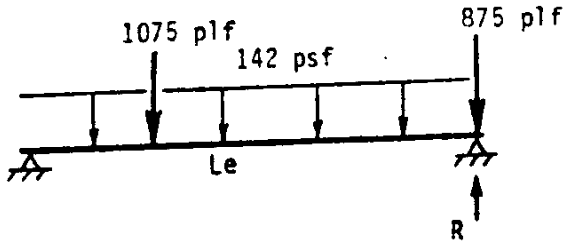
Pi = rib + wall* = 375 + 700 = 1075 plf

* 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

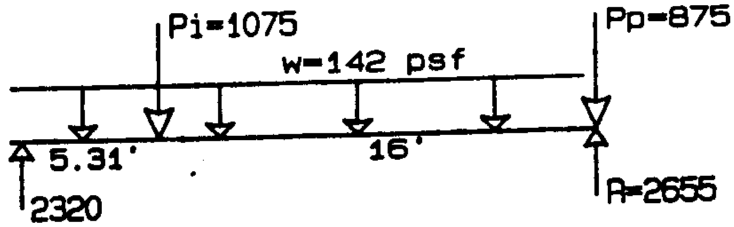
from heave/pressure curve, for D=.54 find Psw=1800 psf

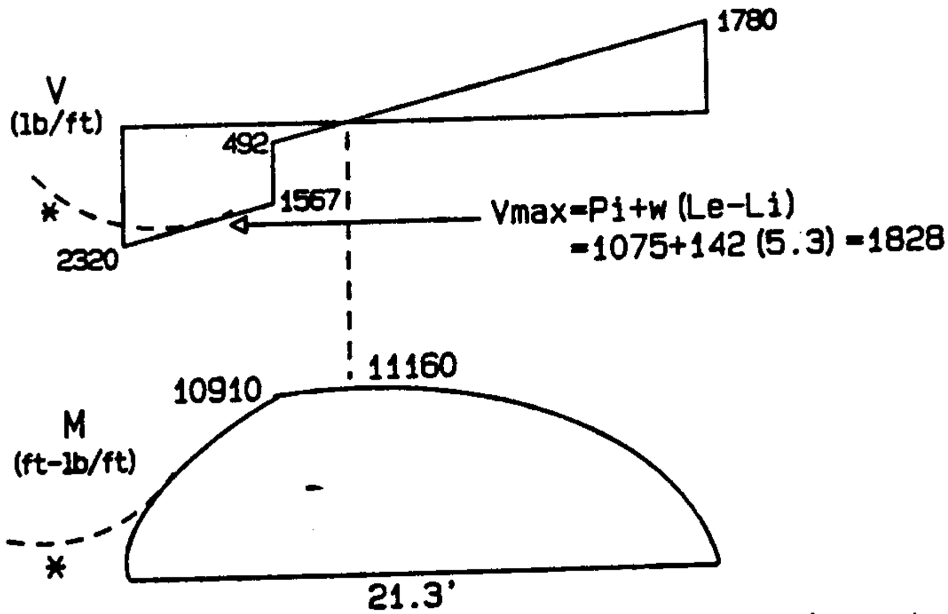
Lb = 1.1(R/Psw) = 1.1(2655/1800) = 1.62 ft

$D = 1.0(6.0-1.62)^2/6.0^2 = .533$ 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

$R = Pp + 1/2\ w\ Le = 1875 + (142 \times 22.7)/2 = 3485$ 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

$Lo = 2.3 + .4\ Lm = 2.3 + (.4 \times 6) = 4.7$ ft

$C = .8\ Ym^{.12}\ I^{.16}/\ Pp^{.12}$

$C = .8 \times 1.5^{.12} \times 2250^{.16}/\ 875^{.12} = 1.28$

$Lc = Lo\ C = 4.7 \times 1.28 = 6.02$ 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

$Mr = M \times S = 9544 \times 16 = 153{,}000$ 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

$\theta = M^{1.4} / 9800\ I\ k^{.5}$

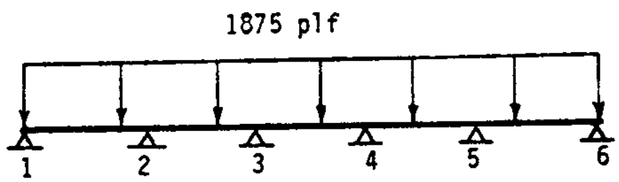
$\theta = 9544^{1.4} / 9800 \times 2250 \times 100^{.5} = .0017$ radian

$D = .11 + 12\ Lc\ \theta = .11 + (12 \times 6.02 \times .0017) = .23$ 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)

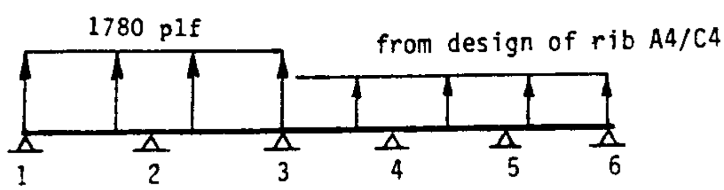


10.2 Analyze by conventional methods

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.

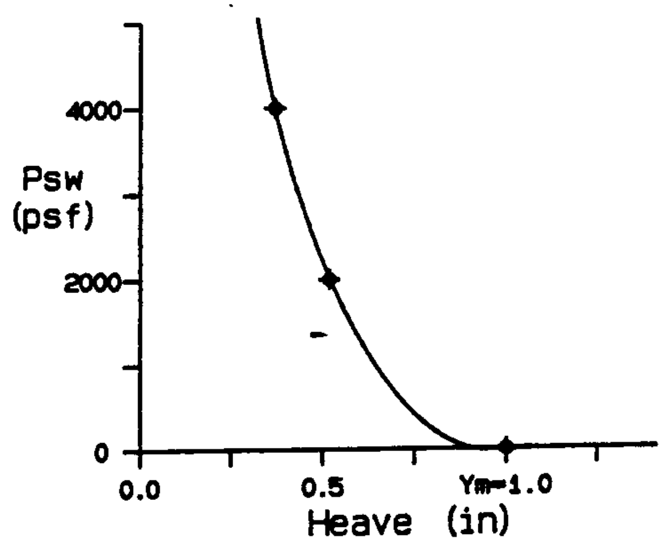
13. RIB D3/D4 (ref. Part I - 4.5)

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 Fisher
for ARTHUR D. DENYS, P.E.
Chief, Engineering Division

Encl

CONTENTS

DEVELOPMENT OF GEOTECHNICAL DESIGN PARAMETERS FOR RIBBED MAT FOUNDATIONS

1. REFERENCE.

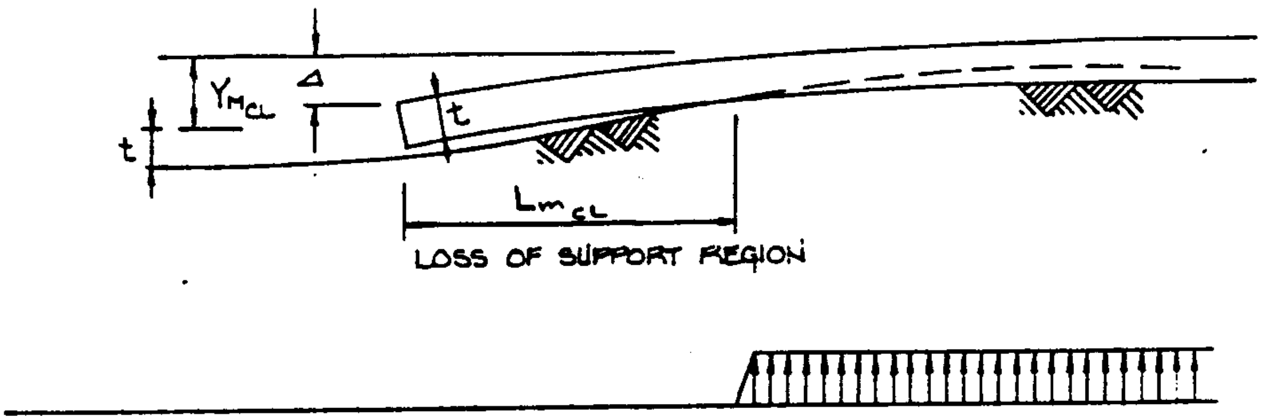
1.1 SWDED-TS/G, Design Criteria for Ribbed Mat Foundations, dated 23 Dec 86.

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

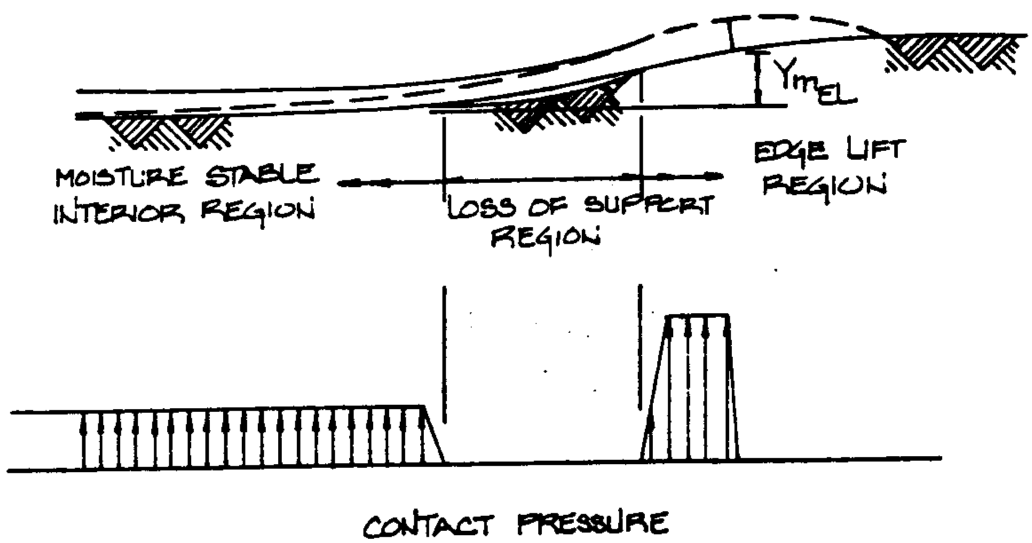


CENTER LIFT

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 <u>DESIGN ALLOWABLE BEARING</u>. 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.

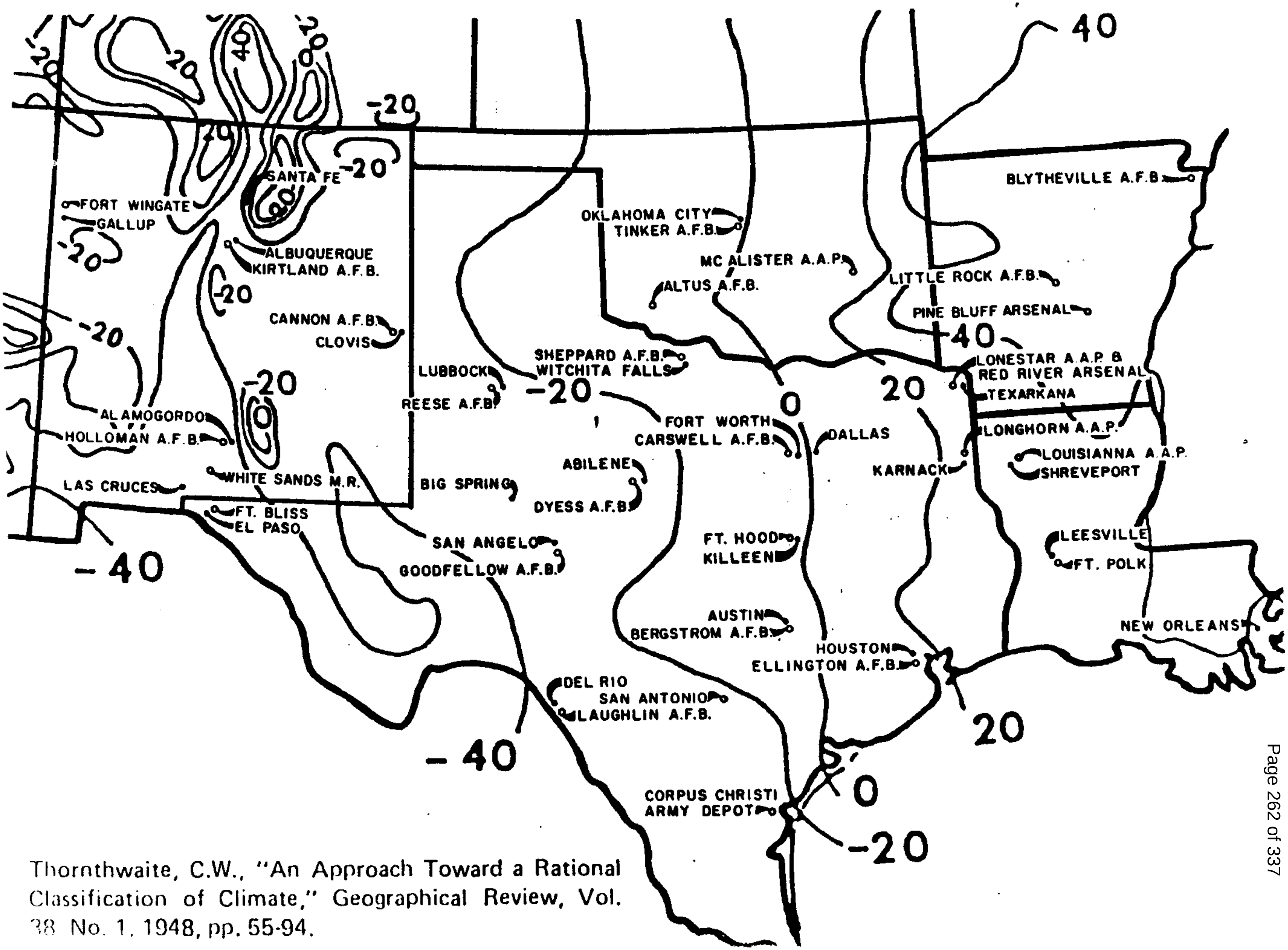
Expansion pressures should be developed versus depth using small depth intervals. These should be developed from laboratory data for the site. Additionally, these may be supplemented using proper correlations with nearby, preferably adjacent sites.

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

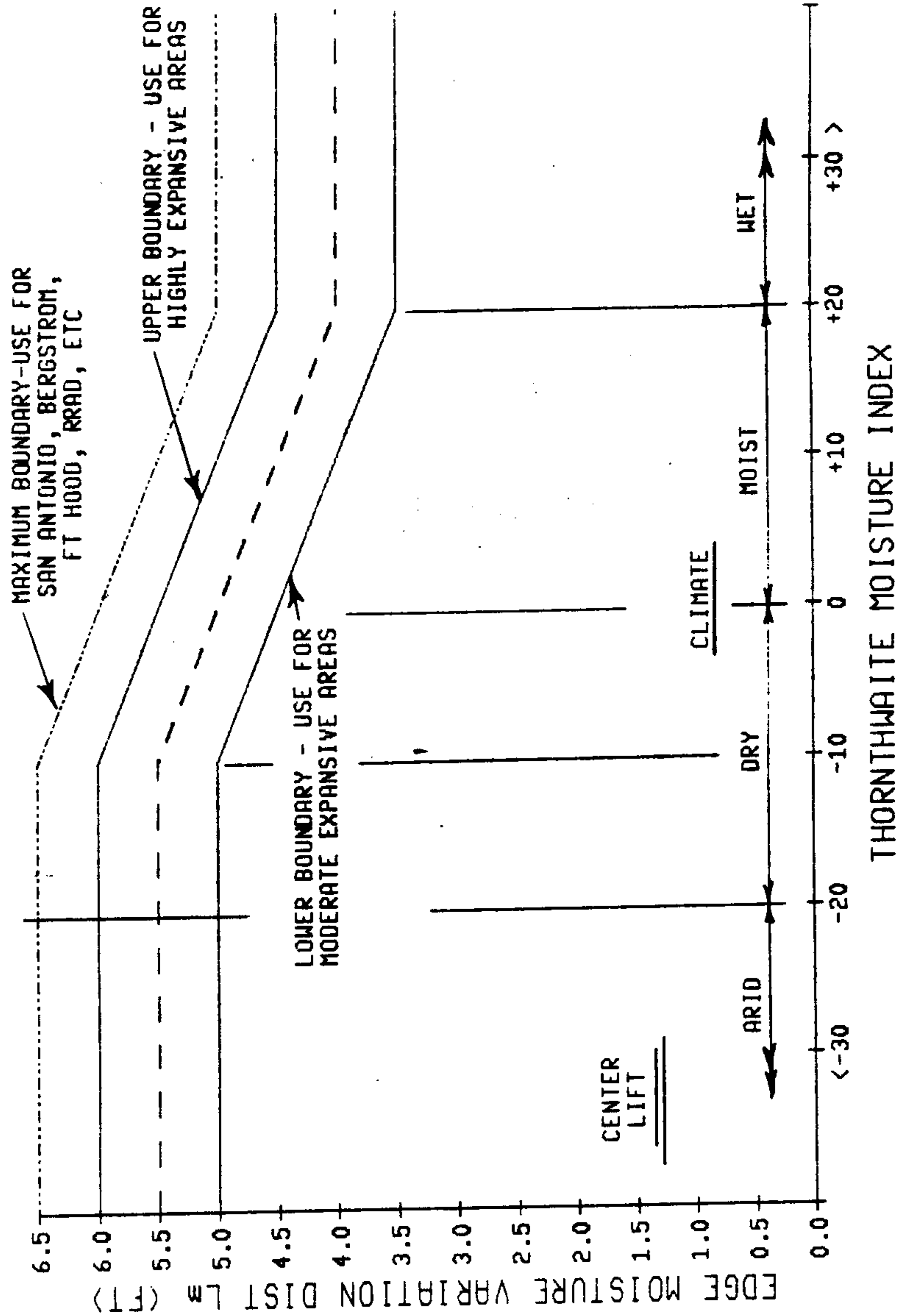
San Antonio area has been to assign upper or near upper bound values from TMI for design L_{MCL} values. At least two aspects of designs probably tend to moderate the actual edge moisture variation distance experienced; these being (1) relatively deep perimeter beams which act as a physical barrier and (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_{msL}) 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).

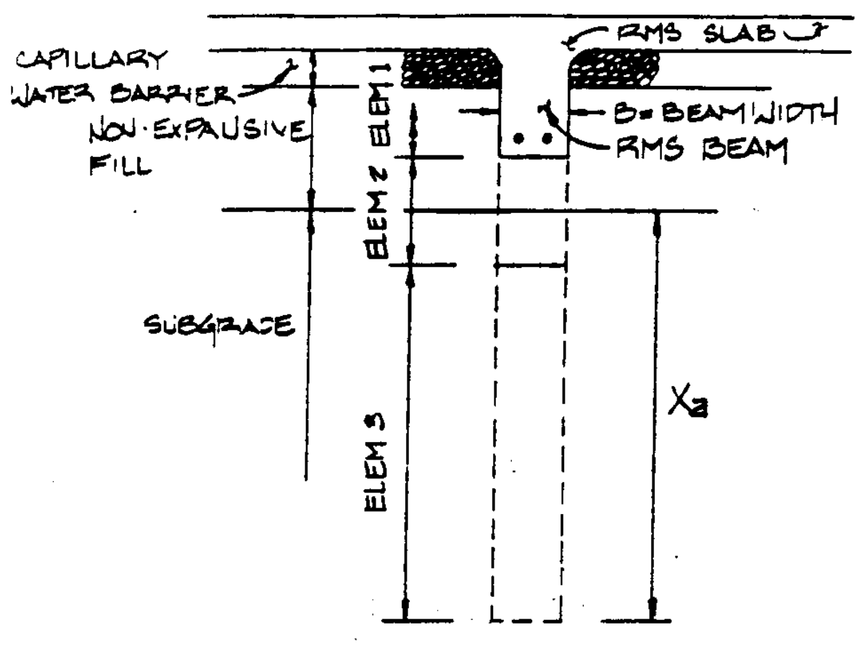


FIGURE 5

The load-deformation relationship of element 1 interacting with element 2 can be represented by a P-Y curve shown in figure 6.

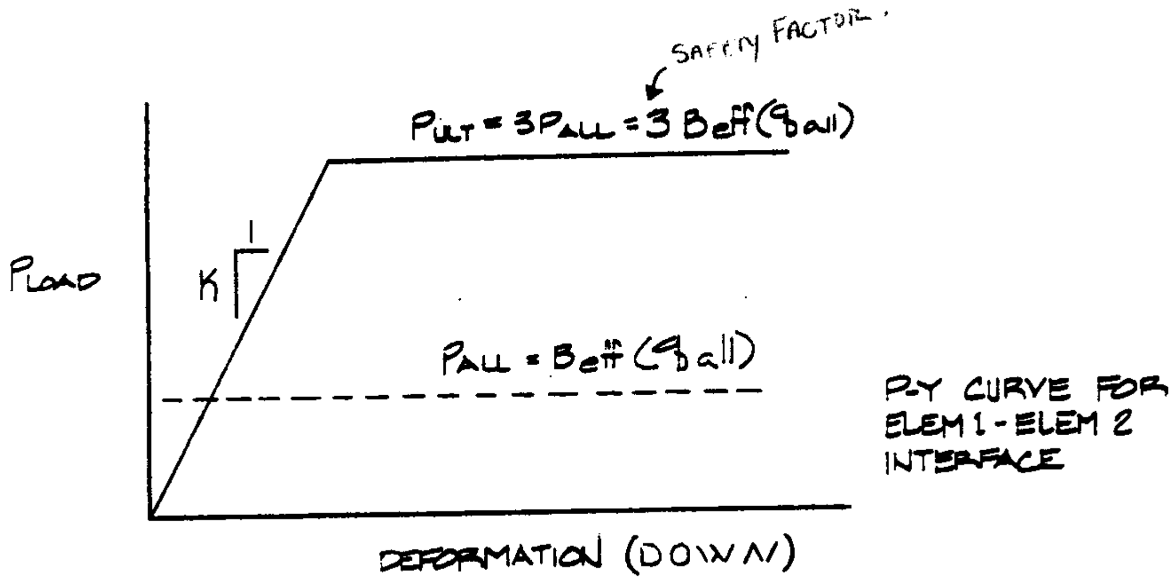


FIGURE 6

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.

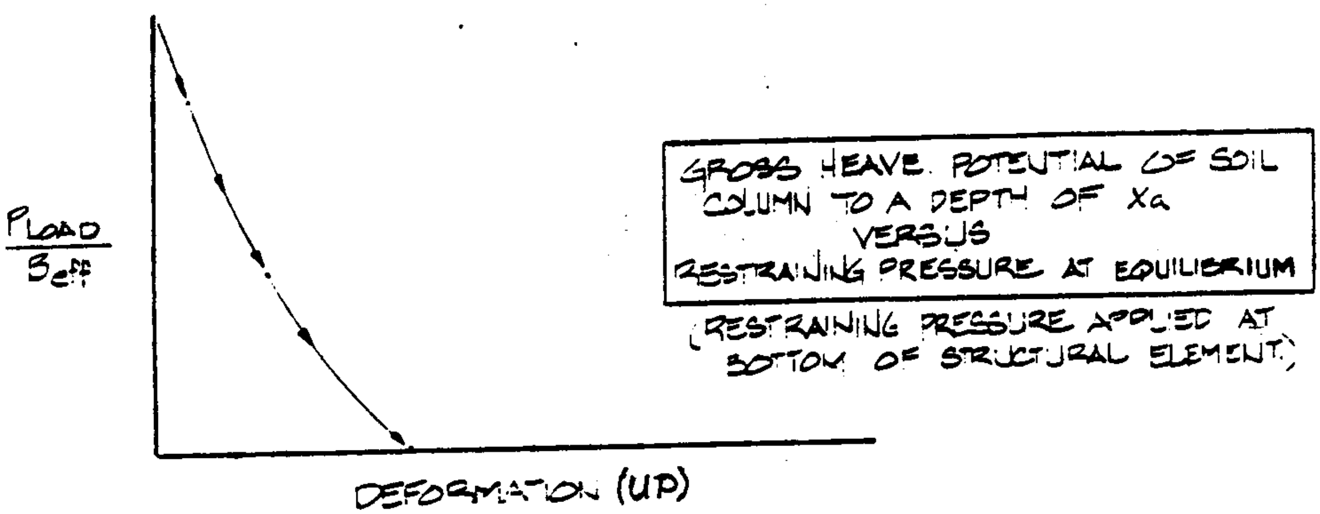
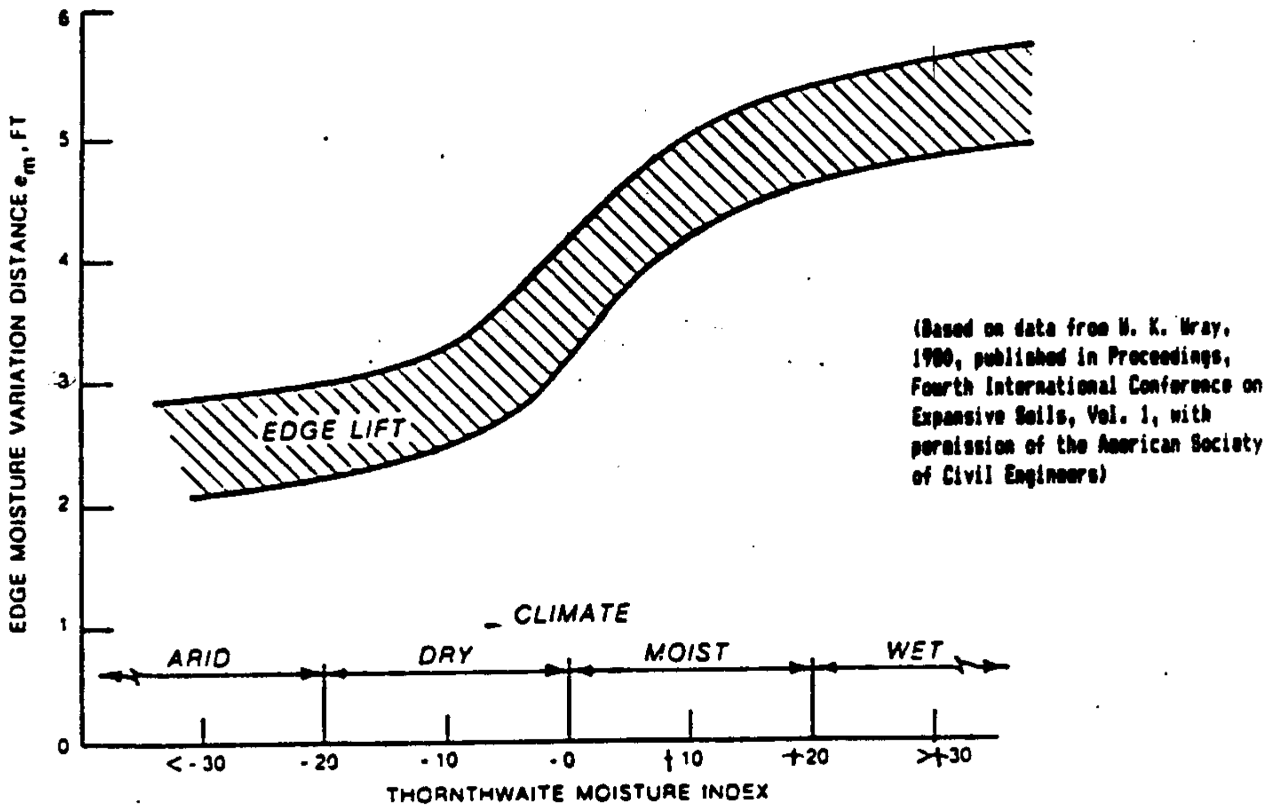


FIGURE 7

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 P_{SW} and
$P_{ULT} = F.S. \times P_{ALLOW}$
Y_{MBL} coordinates for (1) pressure equal to P_{ult}, (2) pressure equal to P_{all} and (3) pressure equal to zero.

4.2.3 EDGE MOISTURE VARIATION DISTANCE. 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 without 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. APPENDIX A

5.1 EXAMPLE PROBLEM. 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	Cu (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}). -

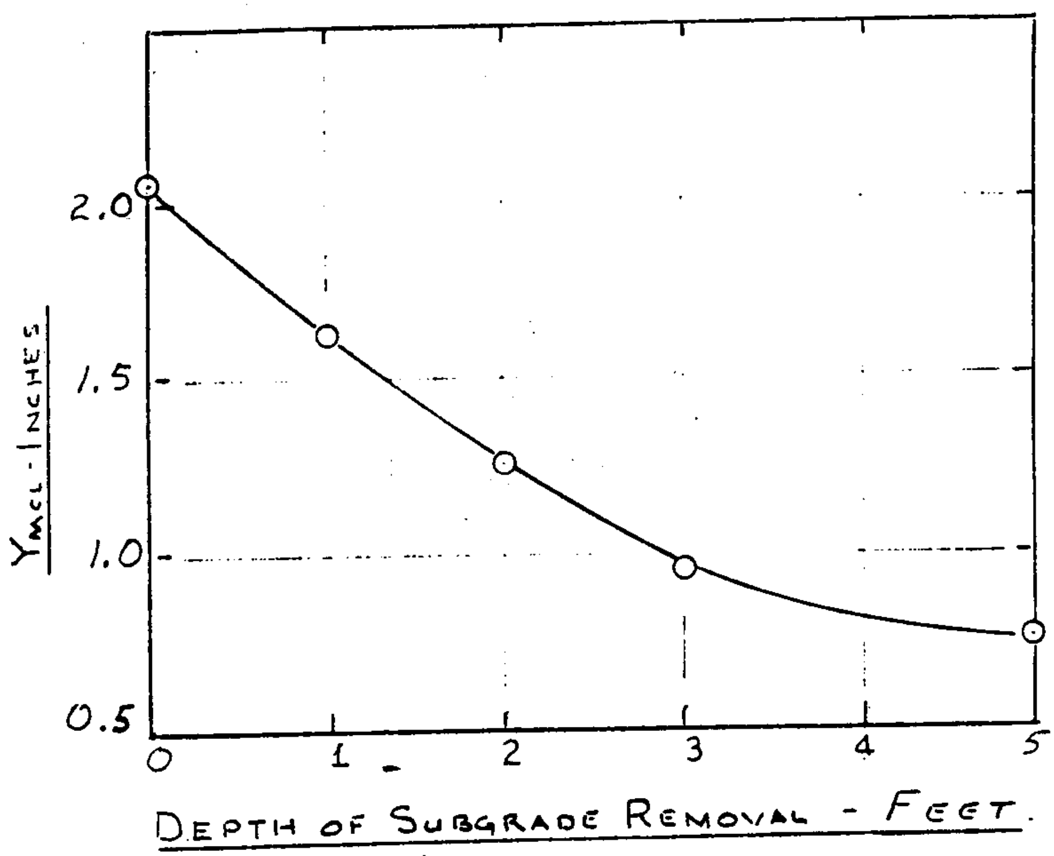
(a) Calculate site heave potential

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.

$C_s = .06$
$e_o = .60$

z (ft)	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. <u>Edge Moisture Variation Distance (L_{mcl})</u> - taken from figures 3 and 4 as L_{mcl} = 6.5 feet.

3. Determine parameters required for Edge Lift analyses:

a. <u>Modulus of Subgrade Reaction (K_1)</u>. - Same as for Center Lift.

b. <u>Design Allowable Bearing (q_{all})</u>. - Same as for Center Lift.

c. <u>Soil - Beam Interface Pressure (P_{sw})</u> and <u>Magnitude of Edge Lift Heave Potential (Y_{mel})</u>. -

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. <u>Edge Moisture Variation Distance. (L_{mel})</u>. 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

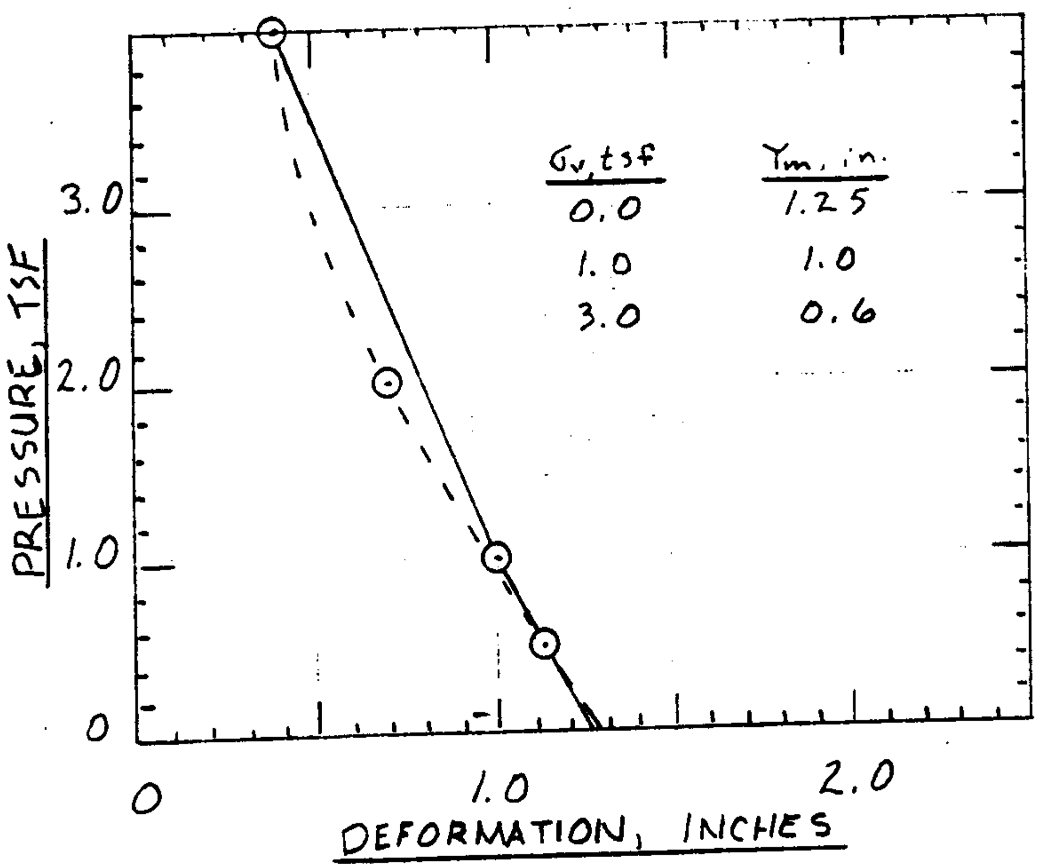
P_s = surcharge pressure next to beam

P_{exp} = expansion pressure

P_f = vertical pressure resisting heave below beam

P = stress @ depth due to to q_{app} $\Delta P = (I_s)(q_{app})$

$$P_f = \begin{cases} \Delta P + P_o \\ \text{or} \\ P_o + P_s \end{cases} \Bigg| \text{ whichever is greater}$$



EDGE LIFT PARAMETER

EXAMPLE PROBLEM

APPENDIX B
List of Drawings

Not Used

** REFER TO APPENDIX J FOR CONNECTION POINTS **

APPENDIX D
Results of Fire Flow Tests

Not Used

RECORD OF ENVIRONMENTAL CONSIDERATION
(32 CFR Part 651 [AR 200-2])

TO	FROM
Chief, DPW, Environmental Management Branch Fort Hood, Texas 76544	Kristina Manning Chief, Planning Branch Fort Hood, TX 76544

PROPOSED ACTION

PROJECT NUMBER	PROJECT TITLE
PN 67020	Pilot Knob Modified Record Fire (MRF) Range

Brief description (a copy of dd form 1391, military construction project data, or another description prepared to meet another requirement may be attached as appropriate).

Fort Hood plans to modify an existing range with the following ~ The primary features include 144 Stationary infantry targets, 32 target boots and 16 Foxholes. Associated Range Operations and Control facilities include a Standard Small Arms ROCA Facilities. A Small Arms ROCA includes: Range Operations Tower (657 SF), Operations/Storage Building (800 SF), General Instruction Building 800 SF), Latrine (330 SF), Bleacher Enclosure (726 SF), Covered Mess (800 SF), and an Ammo Breakdown Building (185SF). Supporting facilities are defined as the roads and utilities brought from existing roads and utilities to the line 5 feet outside the Range Flagpole.

The Modified Record Fire range will be used to train and test individual soldiers on the skills necessary to identify, engage, and defeat stationary infantry targets for day/night qualification requirements with the M16 and M4 rifles. This range modification combines the capabilities of 17803 Automated Field Fire (AFF) and 17805 Automated Record Fire (ARF) to reduce land and maintenance requirements and increase efficiencies at Fort Hood.

ANTICIPATED START DATE	DURATION
FY 2013	Until Complete

DETERMINATION

PROPOSED ACTION IS:
A. Adequately covered in **EA X** or EIS __ dated July 2006 (*Programatic EA ~ For the Construction and Modification of Range Projects Over the Next Ten Years*)
OR
B. Qualifies for Categorical Exclusion(s)

REASON(S) FOR USING RECORD OF ENVIRONMENTAL CONSIDERATION

This project was included in the July 2006 EA referenced above. Waters of the US (WOTUS) in the vicinity of this project were delinated and the project is proposed within a location that will not impact WOTUS.

There are not any threatened or endangered species habitat in this area and no significant archeological resources.

This action will not affect agricultural lands, wetlands, coastal zones, wilderness areas, aquifers, floodplains, wild and scenic rivers, or other areas of critical environmental concern.

All local, state, and federal laws shall be followed. All work should be in accordance with FH 200-1, as well as other applicable regulations.

NAME AND SIGNATURE OF THE PROPONENT OF ACTION		DATE
Kristina Manning Kristina Manning, Chief, Planning Branch, Fort Hood, Texas	254-287-7286	20 Jul 12

CONCURRENCE/NONCONCURRENCE

✓ CONCUR _____NONCONCUR

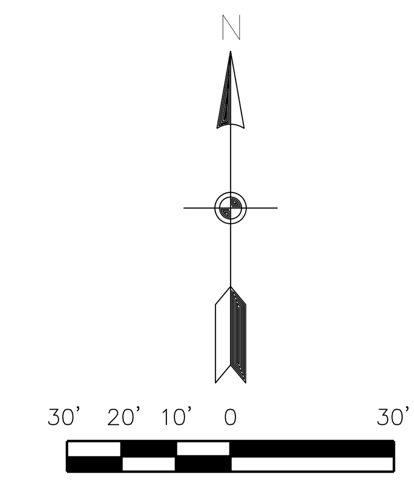
REASONS FOR NONCONCURRENCE:

CHIEF, DPW, ENVIRONMENTAL PROGRAMS	PHONE ~~NUMBER~~	DATE
Steven G. Burrow	254-287-6499	20 JUL 12

FHT FORM 1 JUL ~~89~~ ~~200~~-X2 (DPW) (AUTOMATED)

APPENDIX F
Conceptual Aesthetic Considerations

Not Used



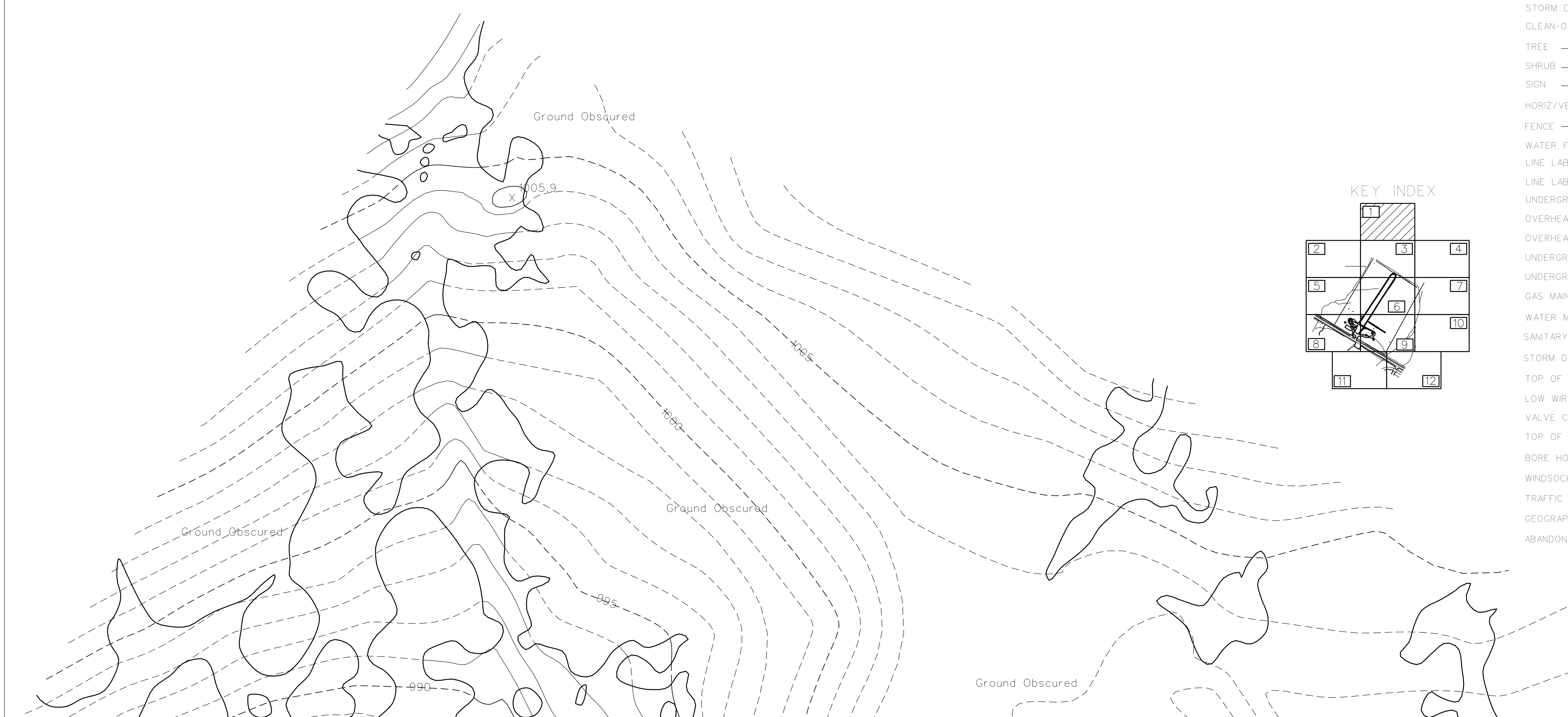
SCALE: 1"= 30'-0"

NOTE:
COORDINATES ARE SURFACE BASED ON
NAD 83(CORS) TEXAS CENTRAL ZONE AND
NAVD 88 (US FT).
SURFACE COORDINATES = GRID COORDINATES X 1.00014

COORDINATES ARE BASED ON
CONTROL POINT #1
N. 10395600.44
E. 3097045.31

NOTE: UTILITIES SHOWN ARE BASED ON ABOVE GROUND EVIDENCE AND EXISTING UTILITY MAPS.
UNDER GROUND LOCATIONS ARE APPROXIMATE.

CP 5
SET 1/2" IRON ROD
W/RED CAP
N=10397474.49
E=3098137.90
EL=1010.76



KEY INDEX

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11
12

LEGEND :

- CENTER LINE
- POWER POLE
- POWER POLE/TRANS. — XXXX
- LIGHT POLE
- LIGHT STANDARD
- HELIPAD LIGHT
- GUY WIRE
- ELECTRIC MANHOLE — E
- COMMUNICATION MANHOLE — C
- UTILITY BOX — X
- TRANSFORMER ON PAD — XXXX
- TRAFFIC SIGNAL BOX
- ELECTRIC PULLBOX — P
- TRAFFIC SIGNAL CONTROLLER
- GAS VALVE
- GAS METER
- SPRINKLER CONTROL VALVE
- GUARD POST
- BOLLARD
- WATER VALVE
- WATER METER
- FIRE HYDRANT — X
- SPRINKLER HEADS
- SAN. SEWER MANHOLE
- STORM DRAIN MANHOLE
- CLEAN-OUT
- TREE
- SHRUB
- SIGN
- HORIZ/VERT CONTROL POINT
- FENCE — X X
- WATER FAUCET
- LINE LABEL ON OVERHEAD UTILITY — OH
- LINE LABEL ON UNDERGROUND UTILITY — UG
- UNDERGROUND ELECTRIC CONDUIT — UE
- OVERHEAD SHIELD WIRE — OHS
- OVERHEAD ELECTRIC LINE — E_X
- UNDERGROUND ELECTRIC LINE — E^U_X
- UNDERGROUND COMMUNICATION LINE — C^U_X
- GAS MAIN LINE — G_X
- WATER MAIN LINE — W_X
- SANITARY SEWER MAIN LINE — SS_X
- STORM DRAIN MAIN LINE — SD_X
- TOP OF POLE — TP
- LOW WIRE ELEVATION — LW
- VALVE COVER — VC
- TOP OF VALVE — TV
- BORE HOLE (UNDRILLED)
- WINDSOCK
- TRAFFIC SIGNAL ARM
- GEOGRAPHIC INFORMATION SYSTEM — (GIS)
- ABANDONED IN PLACE — (AIP)

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US ARMY CORPS OF ENGINEERS
FORT WORTH DISTRICT

Mark	Description	Date	Appr.

U.S. ARMY ENGINEER DISTRICT,
CORPS OF ENGINEERS
FORT WORTH, TEXAS

K. M. NG & ASSOCIATES, INC.
CONSULTING ENGINEERS
SAN ANTONIO, TEXAS 78201
TEXAS REGISTERED ENGINEERING FIRM F-442

Designed by: X		Date: JANUARY 2011	Rev.
Dwn by: X	Ckd by: X	Contract No:	
Reviewed by: X		Task Order No: X	
Submitted by: Kung M. Ng, P.E.			

FORT HOOD, TEXAS
MODIFIED RECORD FIRING RANGE
PROJECT NO.
110155

TOPOGRAPHIC SURVEY

BUILDING NO.

PROJECT NO.
AD018030P

DMI NO.

SHEET REFERENCE NUMBER:
V-101

Sheet 1 of 12

DESIGN FILE:

Contr No.

Section:

$TIME$ $DATE$ $FILE$

LEGEND :

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POWER POLE/TRANS.	XXXX
LIGHT POLE	
LIGHT STANDARD	
HELIPAD LIGHT	
GUY WIRE	
ELECTRIC MANHOLE	E
COMMUNICATION MANHOLE	C
UTILITY BOX	
TRANSFORMER ON PAD	XXXX
TRAFFIC SIGNAL BOX	
ELECTRIC PULLBOX	
TRAFFIC SIGNAL CONTROLLER	
GAS VALVE	
GAS METER	
SPRINKLER CONTROL VALVE	
GUARD POST	
BOLLARD	
WATER VALVE	
WATER METER	
FIRE HYDRANT	
SPRINKLER HEADS	(o)
SAN. SEWER MANHOLE	
STORM DRAIN MANHOLE	
CLEAN-OUT	
TREE	
SHRUB	
SIGN	
HORIZ/VERT CONTROL POINT	
FENCE	-X-X-
WATER FAUCET	
LINE LABEL ON OVERHEAD UTILITY	OH
LINE LABEL ON UNDERGROUND UTILITY	UG
UNDERGROUND ELECTRIC CONDUIT	UE
OVERHEAD SHIELD WIRE	OHS
OVERHEAD ELECTRIC LINE	E_x
UNDERGROUND ELECTRIC LINE	E^U_x
UNDERGROUND COMMUNICATION LINE	C^U_x
GAS MAIN LINE	G_x
WATER MAIN LINE	W_x
SANITARY SEWER MAIN LINE	SS_x
STORM DRAIN MAIN LINE	SD_x
TOP OF POLE	TP
LOW WIRE ELEVATION	LW
VALVE COVER	VC
TOP OF VALVE	TV
BORE HOLE (UNDRILLED)	
WINDSOCK	
TRAFFIC SIGNAL ARM	
GEOGRAPHIC INFORMATION SYSTEM	(GIS)
ABANDONED IN PLACE	(AIP)

N

30' 20' 10' 0 30'

SCALE: 1"= 30'-0"

NOTE:
COORDINATES ARE SURFACE BASED ON
NAD 83(CORS) TEXAS CENTRAL ZONE AND
NAVD 88 (US FT).
SURFACE COORDINATES = GRID COORDINATES X 1.00014

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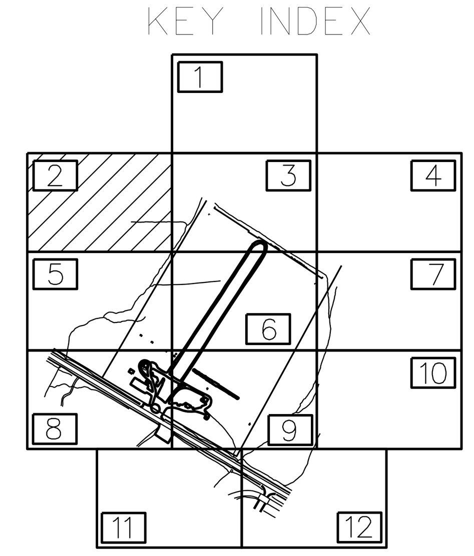
KEY INDEX



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U.S. ARMY ENGINEER DISTRICT,
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FORT WORTH, TEXAS

K.M. NG & ASSOCIATES, INC.
CONSULTING ENGINEERS
SAN ANTONIO, TEXAS 78201
TEXAS REGISTERED ENGINEERING FIRM F-442

Designed by: X	Date: JANUARY 2011	Rev.
Dwn by: X / Ckd by: X	Contract No:	
Reviewed by: X	Task Order No: X	
Submitted by: Kung M. Ng, P.E.		

FORT HOOD, TEXAS
MODIFIED RECORD FIRING RANGE
PROJECT NO.
110155

TOPOGRAPHIC SURVEY

BUILDING NO.

PROJECT NO.
AD018030P

DMI NO.

SHEET
REFERENCE
NUMBER:
V-102
Sheet 2 of 12

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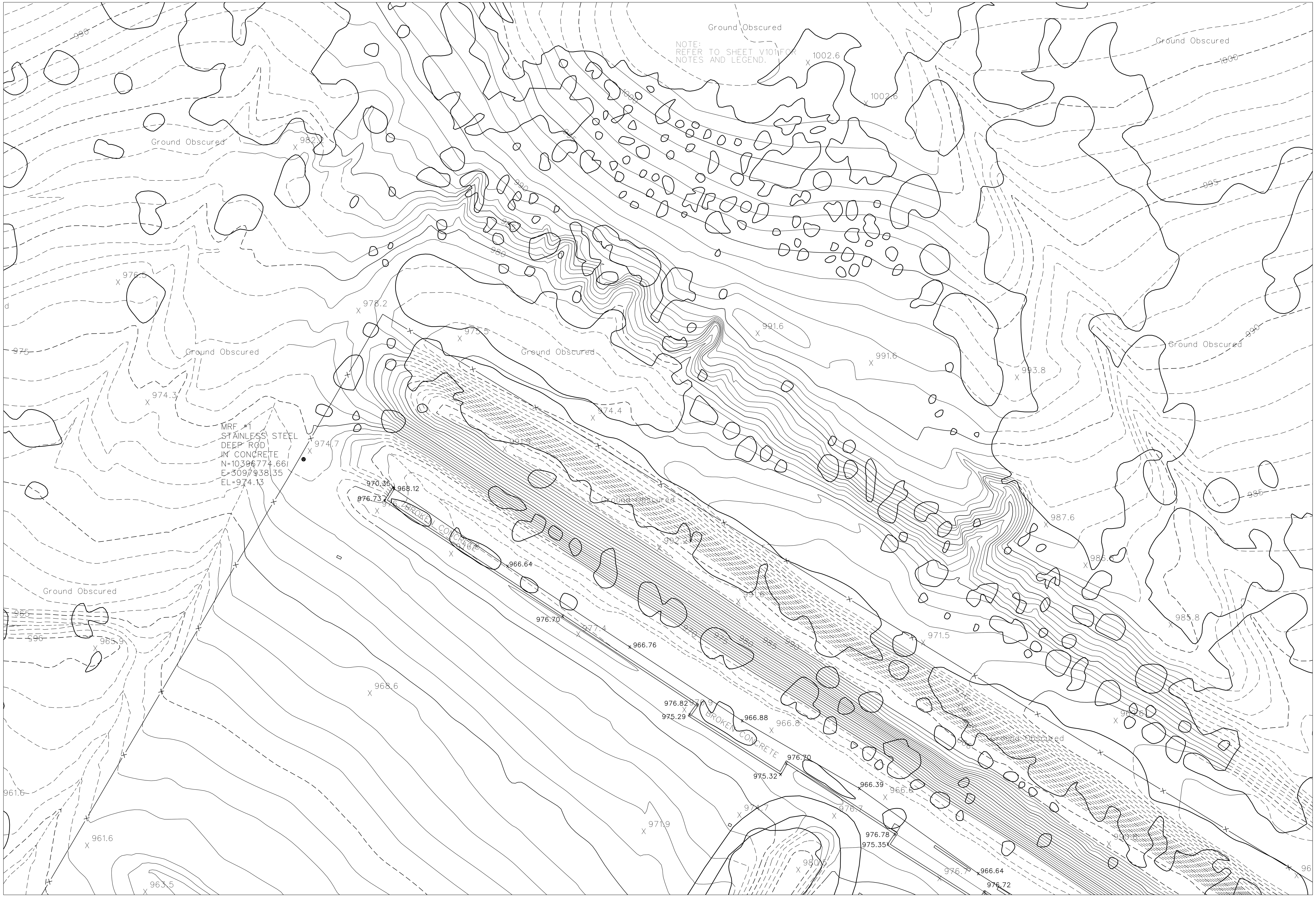

US ARMY CORPS OF ENGINEERS
FORT WORTH DISTRICT

Mark	Description	Date	Appr.

Date: JANUARY 2011
Rev.: MAY 2011
Contract No.:
Task Order No.: X
Designed by: X
Dwn by: X
Ckd by: X
Reviewed by: X
Submitted by: Kung M. Ng, P.E.

U.S. ARMY ENGINEER DISTRICT,
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FORT WORTH, TEXAS

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TEXAS REGISTERED ENGINEERING FIRM F-442

FORT HOOD TEXAS
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PROJECT NO.
110155

TOPOGRAPHIC SURVEY

BUILDING NO.

PROJECT NO.
AD018030P

DMI NO.

SHEET REFERENCE NUMBER:
V-103
Sheet 3 of 12

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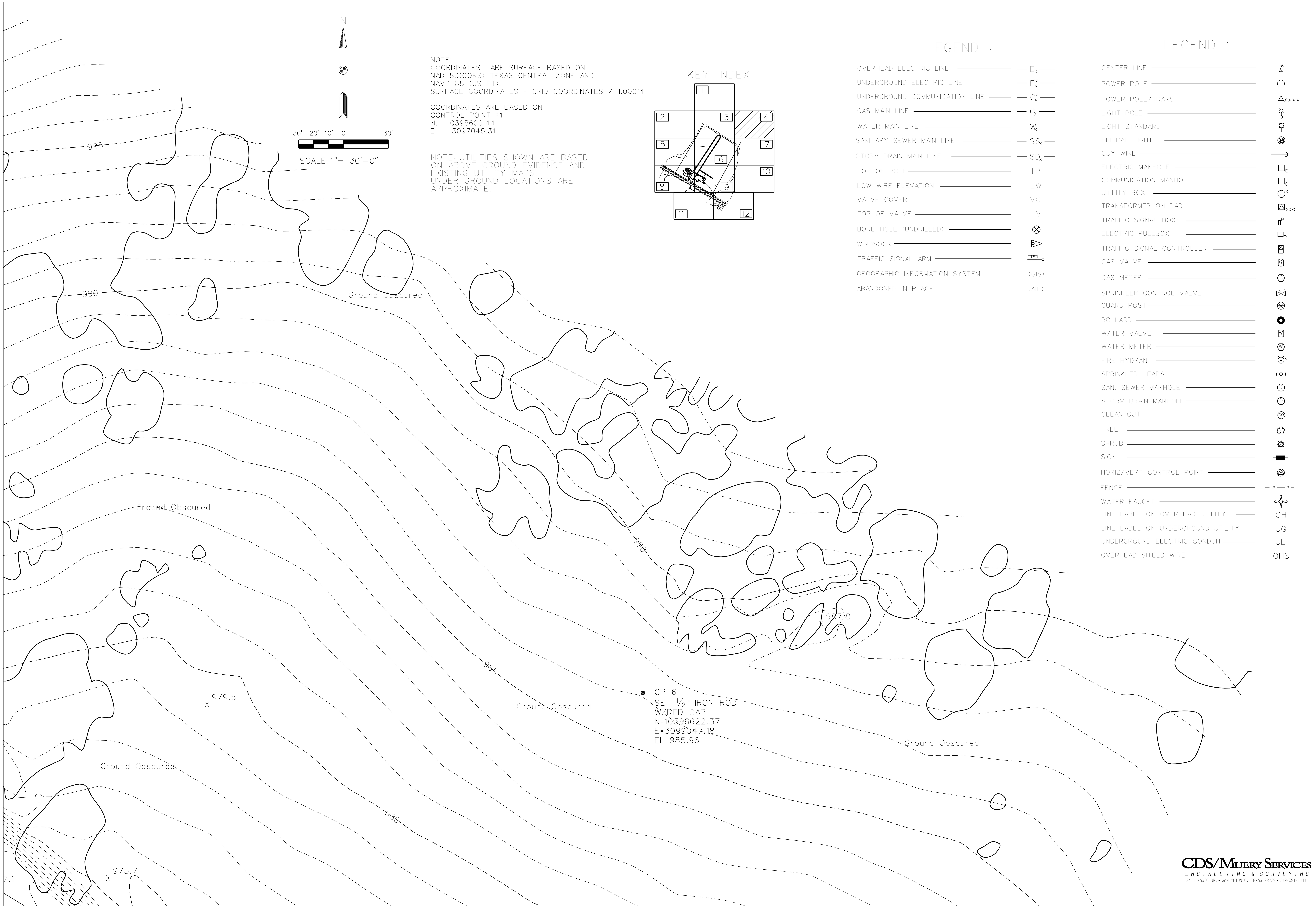

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N. 10395600.44
E. 3097045.31

NOTE: UTILITIES SHOWN ARE BASED ON ABOVE GROUND EVIDENCE AND EXISTING UTILITY MAPS. UNDER GROUND LOCATIONS ARE APPROXIMATE.

LEGEND :

OVERHEAD ELECTRIC LINE	E_x
UNDERGROUND ELECTRIC LINE	E^u_x
UNDERGROUND COMMUNICATION LINE	C^u_x
GAS MAIN LINE	G_x
WATER MAIN LINE	W_x
SANITARY SEWER MAIN LINE	SS_x
STORM DRAIN MAIN LINE	SD_x
TOP OF POLE	TP
LOW WIRE ELEVATION	LW
VALVE COVER	VC
TOP OF VALVE	TV
BORE HOLE (UNDRILLED)	⊗
WINDSOCK	
TRAFFIC SIGNAL ARM	
GEOGRAPHIC INFORMATION SYSTEM	(GIS)
ABANDONED IN PLACE	(AIP)

LEGEND :

CENTER LINE	℄
POWER POLE	○
POWER POLE/TRANS.	△XXXX
LIGHT POLE	
LIGHT STANDARD	
HELIPAD LIGHT	
GUY WIRE	
ELECTRIC MANHOLE	□E
COMMUNICATION MANHOLE	□C
UTILITY BOX	(J)X
TRANSFORMER ON PAD	XXXX
TRAFFIC SIGNAL BOX	P
ELECTRIC PULLBOX	□P
TRAFFIC SIGNAL CONTROLLER	
GAS VALVE	G
GAS METER	G
SPRINKLER CONTROL VALVE	SC
GUARD POST	
BOLLARD	
WATER VALVE	W
WATER METER	W
FIRE HYDRANT	
SPRINKLER HEADS	(o)
SAN. SEWER MANHOLE	S
STORM DRAIN MANHOLE	D
CLEAN-OUT	CO
TREE	
SHRUB	
SIGN	
HORIZ/VERT CONTROL POINT	
FENCE	-X-X-
WATER FAUCET	
LINE LABEL ON OVERHEAD UTILITY	OH
LINE LABEL ON UNDERGROUND UTILITY	UG
UNDERGROUND ELECTRIC CONDUIT	UE
OVERHEAD SHIELD WIRE	OHS

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Ckd by: X
Reviewed by: X
Submitted by: Kung M. Ng, P.E.
Date: JANUARY 2011
Contract No:
Task Order No: X
Rev.

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

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FORT HOOD, TEXAS
MODIFIED RECORD FIRING RANGE
PROJECT NO. 110155
TOPOGRAPHIC SURVEY

BUILDING NO.

PROJECT NO.
AD018030P

DMI NO.

SHEET REFERENCE NUMBER:
V-104
Sheet 4 of 12

DESIGN FILE:
Contr No.
Section:

LEGEND :

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POWER POLE/TRANS.	XXXX
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HELIPAD LIGHT	
GUY WIRE	
ELECTRIC MANHOLE	
COMMUNICATION MANHOLE	
UTILITY BOX	
TRANSFORMER ON PAD	XXXX
TRAFFIC SIGNAL BOX	
ELECTRIC PULLBOX	
TRAFFIC SIGNAL CONTROLLER	
GAS VALVE	
GAS METER	
SPRINKLER CONTROL VALVE	
GUARD POST	
BOLLARD	
WATER VALVE	
WATER METER	
FIRE HYDRANT	
SPRINKLER HEADS	
SAN. SEWER MANHOLE	
STORM DRAIN MANHOLE	
CLEAN-OUT	
TREE	
SHRUB	
SIGN	
HORIZ/VERT CONTROL POINT	
FENCE	
WATER FAUCET	
LINE LABEL ON OVERHEAD UTILITY	OH
LINE LABEL ON UNDERGROUND UTILITY	UG
UNDERGROUND ELECTRIC CONDUIT	UE
OVERHEAD SHIELD WIRE	OHS
OVERHEAD ELECTRIC LINE	Ex
UNDERGROUND ELECTRIC LINE	Ex
UNDERGROUND COMMUNICATION LINE	Cx
GAS MAIN LINE	Gx
WATER MAIN LINE	Wx
SANITARY SEWER MAIN LINE	SSx
STORM DRAIN MAIN LINE	SDx
TOP OF POLE	TP
LOW WIRE ELEVATION	LW
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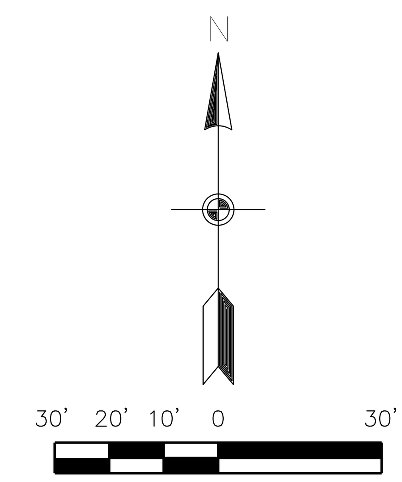
BORE HOLE (UNDRILLED)	
WINDSOCK	
TRAFFIC SIGNAL ARM	
GEOGRAPHIC INFORMATION SYSTEM	(GIS)
ABANDONED IN PLACE	(AIP)



SCALE: 1"= 30'-0"

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E. 3097045.31

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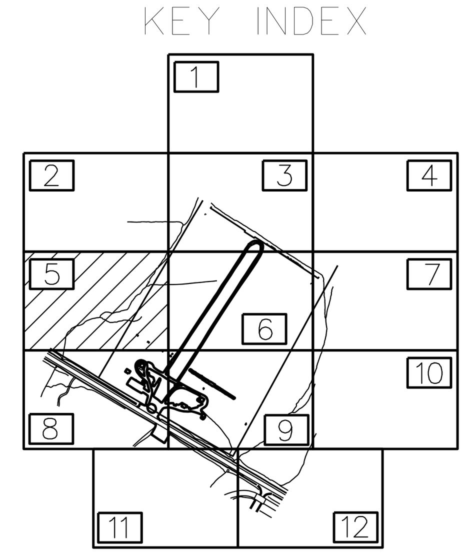
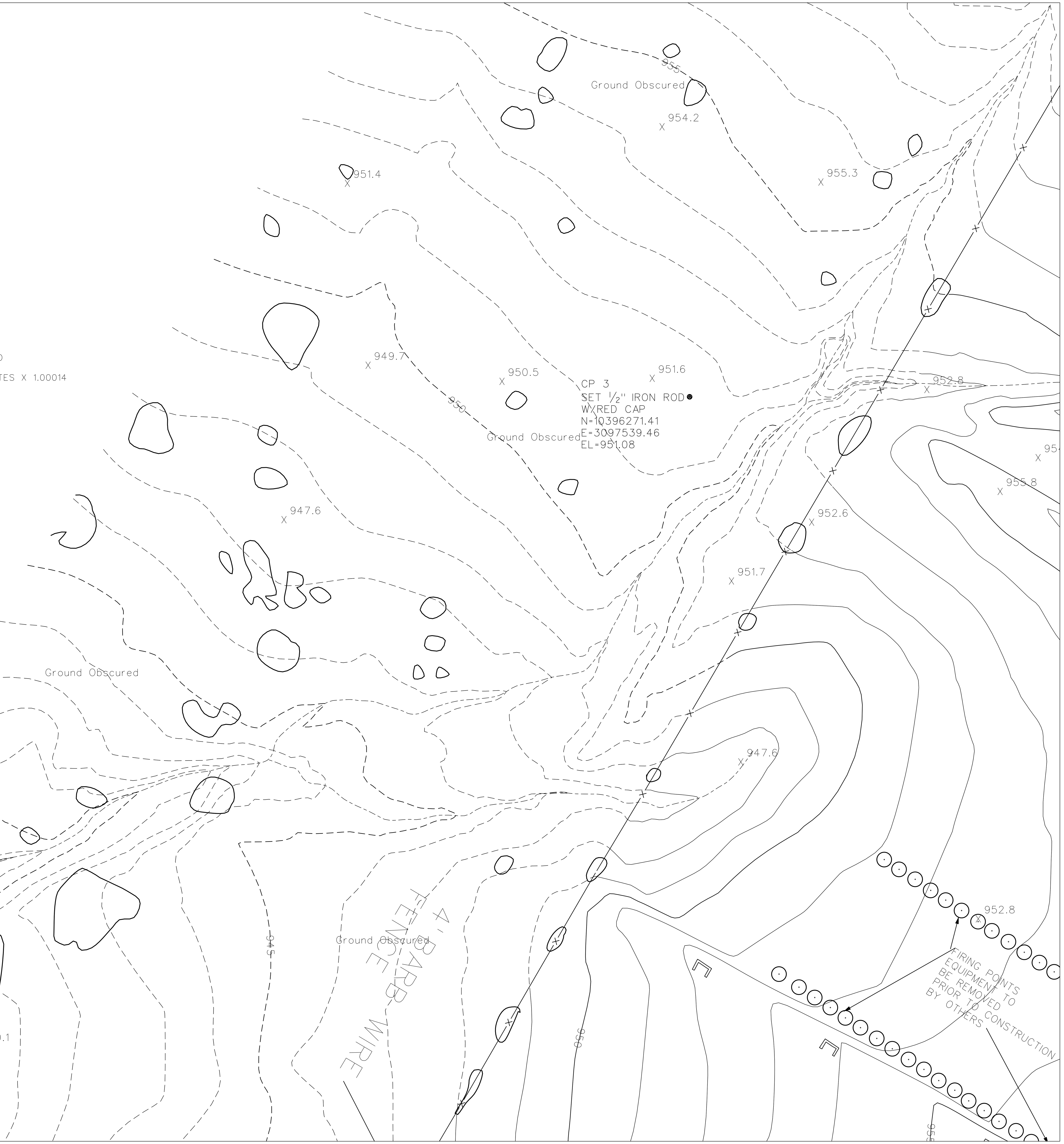
KEY INDEX





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US ARMY CORPS OF ENGINEERS
FORT WORTH DISTRICT

Mark	Description	Date	Appr.

Designed by: X	Dwn by: X	Reviewed by: X	Submitted by: Kung M. Ng, P.E.
Ckd by: X	Date: JANUARY 2011	Contract No.:	Task Order No.: X
Rev.			

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

K.M. NG & ASSOCIATES, INC. CONSULTING ENGINEERS SAN ANTONIO, TEXAS 78230 TEXAS REGISTERED ENGINEERING FIRM F-442

FORT HOOD TEXAS
MODIFIED RECORD FIRING RANGE
PROJECT NO. 110155

TOPOGRAPHIC SURVEY

BUILDING NO.

PROJECT NO. AD018030P

DMI NO.

SHEET REFERENCE NUMBER:
V-105
Sheet 5 of 12

DESIGN FILE:

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US ARMY CORPS
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FORT WORTH DISTRICT

Mark	Description	Date	Appr.

Designed by: X
Dwn by: X
Ckd by: X
Reviewed by: X
Submitted by: Kung M. Ng, P.E.
Date: JANUARY 2011
Rev.: APRIL 2011
Contract No.:
Task Order No.: X

U.S. ARMY ENGINEER DISTRICT,
CORPS OF ENGINEERS
FORT WORTH, TEXAS

K.M. NG & ASSOCIATES, INC.
CONSULTING ENGINEERS
SAN ANTONIO, TEXAS 78201
TEXAS REGISTERED ENGINEERING FIRM F-442

FORT HOOD TEXAS
MODIFIED RECORD FIRING RANGE
PROJECT NO.
110155

TOPOGRAPHIC SURVEY

BUILDING NO.

PROJECT NO.
AD018030P

DMI NO.

SHEET
REFERENCE
NUMBER:
V-106

Sheet 6 of 12

DESIGN FILE:

Contr No.

NOTE:
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E. 3097045.31

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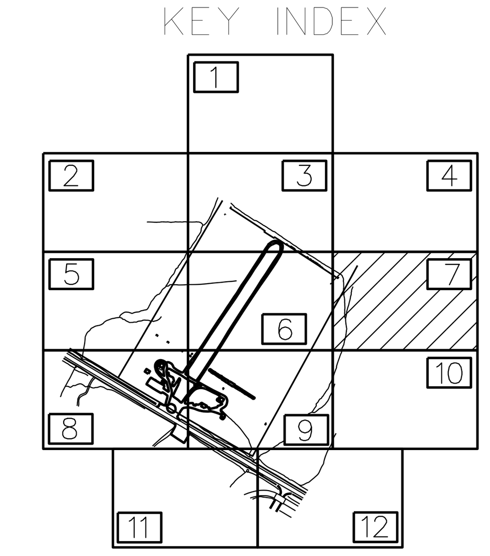
KEY INDEX



LEGEND:

- CENTER LINE
- POWER POLE
- POWER POLE/TRANS. — XXXX
- LIGHT POLE
- LIGHT STANDARD
- HELIPAD LIGHT
- GUY WIRE
- ELECTRIC MANHOLE — E
- COMMUNICATION MANHOLE — C
- UTILITY BOX
- TRANSFORMER ON PAD — XXXX
- TRAFFIC SIGNAL BOX
- ELECTRIC PULLBOX
- TRAFFIC SIGNAL CONTROLLER
- GAS VALVE
- GAS METER
- SPRINKLER CONTROL VALVE
- GUARD POST
- BOLLARD
- WATER VALVE
- WATER METER
- FIRE HYDRANT
- SPRINKLER HEADS
- SAN. SEWER MANHOLE
- STORM DRAIN MANHOLE
- CLEAN-OUT
- TREE
- SHRUB
- SIGN
- HORIZ/VERT CONTROL POINT
- FENCE
- WATER FAUCET
- LINE LABEL ON OVERHEAD UTILITY — OH
- LINE LABEL ON UNDERGROUND UTILITY — UG
- UNDERGROUND ELECTRIC CONDUIT — UE
- OVERHEAD SHIELD WIRE — OHS
- OVERHEAD ELECTRIC LINE — E_x
- UNDERGROUND ELECTRIC LINE — E^U_x
- UNDERGROUND COMMUNICATION LINE — C^U_x
- GAS MAIN LINE — G_x
- WATER MAIN LINE — W_x
- SANITARY SEWER MAIN LINE — SS_x
- STORM DRAIN MAIN LINE — SD_x
- TOP OF POLE — TP
- LOW WIRE ELEVATION — LW
- VALVE COVER — VC
- TOP OF VALVE — TV
- BORE HOLE (UNDRILLED)
- WINDSOCK
- TRAFFIC SIGNAL ARM
- GEOGRAPHIC INFORMATION SYSTEM — (GIS)
- ABANDONED IN PLACE — (AIP)

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3411 MAGIC DR. • SAN ANTONIO, TEXAS 78229 • 210-581-1111

US ARMY CORPS OF ENGINEERS
FORT WORTH DISTRICT

Mark	Description	Date	Appr.

Designed by: X		Date: JANUARY 2011	Rev. MAY 2011
Dwn by: X	Ckd by: X	Contract No:	
Reviewed by: X		Task Order No: X	
Submitted by: Kung M. Ng, P.E.			

U.S. ARMY ENGINEER DISTRICT,
CORPS OF ENGINEERS
FORT WORTH, TEXAS

K. M. NG & ASSOCIATES, INC.
CONSULTING ENGINEERS
SAN ANTONIO, TEXAS 78201
TEXAS REGISTERED ENGINEERING FIRM F-442

FORT HOOD, TEXAS
MODIFIED RECORD FIRING RANGE
PROJECT NO.
110155

TOPOGRAPHIC SURVEY

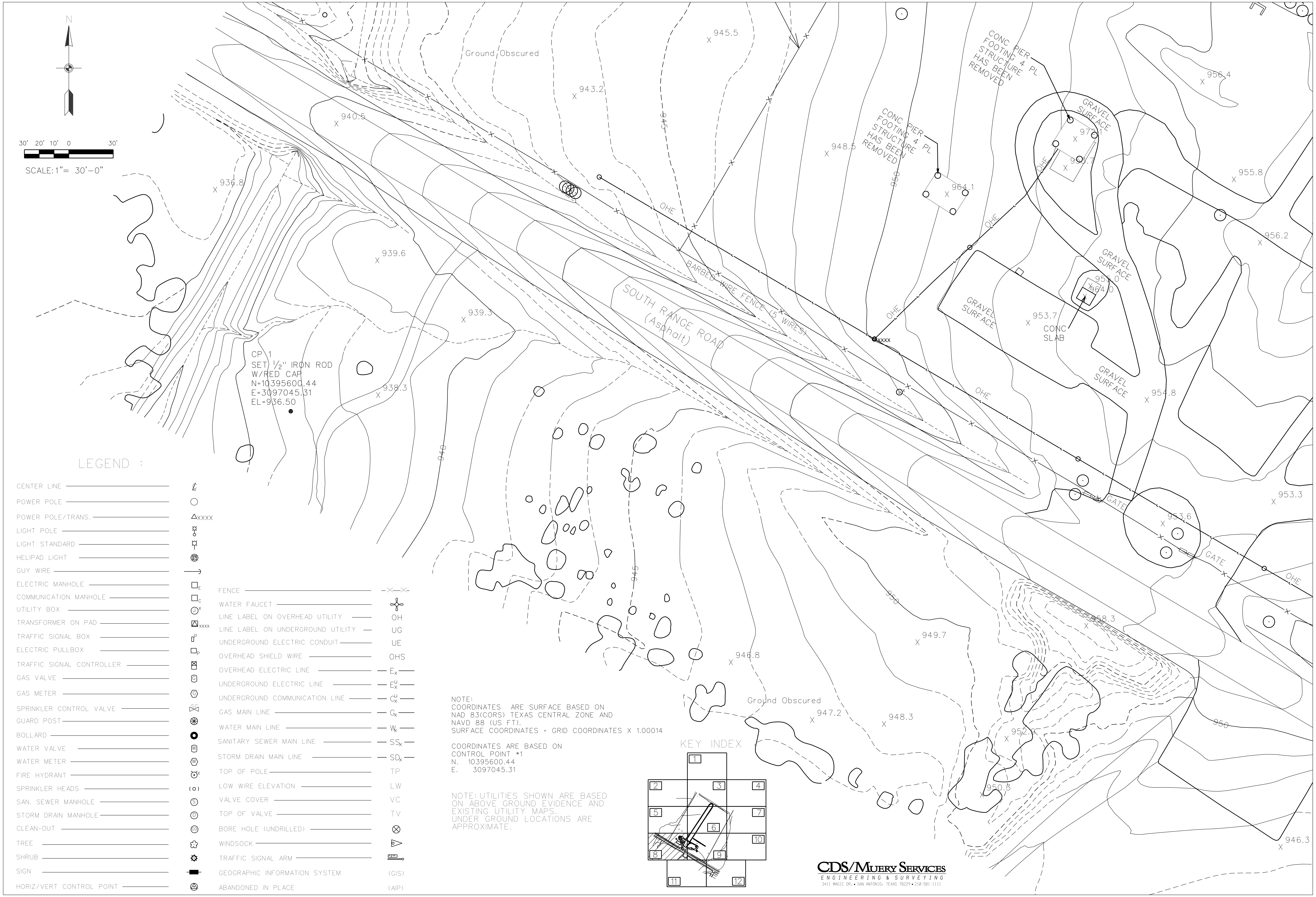
BUILDING NO.

PROJECT NO.
AD018030P

DMI NO.

SHEET REFERENCE NUMBER:
V-107
Sheet 7 of 12

1 2 3 4 5
D C B A
Section:
DESIGN FILE:
Contr No.



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- LIGHT POLE
- LIGHT STANDARD
- HELIPAD LIGHT
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- SHRUB
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- LINE LABEL ON UNDERGROUND UTILITY — UG
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- OVERHEAD SHIELD WIRE — OHS
- OVERHEAD ELECTRIC LINE — Ex
- UNDERGROUND ELECTRIC LINE — EUx
- UNDERGROUND COMMUNICATION LINE — CUx
- GAS MAIN LINE — Gx
- WATER MAIN LINE — Wx
- SANITARY SEWER MAIN LINE — SSx
- STORM DRAIN MAIN LINE — SDx
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- ABANDONED IN PLACE — (AIP)

NOTE:
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SURFACE COORDINATES = GRID COORDINATES X 1.00014

COORDINATES ARE BASED ON CONTROL POINT #1
N. 10395600.44
E. 3097045.31

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FORT HOOD TEXAS
MODIFIED RECORD FIRING RANGE
PROJECT NO. 110155

TOPOGRAPHIC SURVEY

BUILDING NO.

PROJECT NO. AD018030P

DMI NO.

SHEET REFERENCE NUMBER: V-108

Sheet 8 of 12

DESIGN FILE:

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FORT WORTH DISTRICT

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FORT HOOD, TEXAS
MODIFIED RECORD FIRING RANGE
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110155

TOPOGRAPHIC SURVEY

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AD018030P

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REFERENCE
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Sheet 9 of 12

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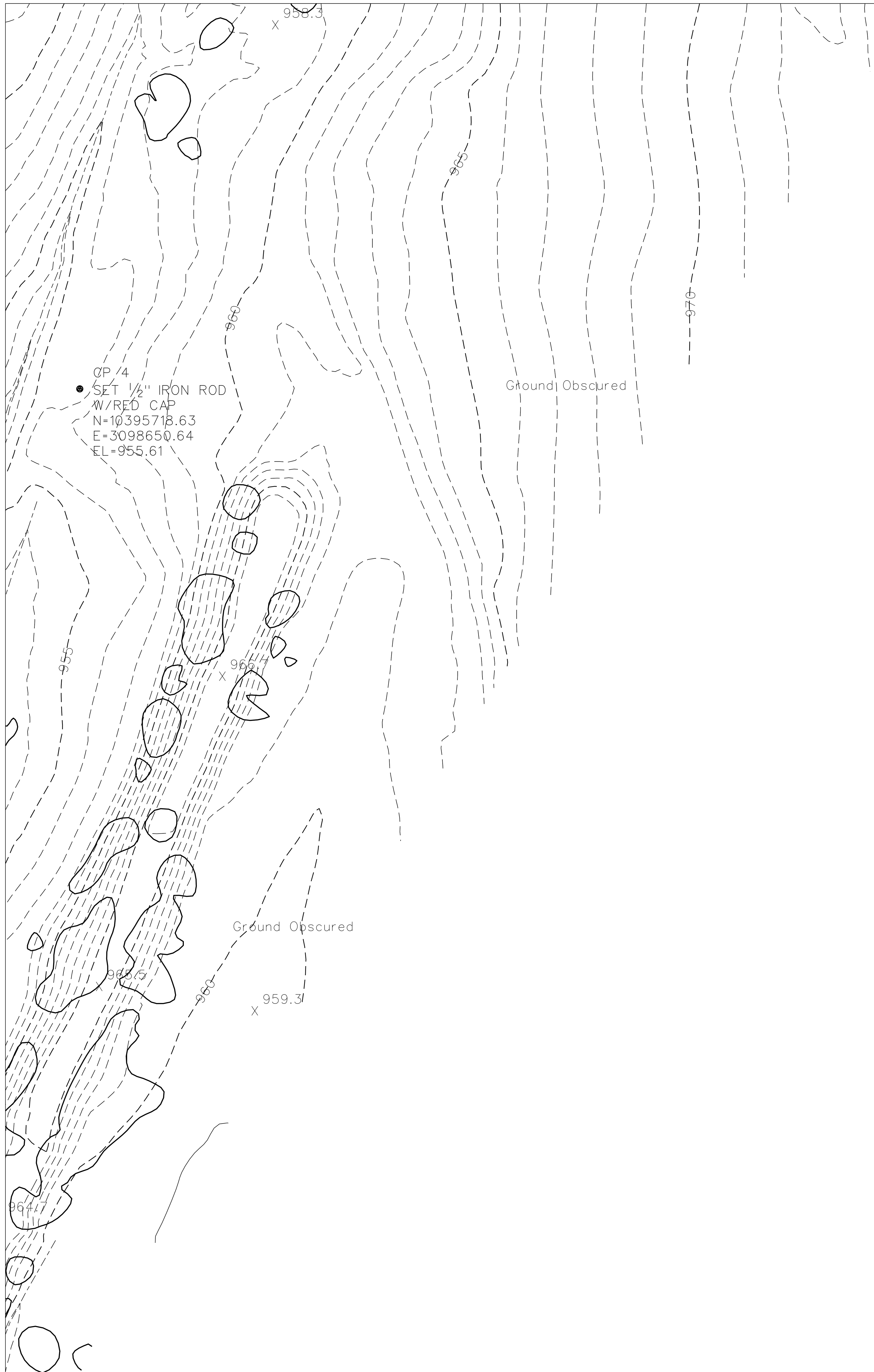
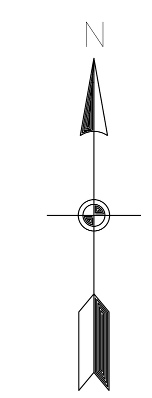


LEGEND :

CENTER LINE	℄
POWER POLE	○
POWER POLE/TRANS.	△XXXX
LIGHT POLE	
LIGHT STANDARD	
HELIPAD LIGHT	
GUY WIRE	⟶
ELECTRIC MANHOLE	□E
COMMUNICATION MANHOLE	□C
UTILITY BOX	
TRANSFORMER ON PAD	XXXX
TRAFFIC SIGNAL BOX	
ELECTRIC PULLBOX	□P
TRAFFIC SIGNAL CONTROLLER	⊠
GAS VALVE	
GAS METER	
SPRINKLER CONTROL VALVE	
GUARD POST	
BOLLARD	
WATER VALVE	
WATER METER	
FIRE HYDRANT	
SPRINKLER HEADS	(o)
SAN. SEWER MANHOLE	
STORM DRAIN MANHOLE	
CLEAN-OUT	
TREE	
SHRUB	
SIGN	
HORIZ/VERT CONTROL POINT	
FENCE	-X-X-
WATER FAUCET	
LINE LABEL ON OVERHEAD UTILITY	OH
LINE LABEL ON UNDERGROUND UTILITY	UG
UNDERGROUND ELECTRIC CONDUIT	UE
OVERHEAD SHIELD WIRE	OHS
OVERHEAD ELECTRIC LINE	— E_x —
UNDERGROUND ELECTRIC LINE	— E^U_x —
UNDERGROUND COMMUNICATION LINE	— C^U_x —
GAS MAIN LINE	— G_x —
WATER MAIN LINE	— W_x —
SANITARY SEWER MAIN LINE	— SS_x —
STORM DRAIN MAIN LINE	— SD_x —
TOP OF POLE	TP
LOW WIRE ELEVATION	LW
VALVE COVER	VC
TOP OF VALVE	TV
BORE HOLE (UNDRILLED)	⊗
WINDSOCK	
TRAFFIC SIGNAL ARM	
GEOGRAPHIC INFORMATION SYSTEM	(GIS)
ABANDONED IN PLACE	(AIP)



30' 20' 10' 0 30'

SCALE: 1"= 30'-0"

NOTE:
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E. 3097045.31

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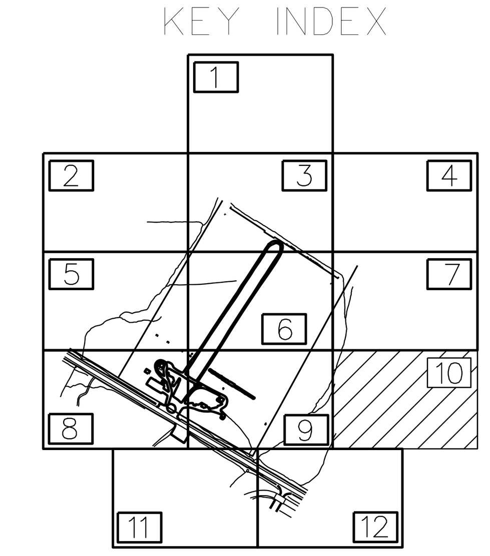

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FORT HOOD, TEXAS
MODIFIED RECORD FIRING RANGE
PROJECT NO.
110155

TOPOGRAPHIC SURVEY

BUILDING NO.

PROJECT NO.
AD018030P

DMI NO.

SHEET REFERENCE NUMBER:
V-110
Sheet 10 of 12

DESIGN FILE:

Contr No.

Section:

LEGEND :

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POWER POLE/TRANS.	XXXX
LIGHT POLE	
LIGHT STANDARD	
HELIPAD LIGHT	
GUY WIRE	
ELECTRIC MANHOLE	
COMMUNICATION MANHOLE	
UTILITY BOX	
TRANSFORMER ON PAD	XXXX
TRAFFIC SIGNAL BOX	
ELECTRIC PULLBOX	
TRAFFIC SIGNAL CONTROLLER	
GAS VALVE	
GAS METER	
SPRINKLER CONTROL VALVE	
GUARD POST	
BOLLARD	
WATER VALVE	
WATER METER	
FIRE HYDRANT	
SPRINKLER HEADS	(o)
SAN. SEWER MANHOLE	
STORM DRAIN MANHOLE	
CLEAN-OUT	
TREE	
SHRUB	
SIGN	
HORIZ/VERT CONTROL POINT	
FENCE	
WATER FAUCET	
LINE LABEL ON OVERHEAD UTILITY	OH
LINE LABEL ON UNDERGROUND UTILITY	UG
UNDERGROUND ELECTRIC CONDUIT	UE
OVERHEAD SHIELD WIRE	OHS
OVERHEAD ELECTRIC LINE	E_x
UNDERGROUND ELECTRIC LINE	E_x^U
UNDERGROUND COMMUNICATION LINE	C_x^U
GAS MAIN LINE	G_x
WATER MAIN LINE	W_x
SANITARY SEWER MAIN LINE	SS_x
STORM DRAIN MAIN LINE	SD_x
TOP OF POLE	TP
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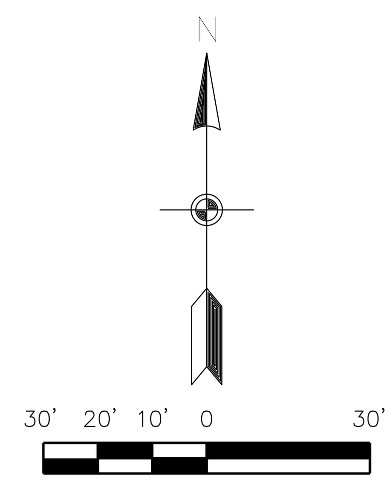

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CP 2
SET ½" IRON ROD
W/RED CAP
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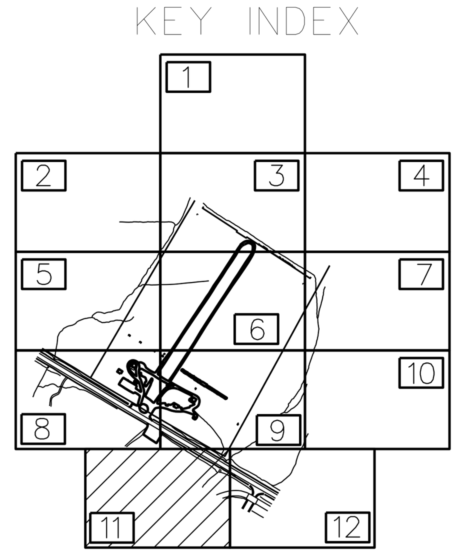
E=3097997.72
EL=941.02

KEY INDEX



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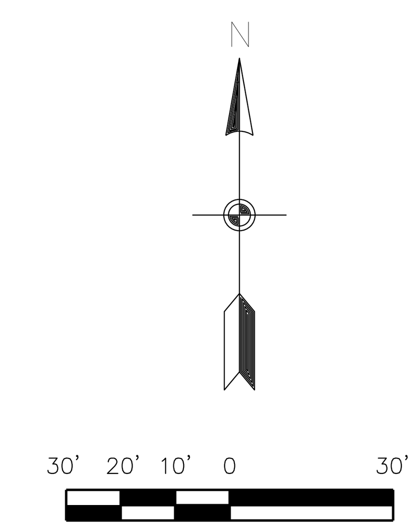
AD018030P

DMI NO.

SHEET
REFERENCE
NUMBER:
V-111
Sheet 11 of 12



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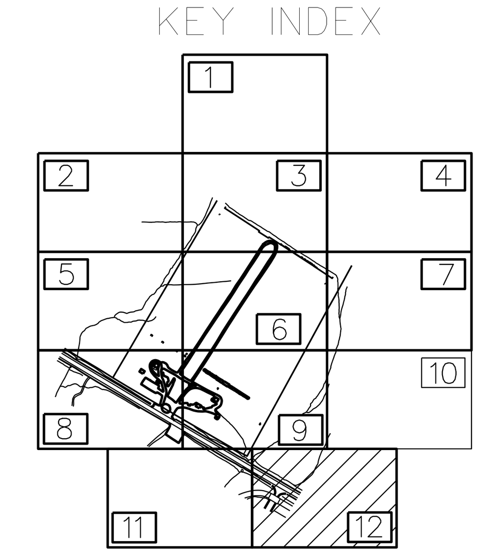

LEGEND :

CENTER LINE	℄
POWER POLE	○
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HELIPAD LIGHT	
GUY WIRE	⟶
ELECTRIC MANHOLE	□E
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TRANSFORMER ON PAD	XXXX
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TRAFFIC SIGNAL CONTROLLER	⊠
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OVERHEAD SHIELD WIRE	OHS
OVERHEAD ELECTRIC LINE	— Ex —
UNDERGROUND ELECTRIC LINE	— Ex —
UNDERGROUND COMMUNICATION LINE	— Cx —
GAS MAIN LINE	— Gx —
WATER MAIN LINE	— Wx —
SANITARY SEWER MAIN LINE	— SSx —
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DMI NO.

SHEET REFERENCE NUMBER:
V-112
Sheet 12 of 12

DESIGN FILE:

Contr No.

Section:

11.3.5 Site Furnishings Manufacturers Qualifications

Preferred manufacturers of site furnishings must provide documentation for the following qualifications:

1. Manufacturer has been manufacturing the specified products or ones very similar in style and material for at least two years.

2. Manufacturer is able to fill additional orders within a 40-day schedule.

3. Manufacturer maintains a current supply contract with the General Services Administration and the Texas Multiple Awards Schedule.

4. Manufacturer can provide documentation regarding proven sustainable operating and manufacturing practices.

11.4 SIGNAGE

Signs are used to visually communicate information. They are highly visible features that should be attractive and compatible with their surroundings. Careful consideration must be given to what a sign says, how it is said, its visual appearance and organization, its location, structural support system, and relation to other signs within the installation. Standardized signage systems facilitate movement, provide a sense of orientation, and reinforce standards of excellence. Signage creates a unifying element throughout the installation that visually ties the installation themes together and builds a reference and continuity that translates into confidence and reassurance when traveling throughout the installation. The standards to apply for signage color, type, and sizing are found in Technical Manual (TM) 5-807-10, *Signage*.

11.4.1 Sign System Characteristics

Several basic design characteristics that help to convey necessary information clearly and attractively are an integral part of any successful signage system.

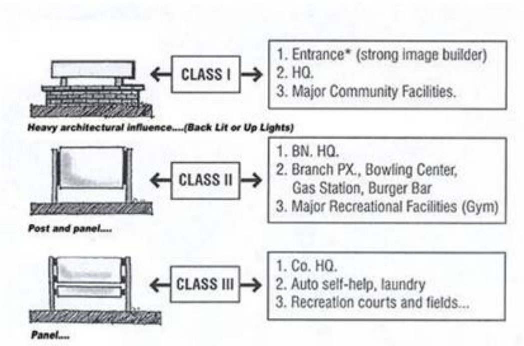
Simplicity. An effective strategy provides only needed information, avoids redundancy, and eliminates over-signing with resultant clutter and visual confusion. Sign messages must be clear, simple, and easy for motorists to process quickly.

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.

Visibility. Sign location is a critical 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.

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 motorists, pedestrians, or bicyclists and the relative travel speed at which each type of user will be traveling when viewing the signs.



Classes within the Visual Hierarchy.

Visual Hierarchy. 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.

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.

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.

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.

11.4.2 Types of Signs

11.4.2.1 Information / Identification Signs

These are signs that identify areas within the installation, command buildings (e.g., brigades, battalions, company headquarters, motorpools, etc.), and organizational or functional components. They identify a location and greet the visitor to that location. They should be compatible in scale and character with the architecture and should blend with the natural surroundings. Information / identification signs are designed to include the following.

Typeface:	
Lettering	self-adhesive backing material
Building Title	Helvetica Medium, upper and lower case
Building Numbers	Helvetica regular
Building Addresses	Helvetica Medium, upper and lower case

Color:	
Panel	Dark Brown
Lettering	White
Post	Dark Brown
Exposed panel backs and edges	Dark Brown
All paint	Semi-gloss

Materials:	
Panel	Double-faced 1/8-inch thick aluminum
Post	Steel pipe
Foundation	Concrete pier or direct burial

11.4.2.2 Commercial Identification Signs

Commercial Signs

- Only one ground-mounted sign and one building sign shall be allowed for each premise. An exception may be approved during the planning charrette for corner and double frontage lots.

- The design of the sign shall be coordinated with the design of the principle building(s) in terms of color, material, detailing, and style. Substantial contrast between the color and material of the background and the letters or symbols shall be used to make the sign easier to read both day and night

An example of a monument-style sign using native stone.

The use of pole signs is not permitted at Fort Hood.

- All ground-mounted signs will be monument type; pole signs are not permitted.
- Only essential information (the name of the tenant/business) shall be displayed on the monument sign.
- Monument signs shall be designed for horizontal massing, not vertical.
- Monument signs will have a base structure of a minimum height of 1 foot and a maximum height of 2 feet high. Base material shall be designed to complement the architectural style of the building and should be of native stone, brick, or as otherwise approved during the planning charrette.
- Monument sign dimensions for a single building shall not exceed 4 feet in height and 8 feet in width. This does not include base material.
- Landscaping around the sign should be avoided to minimize future maintenance.

These types of signs are not permitted for use at Fort Hood.

<u>Lettering and Color</u>

- Letters and words should not be spaced too closely. In general, letters should not occupy more than 75 percent of the sign panel area when external or no lighting is used.
- Lettering types shall be limited to no more than two for small signs and three for larger signs to increase legibility.
- Signs shall conform to a simple color and graphic palette in order to minimize the confusion and clutter of the sign. In general, signs shall have no more that three colors or shades of the same color.

Sign Material

- Wood, stone, brick, masonry, or metal materials are preferred.
- Polished, glossy, shiny, or reflective surfaces are not permitted.

Lighting

- All electrical wiring required for the lighting shall be hidden or located in as unobtrusive a location as possible. Any visible conduit or wires should be painted out to blend with the background.
- Moving, flashing, rotating, or twinkling lights are prohibited and shall not be used as signage. Whole panel lighted signs are not permitted.
- Illuminated signs should be designed to provide a high quality appearance in both natural light during the day and in artificial light at night.
- Use external signs over internally lit signs.
- Average illumination on the surface of signs shall not exceed 3.0 foot-candles.
- Signs should be lighted with external fluorescent luminaries or, if internally lighted, with LEDs.

Externally Lighted Signs (preferred)

- Sign lighting shall be shielded, and concentrated and focused on the sign area and not diffused over the building or property.
- Ground–mounted lighting shall be screened or partially buried to minimize the view of the light source. Bare bulbs are not permitted. The design of ground-mounted lighting shall be such that it causes no special lawn maintenance concerns. For example, the lighting type shall not be a type that requires lawn maintenance personnel to use a weed eater around the light.
- Top-mounted lighting fixtures shall be directed downwards in a manner that hides the light source.
- Up-lighting may be used if the fixture will be aimed to prevent light spillage beyond the sign.
- Back-lighted solid lettered signs are permitted.

This type of signage, including color scheme and material, is inappropriate for the landscape character of Fort Hood.

Internally Lighted Signs

- Internally illuminated signs such as the type consisting of a large rectangle metal sign cabinet with large surface areas (whole panel) of illumination that produces glare and excessive light are prohibited. No whole panel lighting is permitted.
- Internally lit signs that consist of internally lit lettering and/or symbols set against a dark background to minimize the amount of light emanating from the sign are permitted. The letters and/or symbol should constitute no more than 40 percent of the sign's surface area.
- Individual letters with interior lighting are permitted (e.g., facade signs).

Multi-Tenant Buildings or Sites

- Multi-tenant/business buildings or sites shall have one monument identification sign conveying the overall identification for the property.
- Identification signs listing multiple tenants shall exhibit a logical hierarchy in the display of information.
- Multi-tenant freestanding signs shall utilize one uniform background color for all tenants.

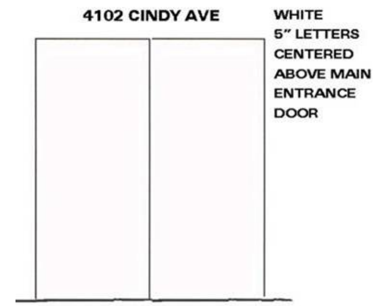
Façade-Mounted Signs

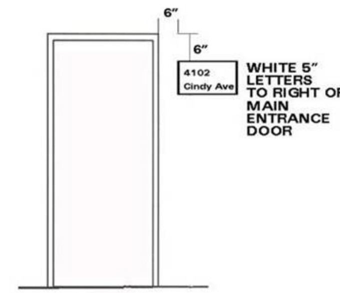
- Façade-mounted signs shall be designed as an integral element of the architecture. The shape and material of the sign shall complement the architectural features of the building.
- Signage shall be mounted with concealment hardware, or with decorative hardware to complement the design of the sign. Metal hardware shall be stainless steel or galvanized. If hardware will be painted to blend with the sign, rust-inhibiting paint shall be used.
- For single tenant buildings or site, multiple signs on the same façade are prohibited.
- For multi-tenant buildings or sites, all signage on the same façade shall be consistent in color size and elevation.

11.4.2.3 Building Identification

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 (Section C3.3 of the mail manual).
- The DoD installation is responsible for assigning city-style, street addresses on the installation (Section C3.3.2.2 of the mail manual).
- Street addresses shall be assigned and used even though a DoD activity may deliver the mail to the addressee (Section C3.3.2.2.1 of the mail manual).
- Only geographically locatable civilian-style street addresses (such as 4102 Cindy Avenue, shall be used (Section C3.3.2.2.4 of the mail manual).
- 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 (Section C3.3.2.2.5 of the mail manual).
- Addresses such as "Building 123 Roberts Street" are not a valid address format and shall not be used (Section C3.3.2.2.6 of the mail manual).
- **Address Placement.** Place addresses by the front entrance of the building so they can be seen (Section C3.3.2.3.1 of the mail manual).

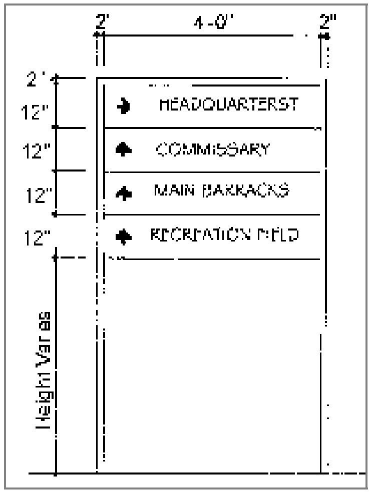




Street address location at entrance doors.

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. Buildings without identification signs shall have the address number and street name centered above the main entrance or located to the right side.

Housing Areas. The entrance sign should be complementary to the architectural setting of the housing area and approved by the installation Real Property Planning Board. 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.



Direction sign.

11.4.2.4 Installation Identification Signs

Installation identification signs name the installation and display the official U.S. Army plaque. 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 will have an installation identification sign displaying only the U.S. Army plaque, with the words "United States Army, Fort (Name of Fort), and gate name - Installation Entrance Signs." The placement of the Senior Mission Commander logo, unit crest, and other installation identification signs, monuments, or displays should be inside the installation beyond the cleared area of the Access Control Point 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.

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.

See Technical Manual (TM) 5-807-10, Signage, paragraph 3-3, for sign specifications and paragraph 3-11 for sign placement guidelines.

11.4.2.5 Street and Contractor Signs

Design street and contractor signs with the same lettering, color and materials as other information signs. However, the standard for reflective sheeting will be diamond Grade™ Reflective Sheeting, series 4000 manufactured by 3MReflective sheeting: Diamond Grade™ Reflective Sheeting, series 4000 manufactured by 3M.

11.4.2.6 Wheeled Electrical Signs

Wheeled electrical signs will have an attractive presentation. Temporary landscape elements should be used whenever possible. The sitting of this type of sign will be approved by the Real Property Planning Board. No sign of this type will be left in place for longer than six months, after which time, the sign will be removed or turned into a permanent sign.

11.4.2.7 Directional Signs

These signs guide the motorist or pedestrian in, around, and out of the installation. 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. Directional signs are designed to include the following.

Typeface:	
Lettering	self-adhesive backing material
All	Helvetica Medium upper and lower case

Materials:	
Panel	Double-faced 1/8-inch thick aluminum
Post	Steel pipe
Foundation	Concrete pier or direct burial

Color:	
Panel	Dark Brown
Lettering	White
Post	Dark Brown
Exposed panel backs and edges	Dark Brown
All paint	Semi-gloss

Arrow:	
Place at end indicating direction	
Stroke width	Helvetica Medium cap

11.4.2.8 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. Related to these signs are pavement markings and traffic signals. Regulatory signs are designed to include the following:

Typeface:	
Lettering	self-adhesive backing material
All	Helvetica Medium upper and lower case

Materials:	
Panel	Double-faced 1/8-inch thick aluminum
Post	Steel pipe
Foundation	Concrete pier or direct buria

Color:	
Panel	Dark Brown
Lettering	White
Post	Dark Brown
Exposed panel backs and edges	Dark Brown
All paint	Semi-gloss

11.4.2.9 Traffic Control Signs

National highway standards will be used for signs to regulate vehicular traffic on CONUS installations (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 will be used installation-wide to include installation Access Control Points.

Prohibitory (warning) signs are 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.

11.4.2.10 Electronic Exterior Signs

All exterior flashing signs, traveling lights, or signs animated by lights of changing degrees of intensity or color are prohibited.

11.4.3 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.
- 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.
- Place signs approximately 1.2 meters (4 feet) above ground level to be within 10 degrees of the driver’s line of vision. Provide proper placement to avoid a hazard to children.

11.4.4 Sign System Typography

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.

The Department of the Army 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.

The use of branch *insignia*, shoulder-sleeve insignia, coats 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.

Reduce visual clutter. Over-signing detracts from a uniform sign system and if left uncontrolled will eventually destroy the integrity of the system. 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.

11.4.5 Location Maps

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.

The location map should contain the following characteristics within the design:

- Plexiglas-covered map for protection;
- Architecturally compatible materials used for the base;
- Paved walk-up area;
- Litter receptacle;
- Adjacent parking; and
- Current takeaway maps.

APPENDIX I
Acceptable Plants List

Not Used

NOTES:

1. REFER TO SPEC 01 35 10.00 44 "SPECIAL PROJECT PROCEDURES FOR FORT HOOD" FOR REQUIREMENTS REGARDING WASTE DISPOSAL. WASTE DISPOSAL WILL BE ALLOWED FOR CLEAN DEBRIS WITHIN 10- MILES OF THE CONSTRUCTION SITE. THIS SITE WILL BE DESIGNATED BY THE CONTRACTING OFFICER.

2. ALL BORROW AREAS SHALL BE LOCATED OFF GOVERNMENT PROPERTY AND SHALL BE THE RESPONSIBILTY OF THE CONTRACTOR.

3. DELIVERY TRUCKS, SERVICE TRUCKS, CONCRETE TRUCKS AND TRAILERS, ETC. SHALL ENTER ALONG NOLAN ROAD OR OTHERWISE USE THE CLARKE ROAD ENTRANCE AND BE PREPARED FOR INSPECTIONS AND 1 HOUR DELAYS.

PROJECT LOCATION MAP

1000 0 1000 2000

SCALE IN FEET

VICINITY MAP

N.T.S.

US Army Corps of Engineers
Fort Worth District

Designed by: J. MCKENZIE, P.E.	Date:	Rev.
Dwn by: J. MCKENZIE, P.E.	Sol No.	
Reviewed by: D. BROWN, P.E.	Contr No.	
Submitted by: DAVID G. BROWN, P.E. CHIEF, CIVIL SECTION	File name: FH_MRFR-G-101--1.dgn Plot date: 9/13/2012 Plot scale:	

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION ENGINEERING BRANCH

FORT HOOD, TEXAS
MODIFIED RECORD FIRE RANGE
PN 67020

PROJECT LOCATION MAP I

SHEET SEQUENCE NUMBER

G-101

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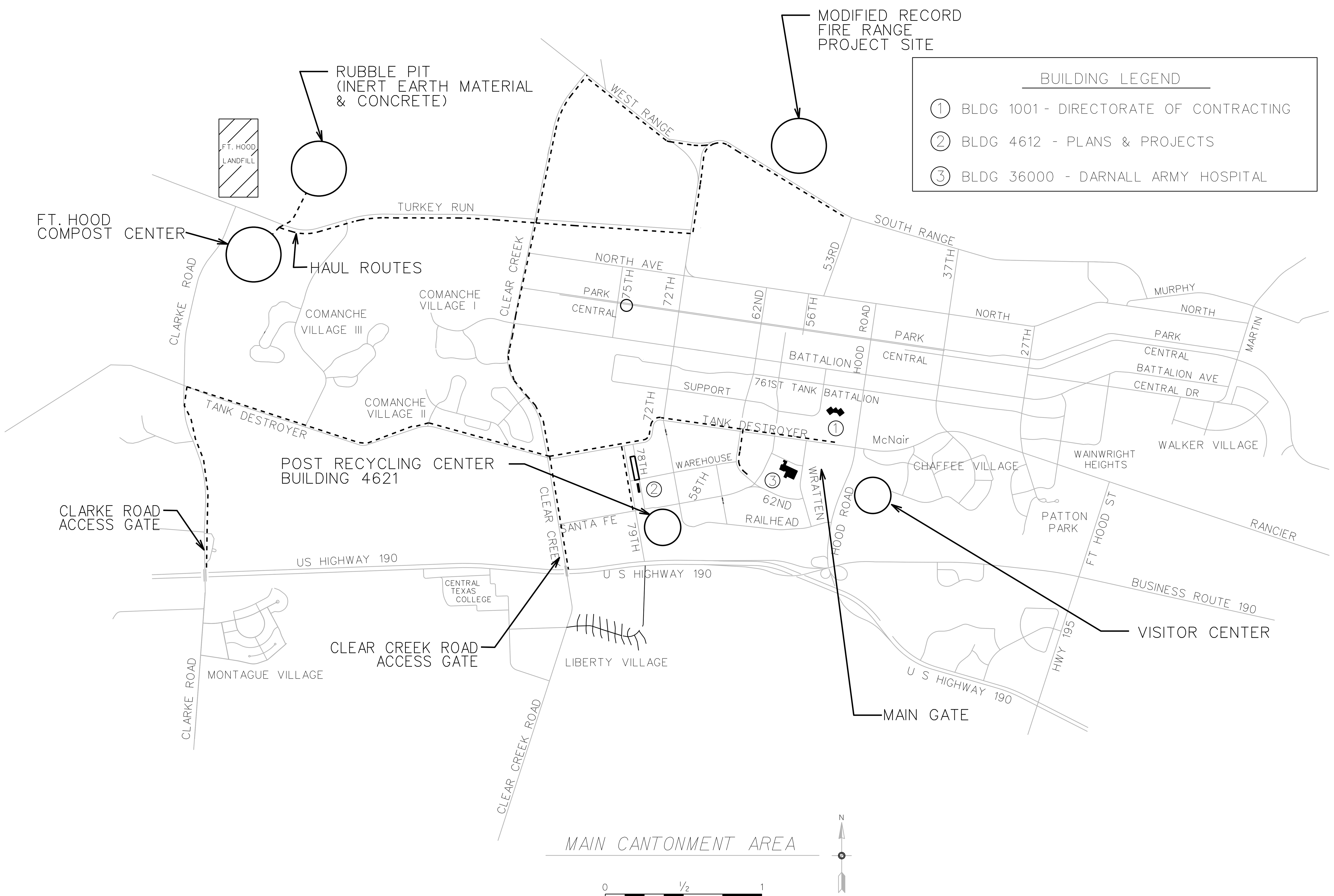
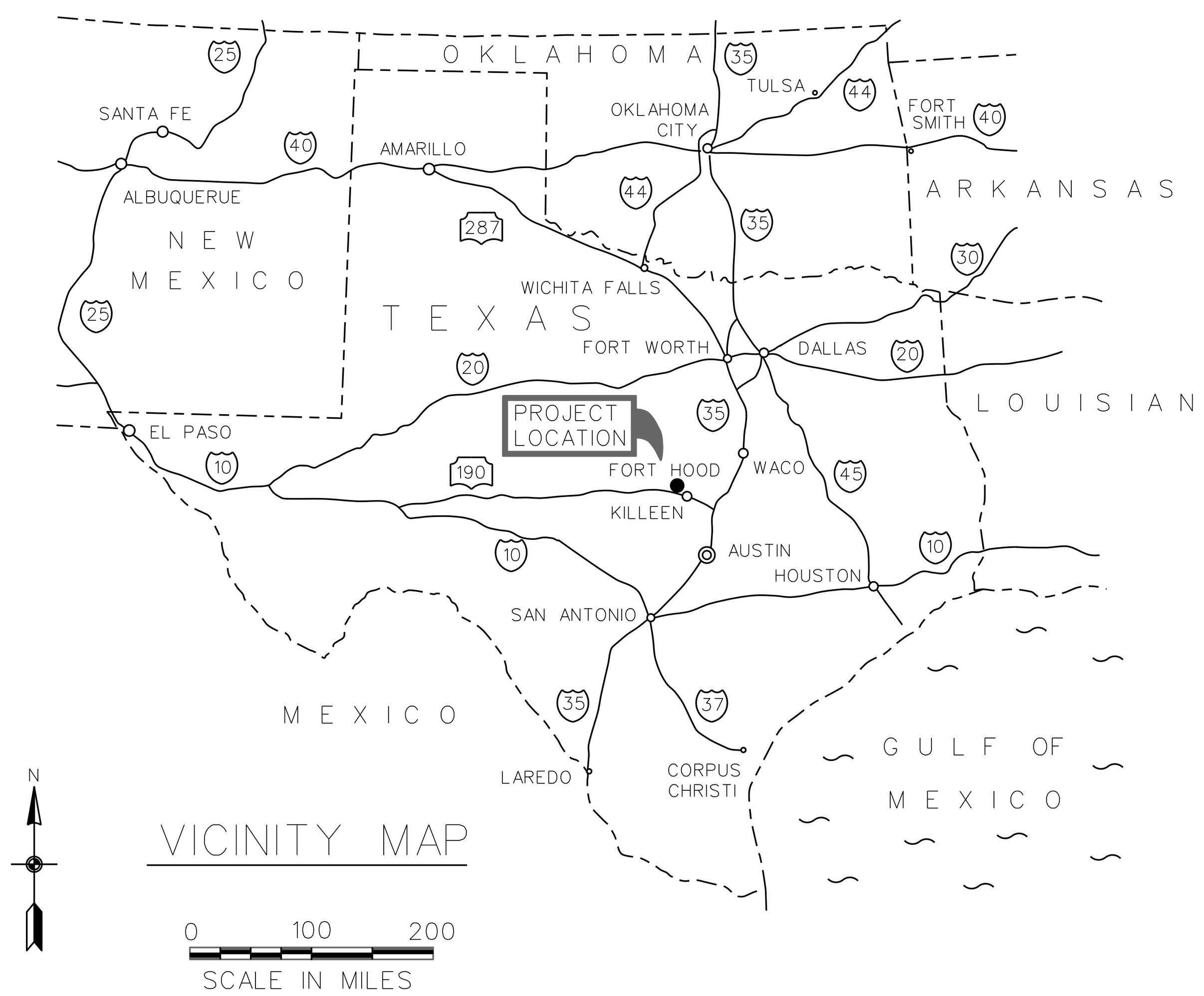
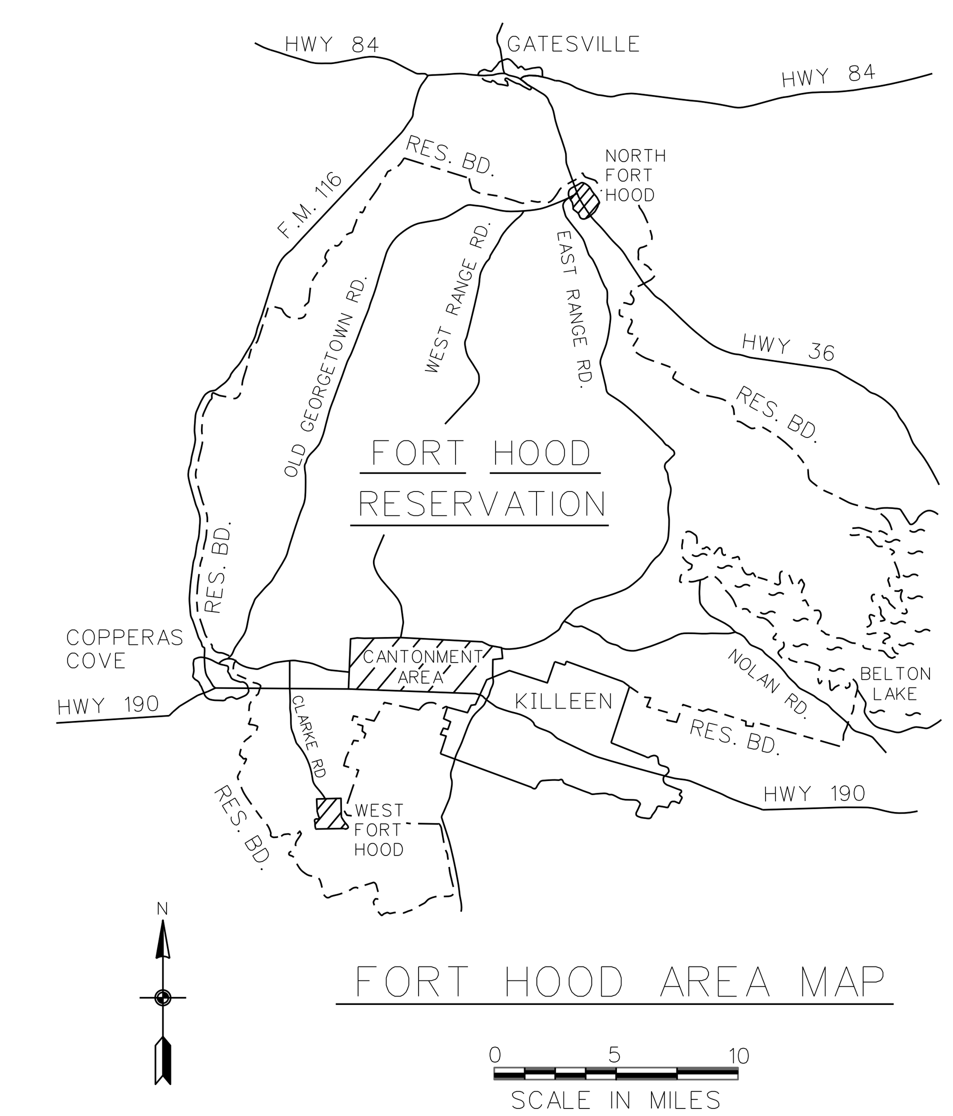


HAUL ROUTE





NOTES:

1. THE FORT HOOD LANDFILL IS LOCATED NEAR THE INTERSECTION OF CLARKE ROAD & TURKEY RUN ROAD. SEE SPECS SECTION 01 35 10.00 44, SPECIAL PROJECT PROCEDURES FOR USE OF THE FORT HOOD LANDFILL.

2. INERT EARTH MATERIAL AND CONCRETE CAN BE DEPOSITED IN THE RUBBLE PIT NEXT TO THE LANDFILL. INERT CONCRETE SHALL NOT CONTAIN EXPOSED REBAR.

3. DEMOLISHED ASPHALT MATERIAL CAN BE DEPOSITED IN THE DPW MATERIAL COMPOUND.

4. AREAS OTHER THAN NOTED ABOVE ARE LOCATED OFF GOVERNMENT PROPERTY AT THE CONTRACTORS RESPONSIBILITY.

5. ALL BORROW AREAS SHALL BE LOCATED OFF GOVERNMENT PROPERTY AND SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR.

6. COMPOST CENTER ACCEPTS UNPAINTED, NON-TREATED LUMBER WHICH IS NOT PERMITTED IN THE FORT HOOD LANDFILL. SEE SPECS SECTION 01 35 10.00 44, SPECIAL PROJECT PROCEDURES, FOR USE OF THE FORT HOOD LANDFILL. CEDAR TREES SHALL NOT BE ACCEPTED.

7. SEE SPECIFICATION SECTION 01 35 10.44 - SPECIAL PROJECT PROCEDURES, FOR MATERIALS ALLOWED TO BE STOCKPILED IN THE INERT MATERIAL MANAGEMENT UNIT YARD.

8. SEE SHEET G-101 FOR PROJECT LOCATION AND CONSTRUCTION ENTRANCE NOTES.

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: J. MCKENZIE, P.E.
Dwn by: J. MCKENZIE, P.E.
Reviewed by: D. BROWN, P.E.
Submitted by: DAVID C. BROWN, P.E. CHIEF, CIVIL SECTION
Date:
Sol No.
Contr No.
Rev.
File name: FH_MRFR-G-102----.dgn
Plot date: 9/13/2012
Plot scale:

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS
ENGINEERING/ CONSTRUCTION DIVISION ENGINEERING BRANCH

FORT HOOD, TEXAS
MODIFIED RECORD FIRE RANGE
PN 67020
PROJECT LOCATION MAP II

SHEET SEQUENCE NUMBER
G-102

Contr No.

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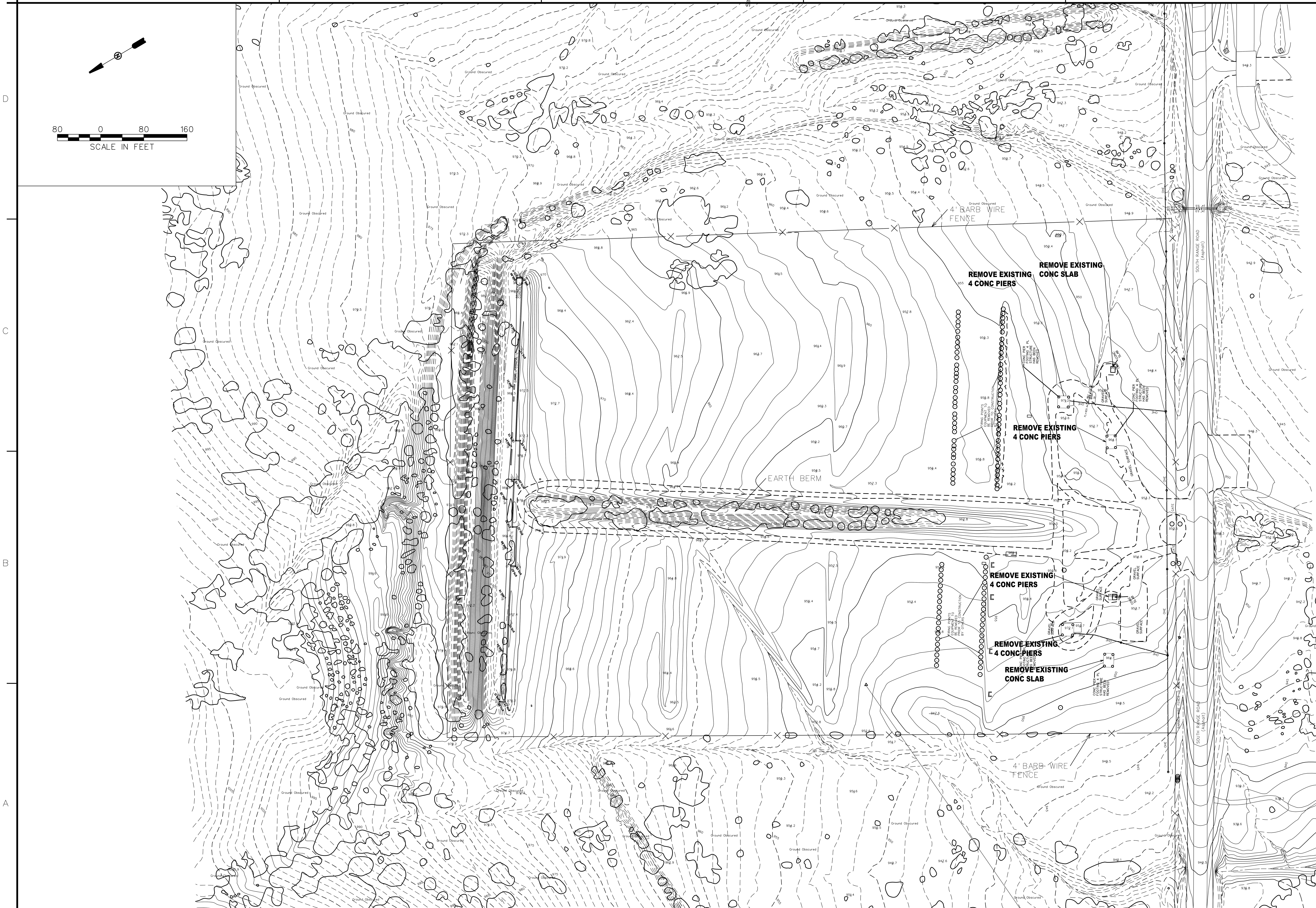

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: J. MCKENZIE, P.E.	Date:	Rev.
Dwn by: J. MCKENZIE, P.E.	Sol.No.	
Reviewed by: D. BROWN, P.E.	Contr No.	
Submitted by: DAVID D. BROWN, P.E. CHIEF, CIVIL SECTION	File name: FH_MRFR-CD101----.dgn Plot date: 9/13/2012 Plot scale:	

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ENGINEERING/ CONSTRUCTION DIVISION ENGINEERING BRANCH

FORT HOOD, TEXAS
MODIFIED RECORD FIRE RANGE
PN 67020

EXISTING SITE CONDITIONS

SHEET SEQUENCE NUMBER

CD101

Contr No.

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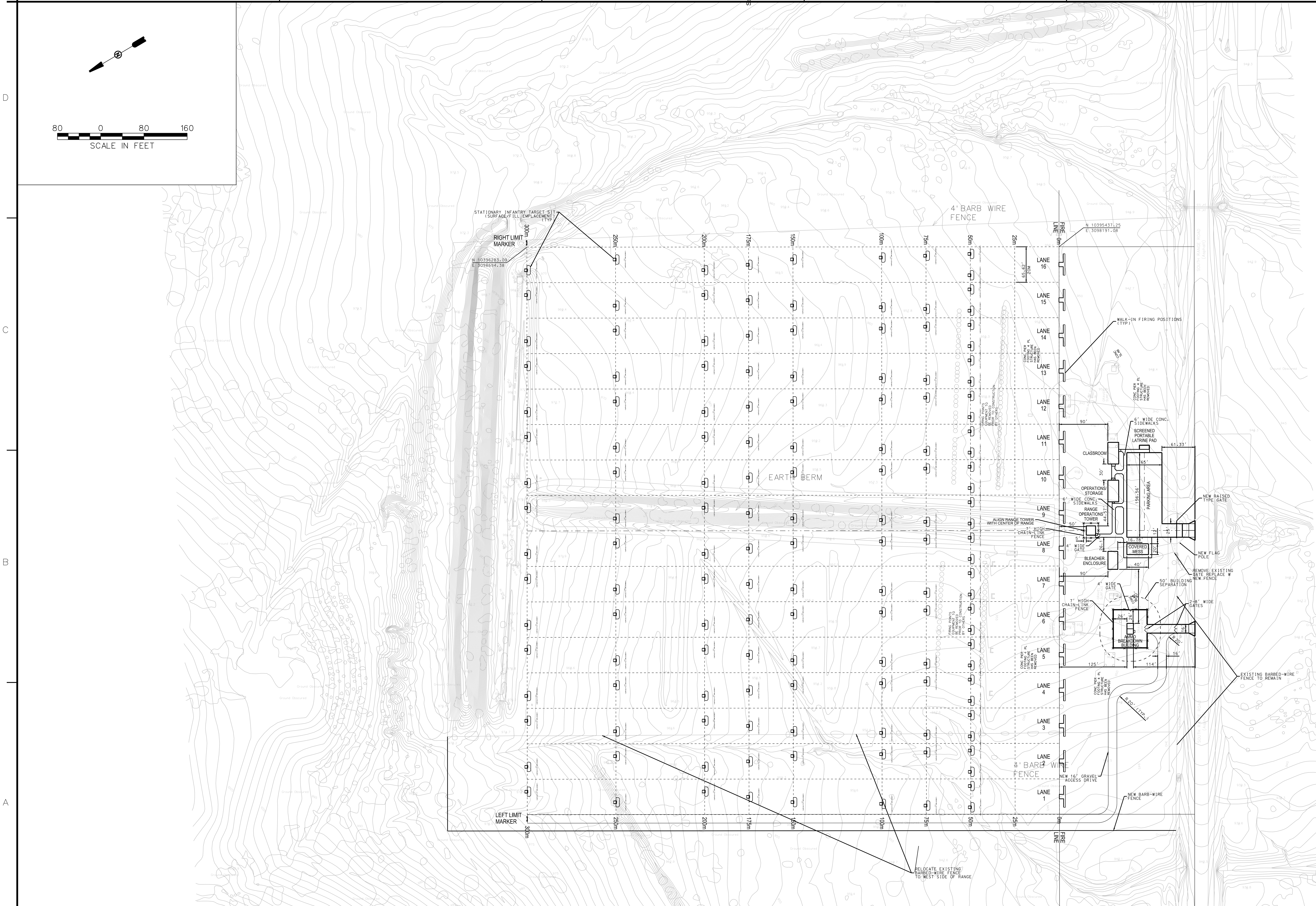

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date
1				

U.S. ARMY ENGINEER DISTRICT,
CORPS OF ENGINEERS
FORT WORTH, TEXAS

ENGINEERING/
CONSTRUCTION DIVISION
ENGINEERING BRANCH

Designed by: J. MCKENZIE, P.E.
Dwn by: J. MCKJENZIE, P.E.
Reviewed by: D. BROWN, P.E.
Submitted by: DAVID G. BROWN, P.E. CHIEF, CIVIL SECTION

Date:
Rev.
Sol No.
Contr No.

File name: FH_MRFR-CS101----.dgn
Plot date: 9/13/2012
Plot scale:

FORT HOOD, TEXAS
MODIFIED RECORD FIRE RANGE
PN 67020

SITE DEVELOPMENT PLAN
SITE LAYOUT

SHEET SEQUENCE NUMBER
CS101

Contr No.

FH_MRFR-CS101----.dgn 9/13/2012 8:39:33 AM

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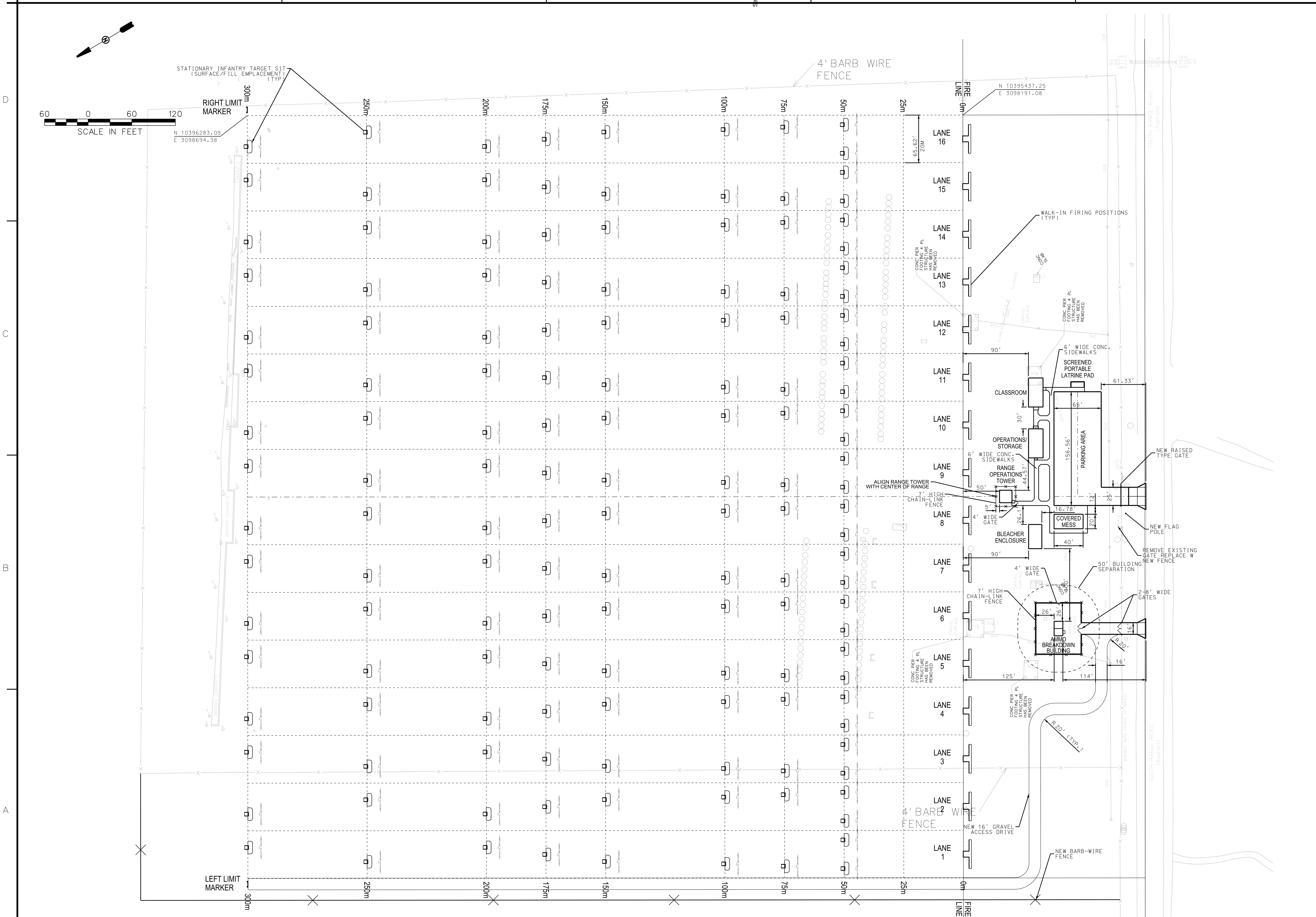

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Fort Worth District

Symbol	Description	Date	Action	Tracking No.

Designed by:	Date:
Dwn by: J. MCKJENZIE, P.E.	Sol No.
Reviewed by: D. BROWN, P.E.	Contr No.
Submitted by: DAVID C. BROWN, P.E. CHIEF, CIVIL SECTION	File name: FH_MRFR-CS102---.dgn Plot date: 9/13/2012 Plot scale:

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ENGINEERING/ CONSTRUCTION DIVISION ENGINEERING BRANCH

FORT HOOD, TEXAS
MODIFIED RECORD FIRE RANGE
PN 67020

MRFR SITE LAYOUT

SHEET SEQUENCE NUMBER
CS102

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FH_MRFR-CS103----.dgn 9/13/2012 8:44:04 AM

CS103
SHEET SEQUENCE NUMBER

FORT HOOD, TEXAS
MODIFIED RECORD FIRE RANGE
PN 67020
FACILITY SITE LAYOUT

U.S. ARMY ENGINEER DISTRICT,
CORPS OF ENGINEERS
FORT WORTH, TEXAS

ENGINEERING/
CONSTRUCTION DIVISION
ENGINEERING BRANCH

Designed by: J. MCKENZIE, P.E.	Date:	Rev.
Dwn by: J. MCKJENZIE, P.E.	Sol No.	
Reviewed by: D. BROWN, P.E.	Contr No.	
Submitted by: DAVID G. BROWN, P.E. CHIEF, CIVIL SECTION	File name: FH_MRFR-CS103----.dgn Plot date: 9/13/2012 Plot scale:	

Symbol	Description	Tracking No.	Action	Date

US Army Corps of Engineers
Fort Worth District

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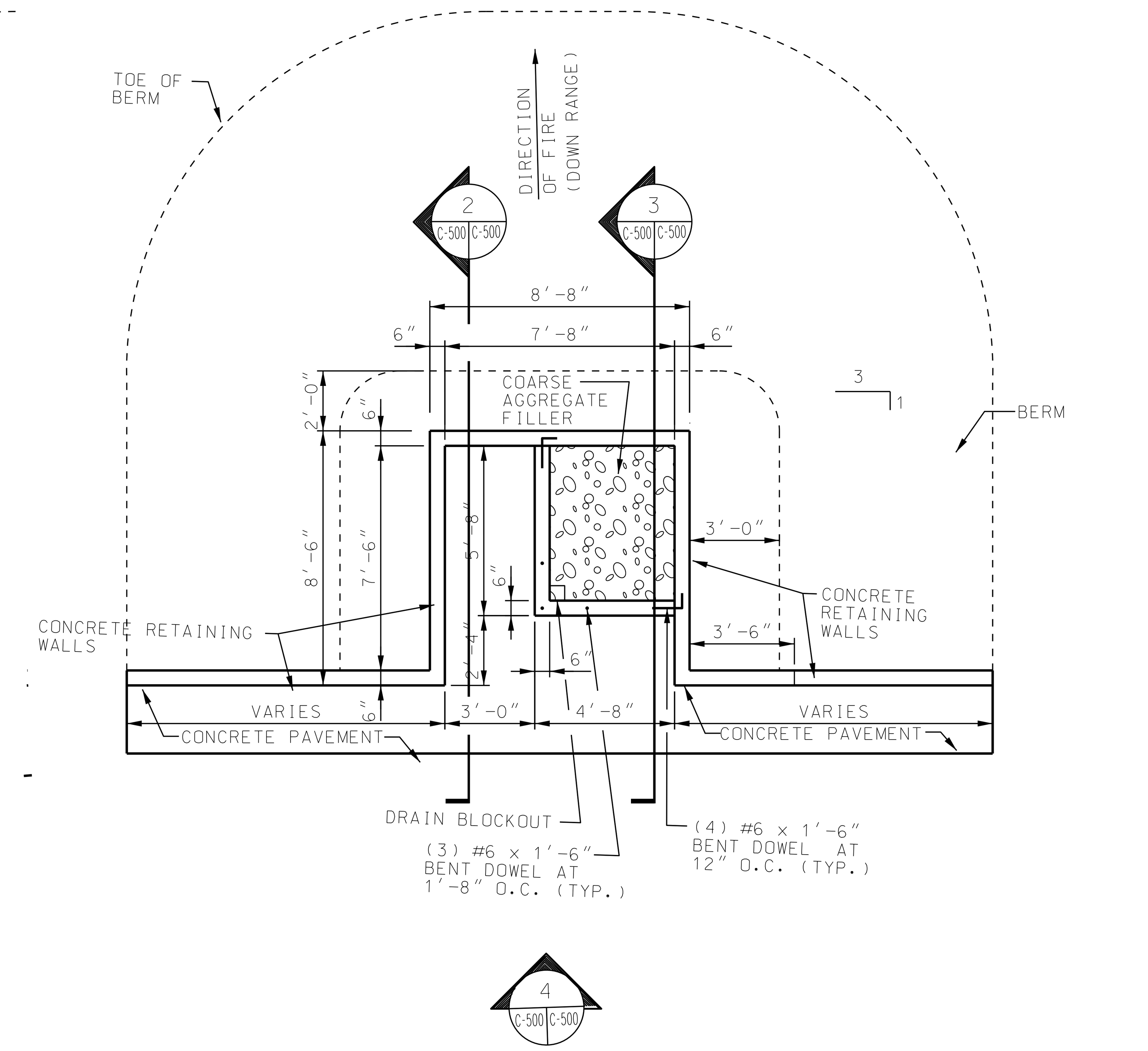
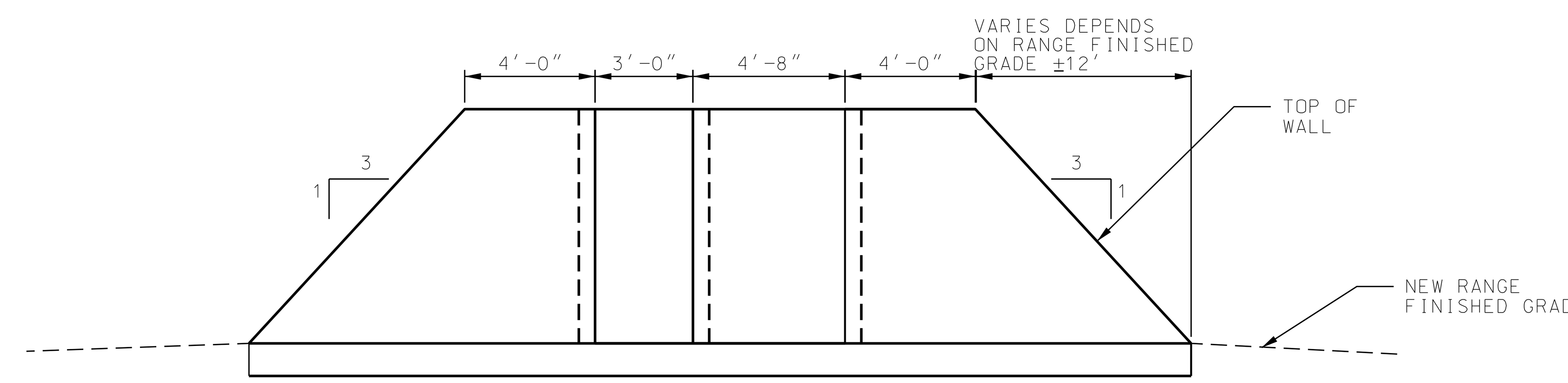


1 TWO MAN WALK-IN FIRING POSITION PLAN
NTS



4 SECTION
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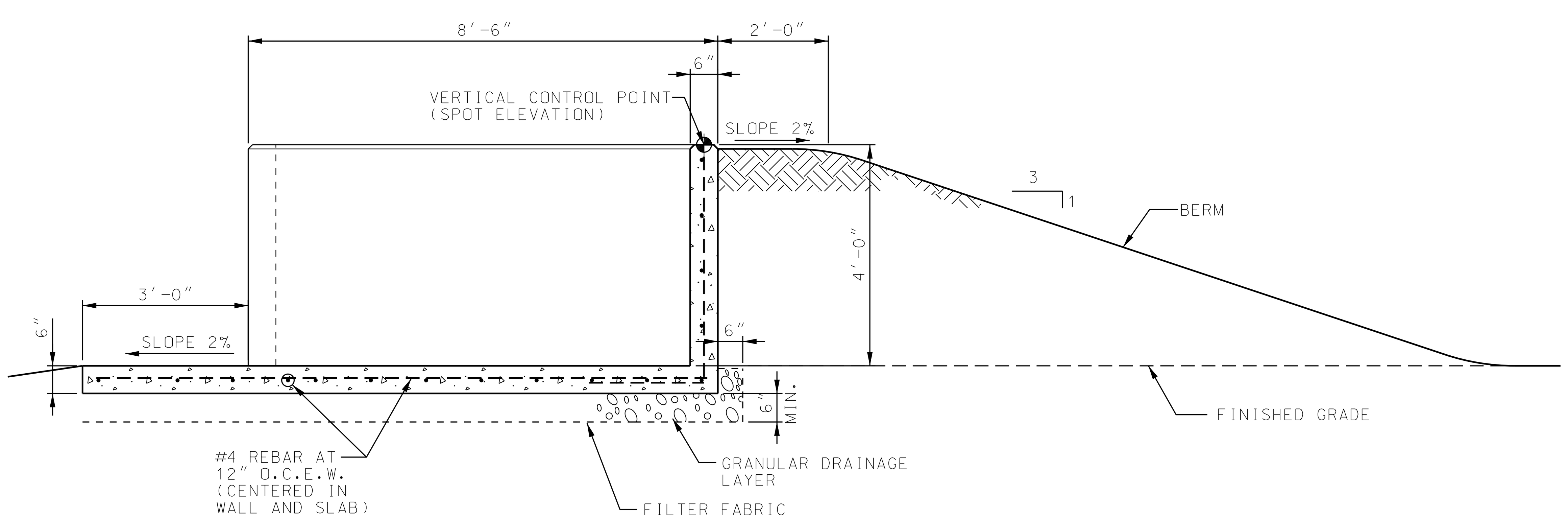

2 SECTION
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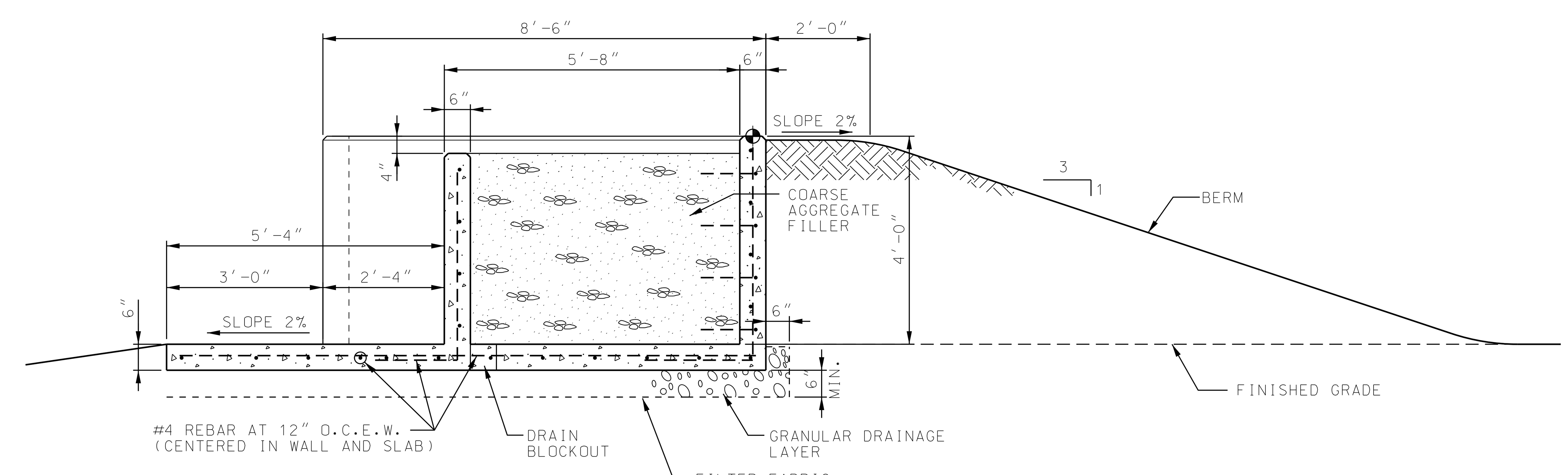

3 SECTION
NTS

GENERAL NOTES:

1. CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 4,000 P.S.I. IN 28 DAYS.
2. FIGHTING POSITIONS SHALL BE CONSTRUCTED OF REINFORCED CONCRETE; CONCRETE STRUCTURES SHALL BE PRE-CAST OR CAST-IN-PLACE.
3. ALL REINFORCING STEEL SHALL BE PER ASTM A615, GRADE 60.
4. AREAS DISTURBED BY CONSTRUCTION ACTIVITIES SHALL BE REVEGETATED OR RESURFACED CONSISTENT WITH THE NATURAL SURROUNDINGS. GROUND COVER SHALL NOT REDUCE TARGET VISIBILITY.
5. ALL EXPOSED CONCRETE EDGES SHALL HAVE A 3/4" CHAMFER.
6. GRANULAR DRAINAGE LAYER SHALL BE CLEAN DRAIN ROCK WITH NO MORE THAN 3% FINES (0.080 mm SCREEN) RESIDUAL AFTER SCREENING AND SHALL BE BETWEEN 3/4 INCH TO 2 1/2 INCH IN SIZE. DRAIN ROCK SHALL COVER THE ENTIRE ABSORPTION AREA AS SHOWN ON THE DRAWINGS.

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 ENGINEERING BRANCH

Designed by: | Date: | Rev.
Dwn by: | Sol No.
Reviewed by: | Contr No.
Submitted by: BILL BOYLE, A.I.A. CHIEF, ARCHITECTURAL SECTION
File name: FHMRFR-C-500.dgn
Plot date: 9/13/2012
Plot scale:

FORT HOOD, TEXAS
MODIFIED RECORD FIRE RANGE
PN 67020

FIRING POSITIONS DETAILS

SHEET SEQUENCE NUMBER
C-500

FHMRFR-C-500.dgn 9/13/2012 8:46:13 AM

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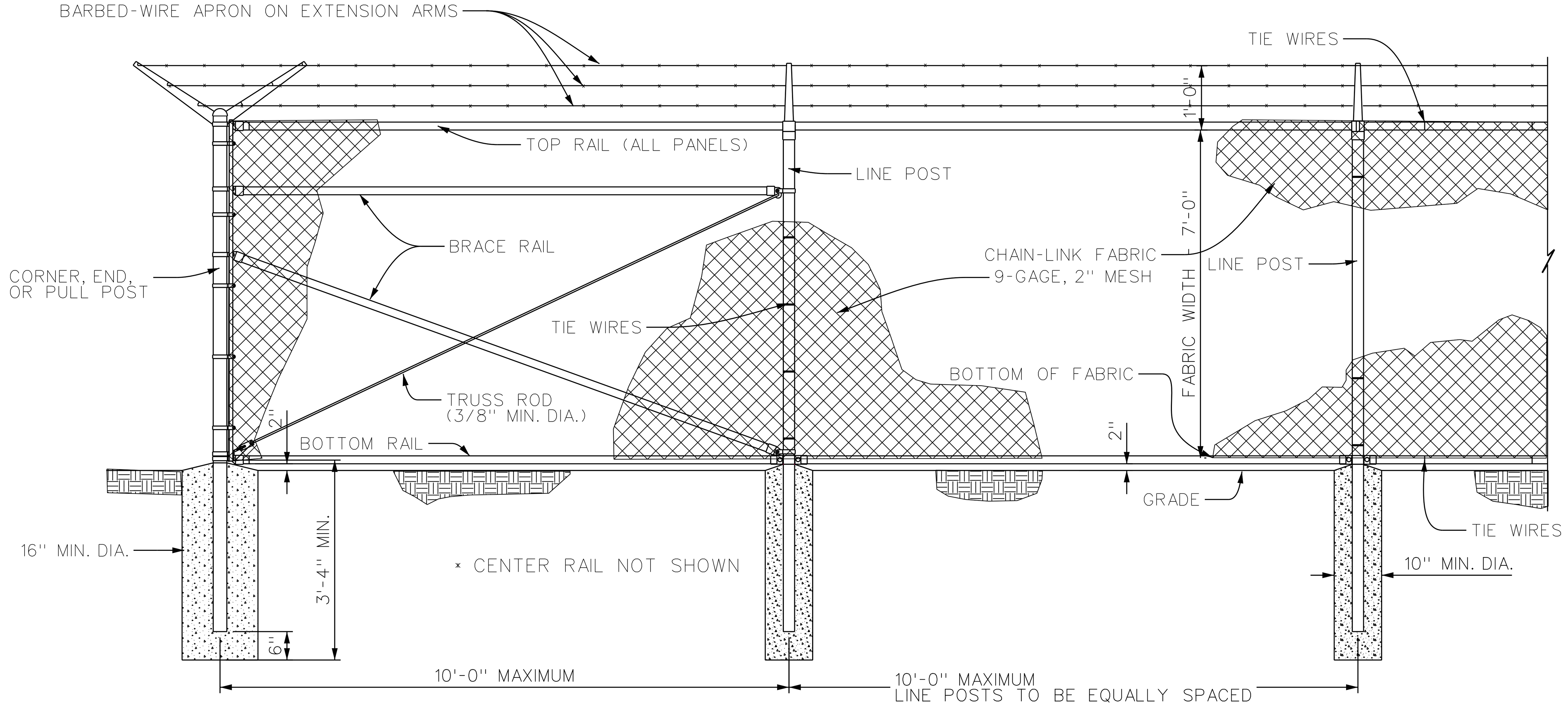
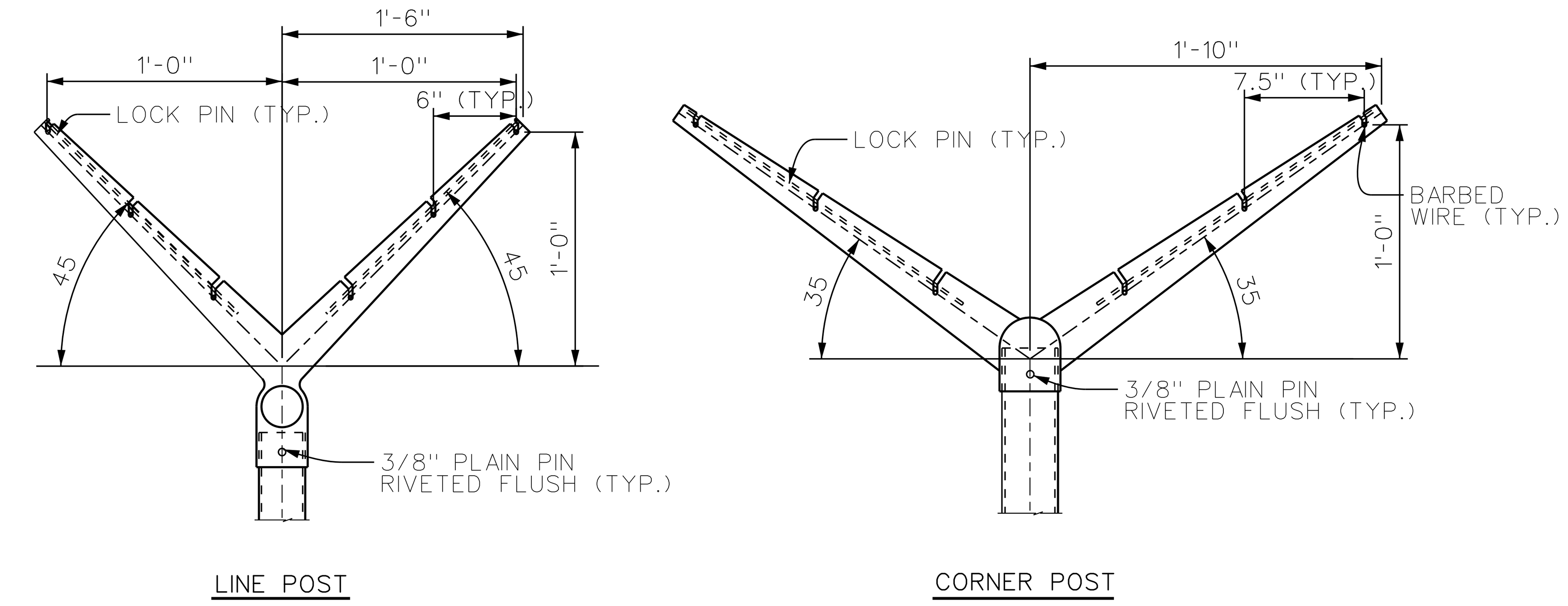


TEMF PERIMETER FENCE / CHAIN-LINK SECURITY FENCE DETAIL

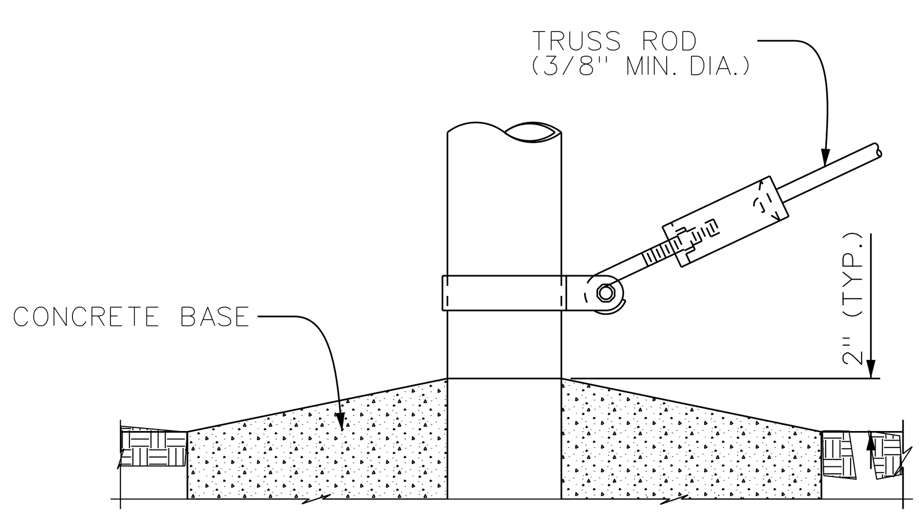
NO SCALE



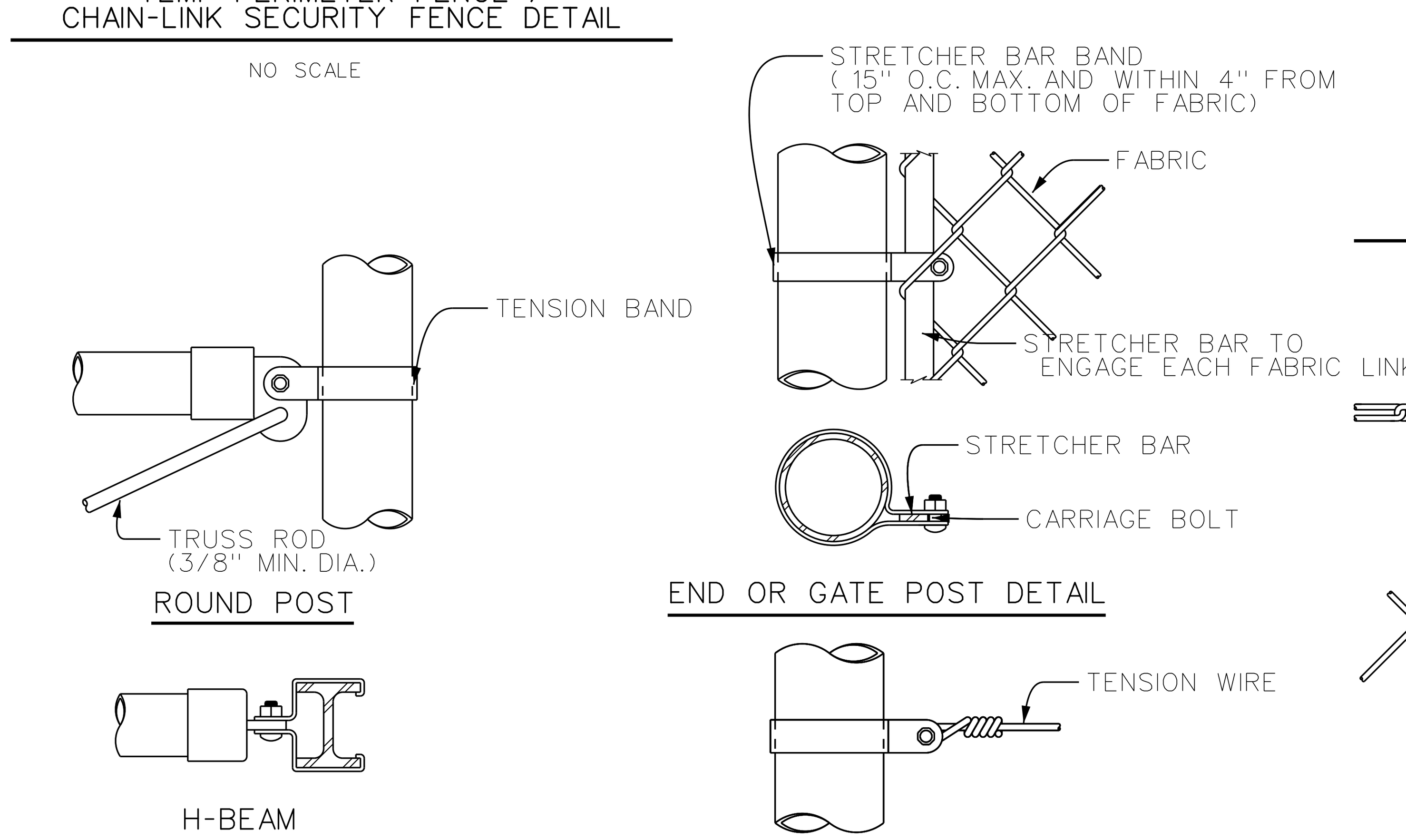
EXTENSION ARM DETAILS

NO SCALE

STEEL POST SCHEDULE			
USE AND SECTION	MINIMUM OUTSIDE DIMENSIONS (NOMINAL)		
Corner, End & Pull Posts			
Tubular - Round	2.875" O.D.		
Line Posts			
Tubular - Round	2.375" O.D.		
Top, Bottom & Brace Rails			
Tubular - Round	1.66" O.D.		



TRUSS ROD AND BAND



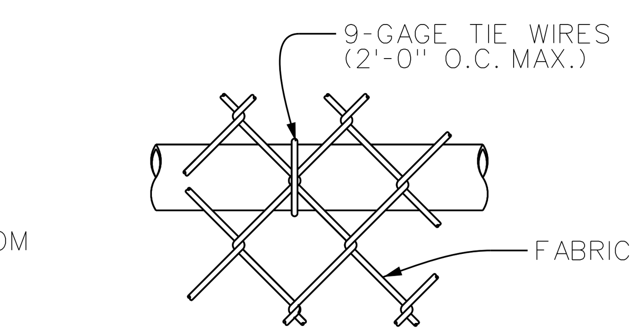
BRACE RAIL CLAMP DETAILS

END OR GATE POST DETAIL

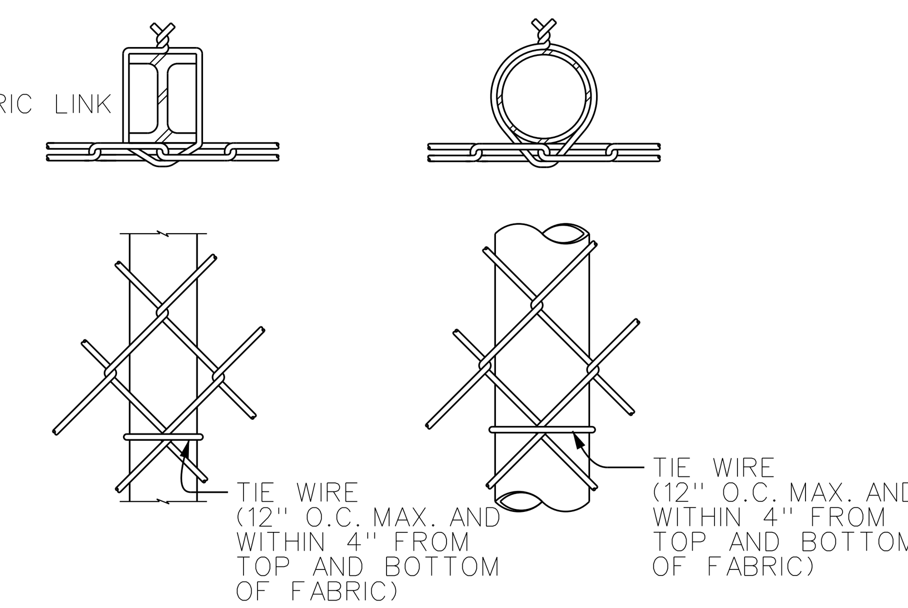
TENSION BAND DETAIL

FASTENING DETAILS

NO SCALE



TOP, BOTTOM, OR BRACE RAIL ATTACHMENT

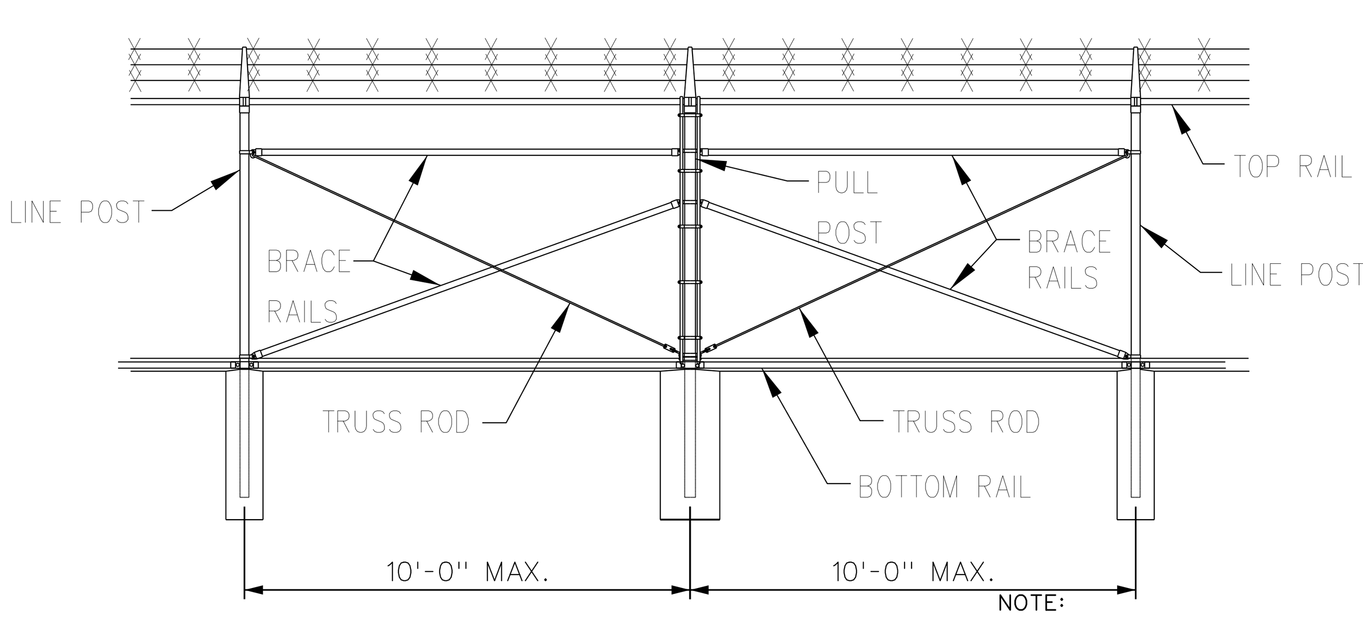


LINE POST ATTACHMENTS

NO SCALE

NOTES:

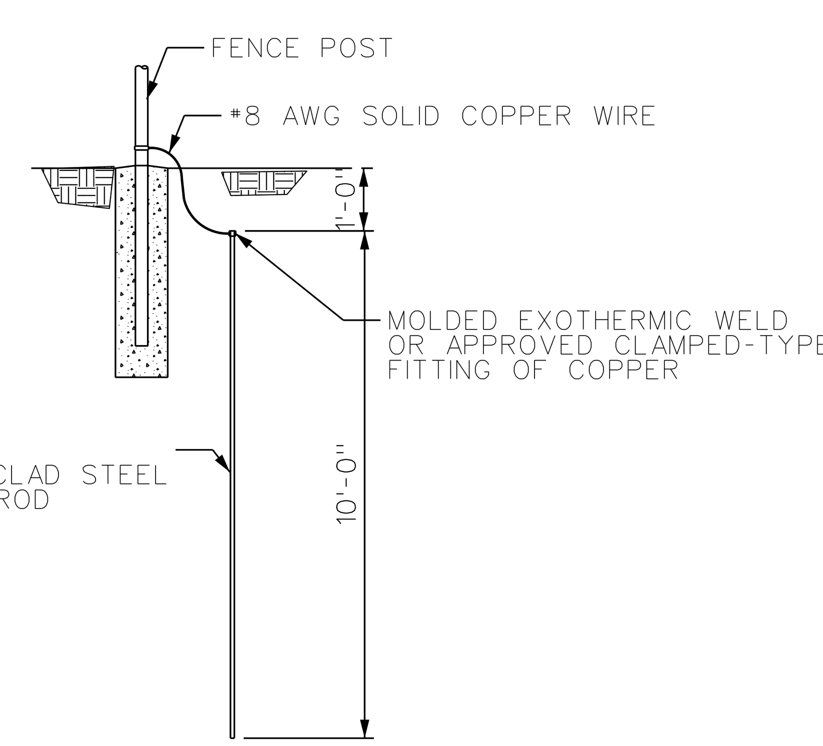
1. Details shown are to clarify requirements and are not intended to limit other types of fence sections and methods of installation.
2. Wire ties, rails, posts, and braces shall be constructed on the secure side of the fence alignment. Chain-link fabric shall be placed on the opposite side of the secure area.
3. C-Section posts shall be installed so that the void inside the post is completely filled with concrete up to the top of the foundation.
4. Bottom rail shall be attached to double rail ends using 3/8" carriage bolts as shown.



NOTE:
Provide brace panel whenever straight runs exceed 500 feet and at changes of direction.

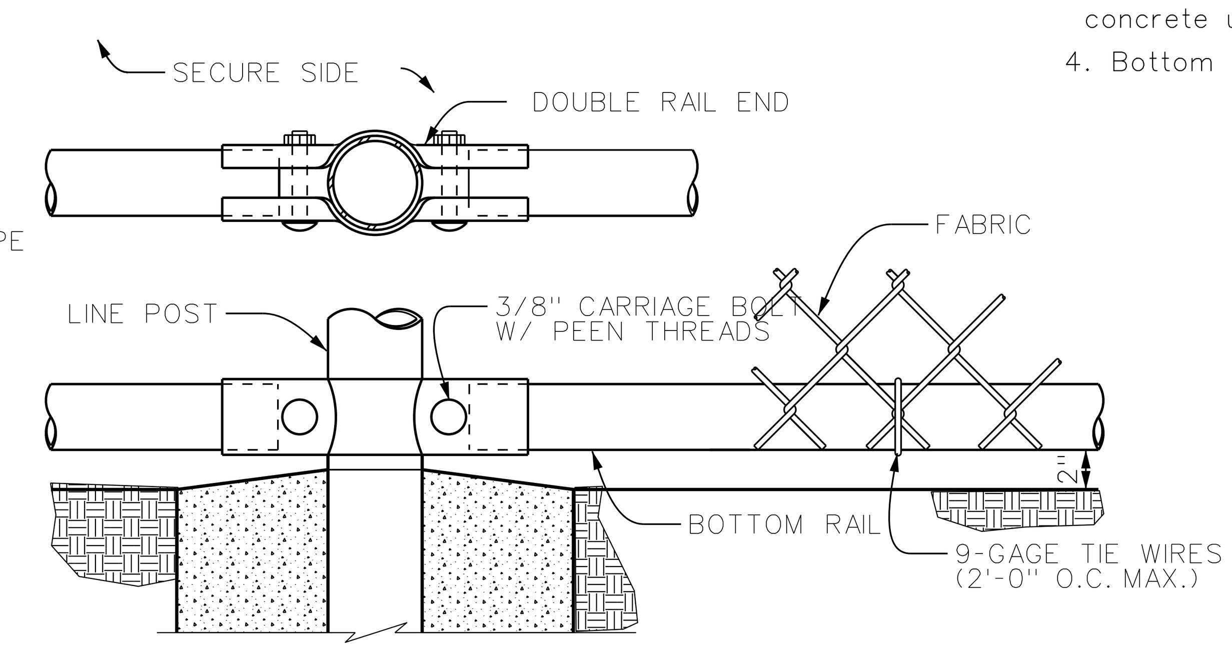
BRACE PANEL DETAIL

NO SCALE



GROUNDING DETAIL

NO SCALE



BOTTOM RAIL DETAILS

NO SCALE

FE7 CHAIN-LINK SECURITY FENCE DETAILS NON-SENSORED FENCE

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: | Date: | Rev.
Dwn by: | Sol No.
Reviewed by: | Contr. No.
Submitted by: BILL BOYLE, A.I.A. CHIEF, ARCHITECTURAL SECTION
File name: FHMRFR-C-501.dgn Plot date: 11/27/2012 Plot scale:

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

ENGINEERING/ CONSTRUCTION DIVISION ENGINEERING BRANCH

FORT HOOD, TEXAS
MODIFIED RECORD FIRE RANGE
PN 67020

FIRING POSITIONS DETAILS

SHEET SEQUENCE NUMBER

C-501

Contr. No.

8:08:49 AM 11/27/2012 FHMRFR-C-501.dgn

REFERENCE FILES:
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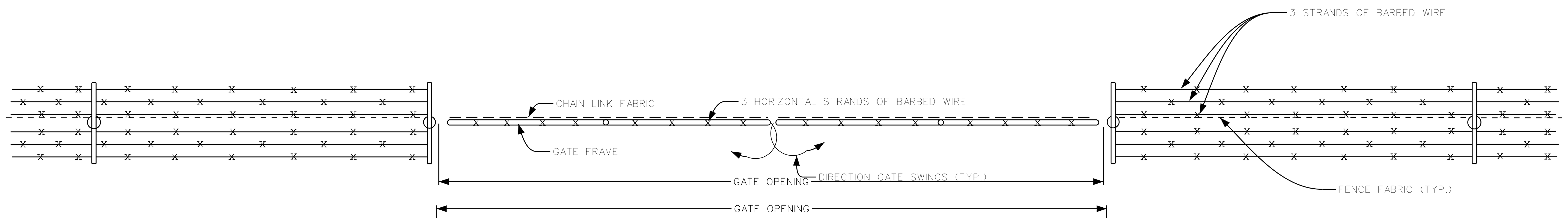
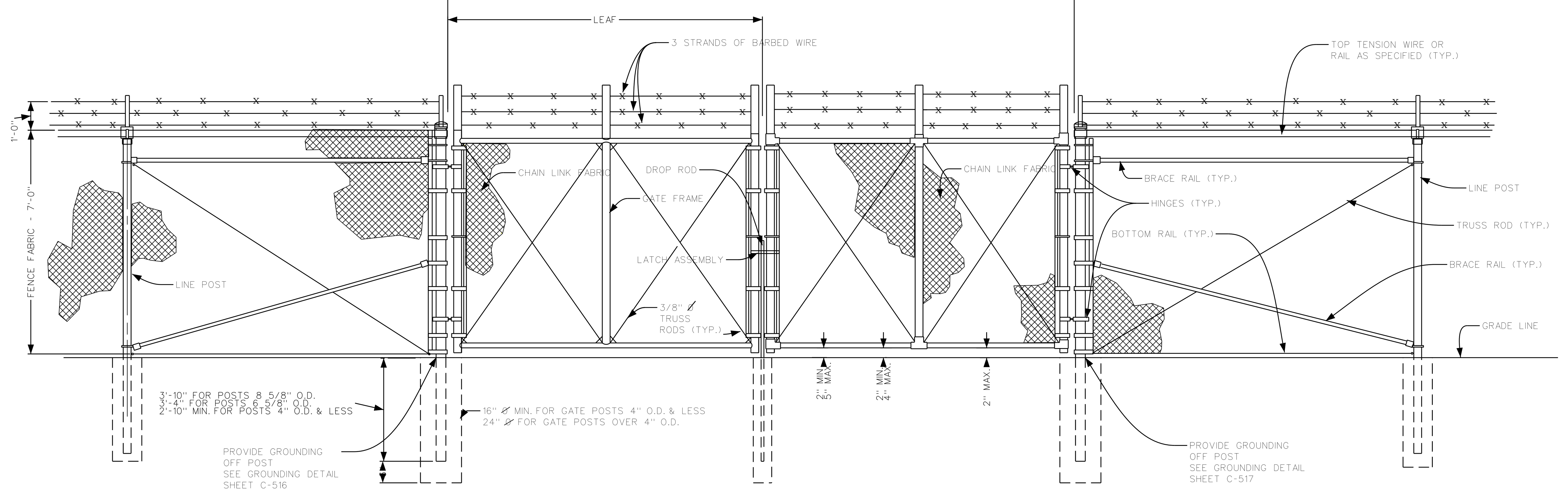
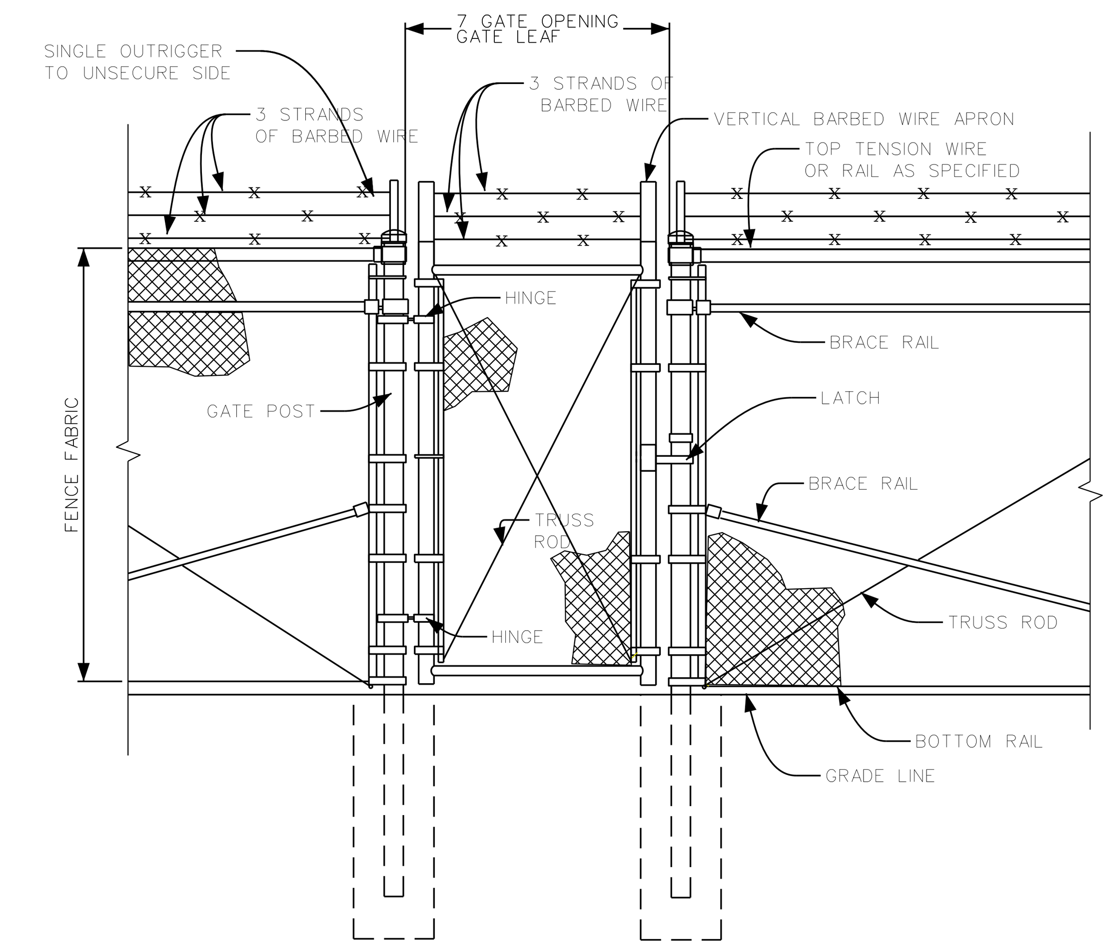


PLAN



ELEVATION
DOUBLE SWING GATE (TYPE FE7 FENCE)

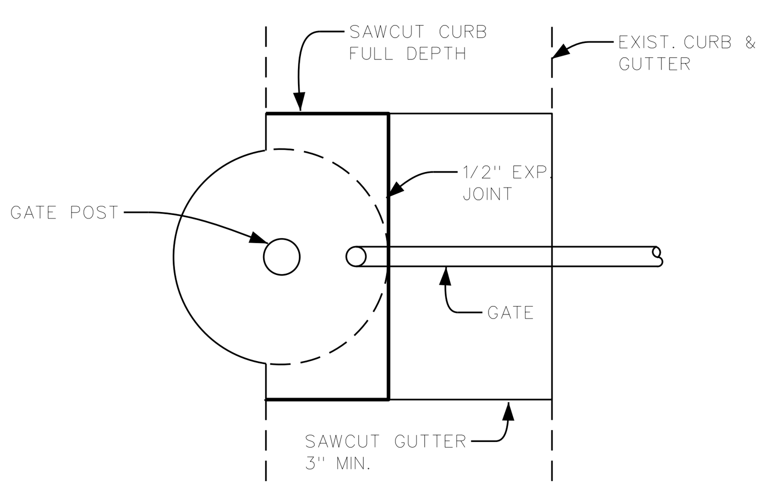


PERSONNEL GATE
TYPE FE7 FENCE

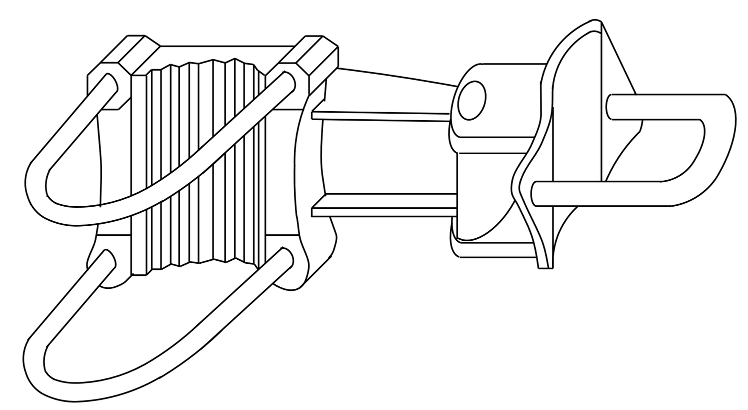
NOTES:
1. Details shown are to clarify requirements and are not intended to limit other type of fence sections and methods of installation.
2. Swing Gates shall be constructed with drop rods, padlocks, latch assembly and gate keepers except as noted.
3. All gate frames shall be a minimum 1.90" nominal (round) or 2.00" nominal (square). Gate frames shall be of welded construction or shall be assembled using heavy fittings. At Contractor's option a welded horizontal brace may be used in lieu of truss rods to brace all welded gate frames. The Contractor shall be responsible for the proper rigid construction of all gates supplied.
4. Gates shall be designated as follows:
   - Fence Type - FE5, FE6, etc.
   - Fence Height - Inches
   - Type Opening - SO (single) - DO (double)
   - Hinge - RA (standard) - HO (offset)
   - Opening - Feet (clear opening between gate posts)
   - EXAMPLES: FE6-84-DO-RA-24, FE5-48-SO-HO-6

GATE POST SCHEDULE

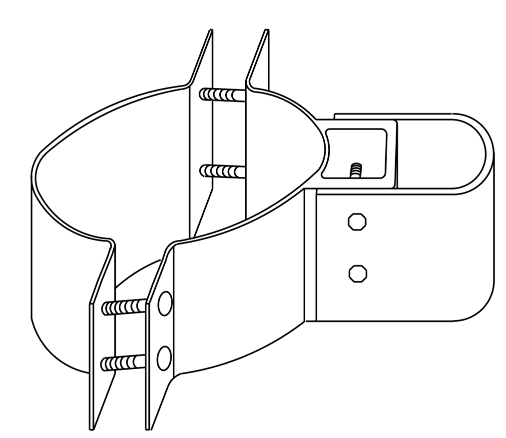
GATE LEAF WIDTH (NOMINAL)	OUTSIDE DIMENSION (NOMINAL)
6' or less	2.875" OD
More than 13' to 18'	6.625" OD
More than 18'	8.625" OD



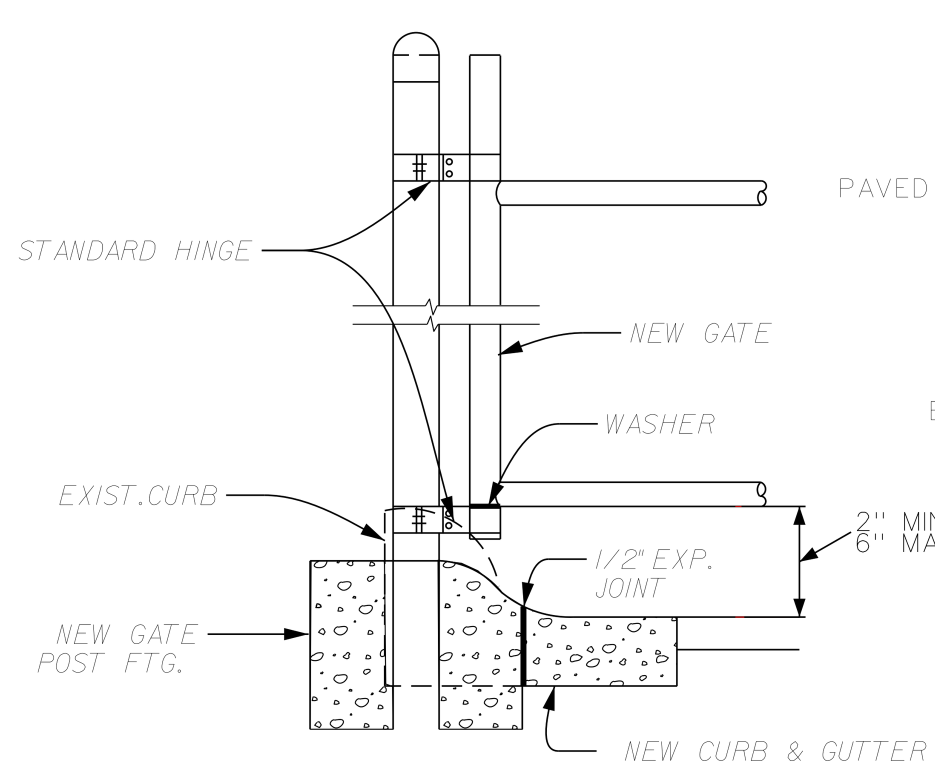
PLAN



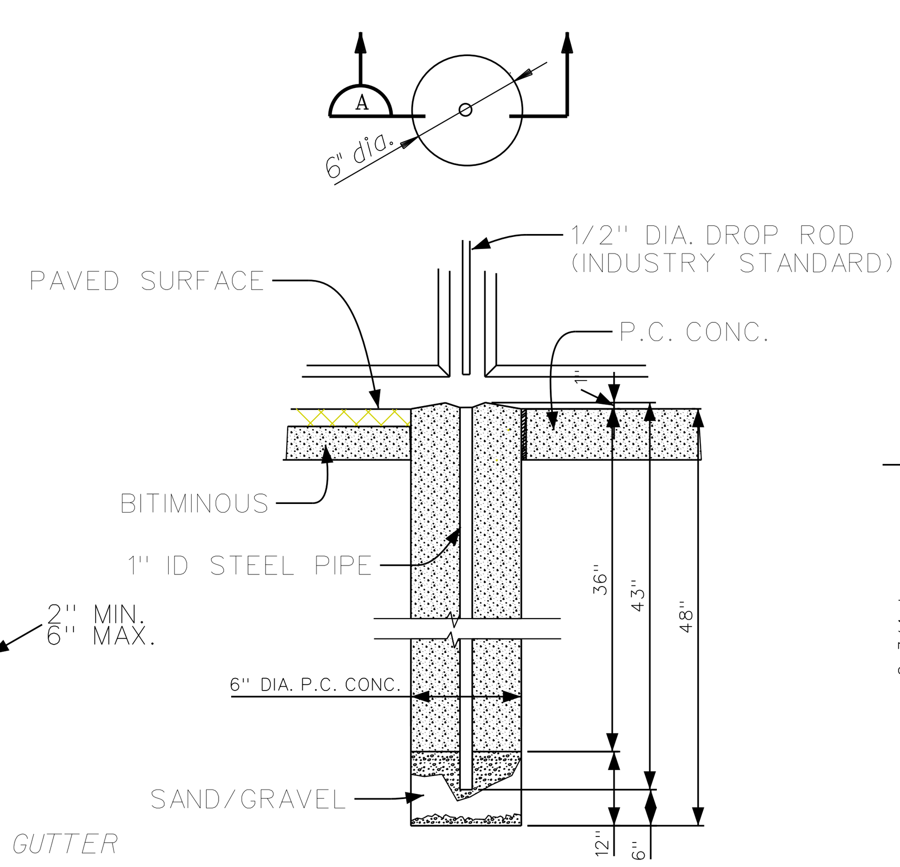
OFFSET HINGE



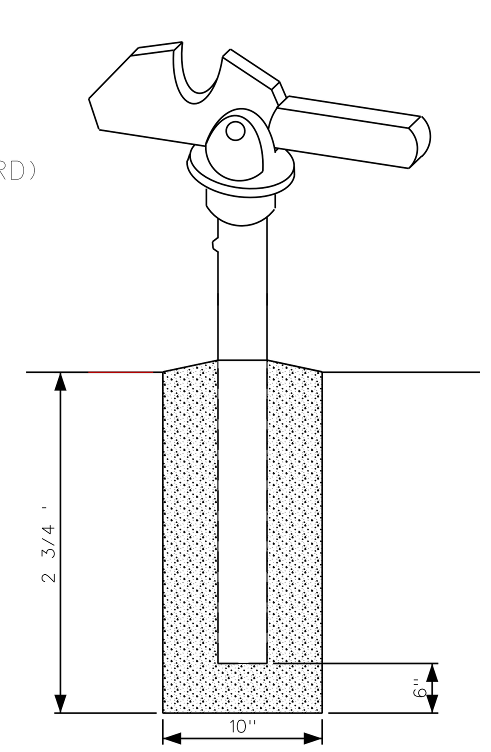
STANDARD HINGE



SECTION
GATE POST DETAIL
AT CURB AND GUTTER
NO SCALE

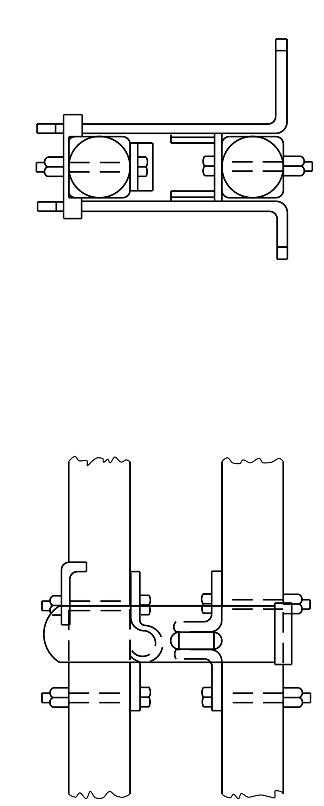


DROP ROD FOUNDATION

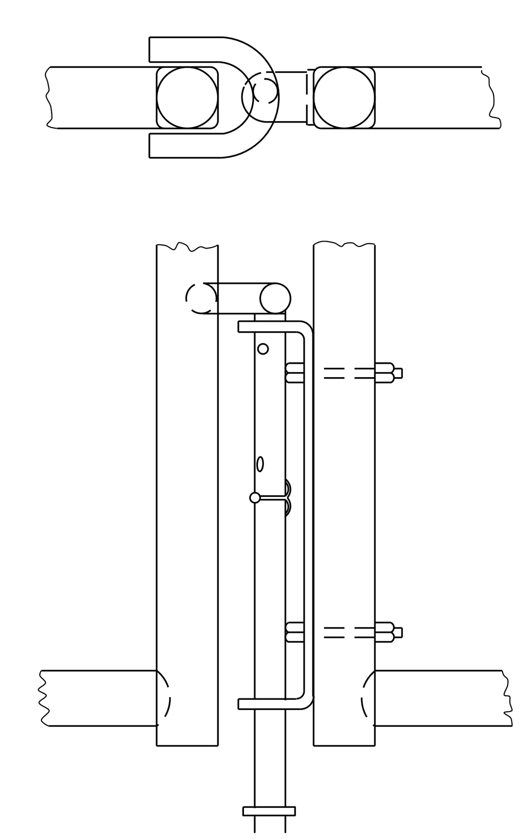


GATE KEEPER
(TO HOLD GATE OPEN)

SWING GATE DETAILS
NO SCALE



LATCH ASSEMBLY



DROP ROD ASSEMBLY

US Army Corps of Engineers
Fort Worth District

Symbol	Description	Tracking No.	Action	Date

Designed by: | Date: | Rev.
Dwn by: | Sol No.
Reviewed by: | Contr No.
Submitted by: BILL BOYLE, A.I.A. CHIEF, ARCHITECTURAL SECTION
File name: FHMRFR-C-502.dgn
Plot date: 11/27/2012
Plot scale:

U.S. ARMY ENGINEER DISTRICT,
CORPS OF ENGINEERS
FORT WORTH, TEXAS

ENGINEERING/
CONSTRUCTION DIVISION
ENGINEERING BRANCH

FORT HOOD, TEXAS
MODIFIED RECORD FIRE RANGE
PN 67020

FENCE & GATE DETAILS

SHEET SEQUENCE NUMBER
C-502

11/27/2012 8:50:40 AM
FHMRFR-C-502.dgn

REFERENCE FILES:
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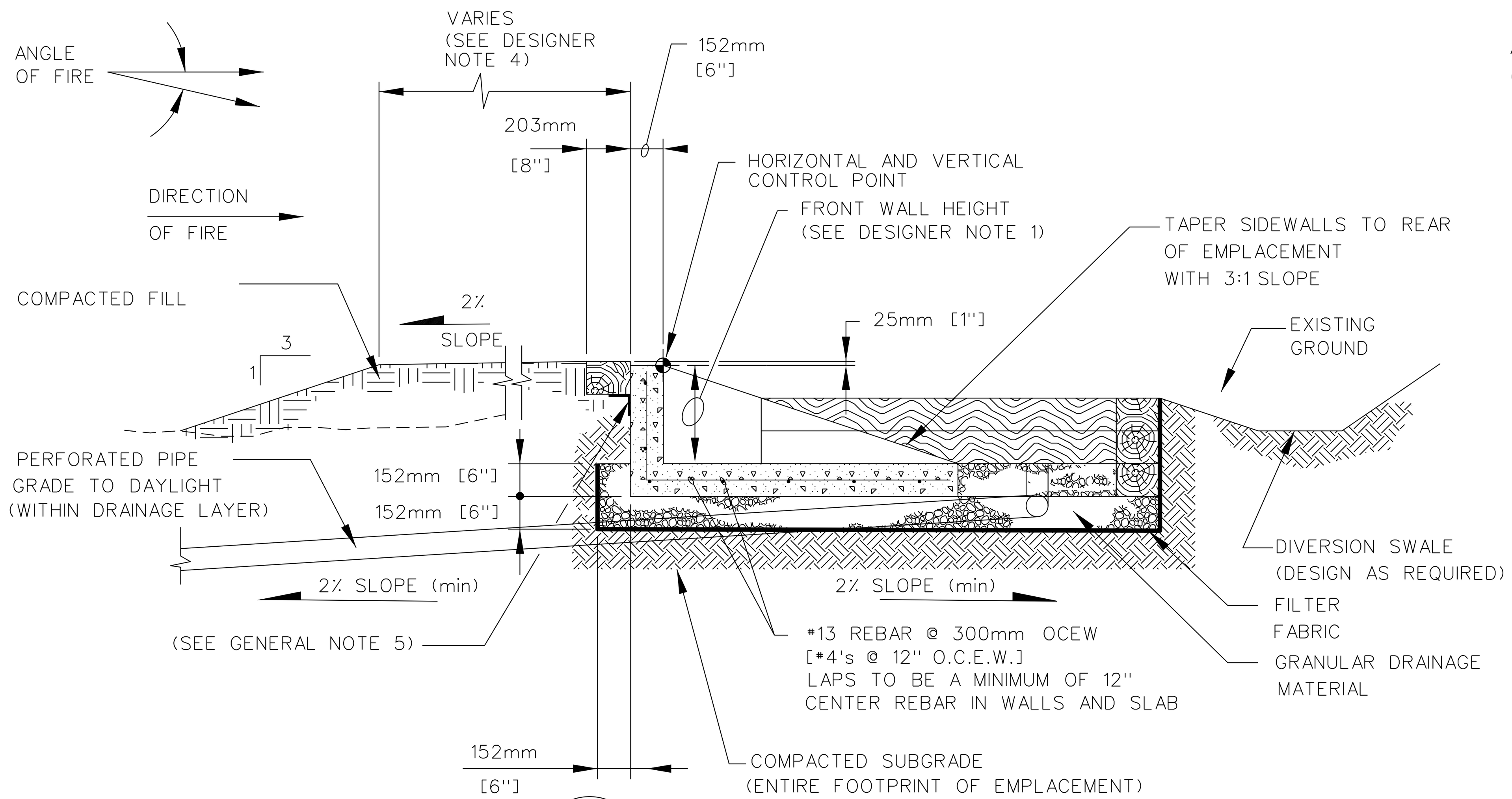
Contr No.



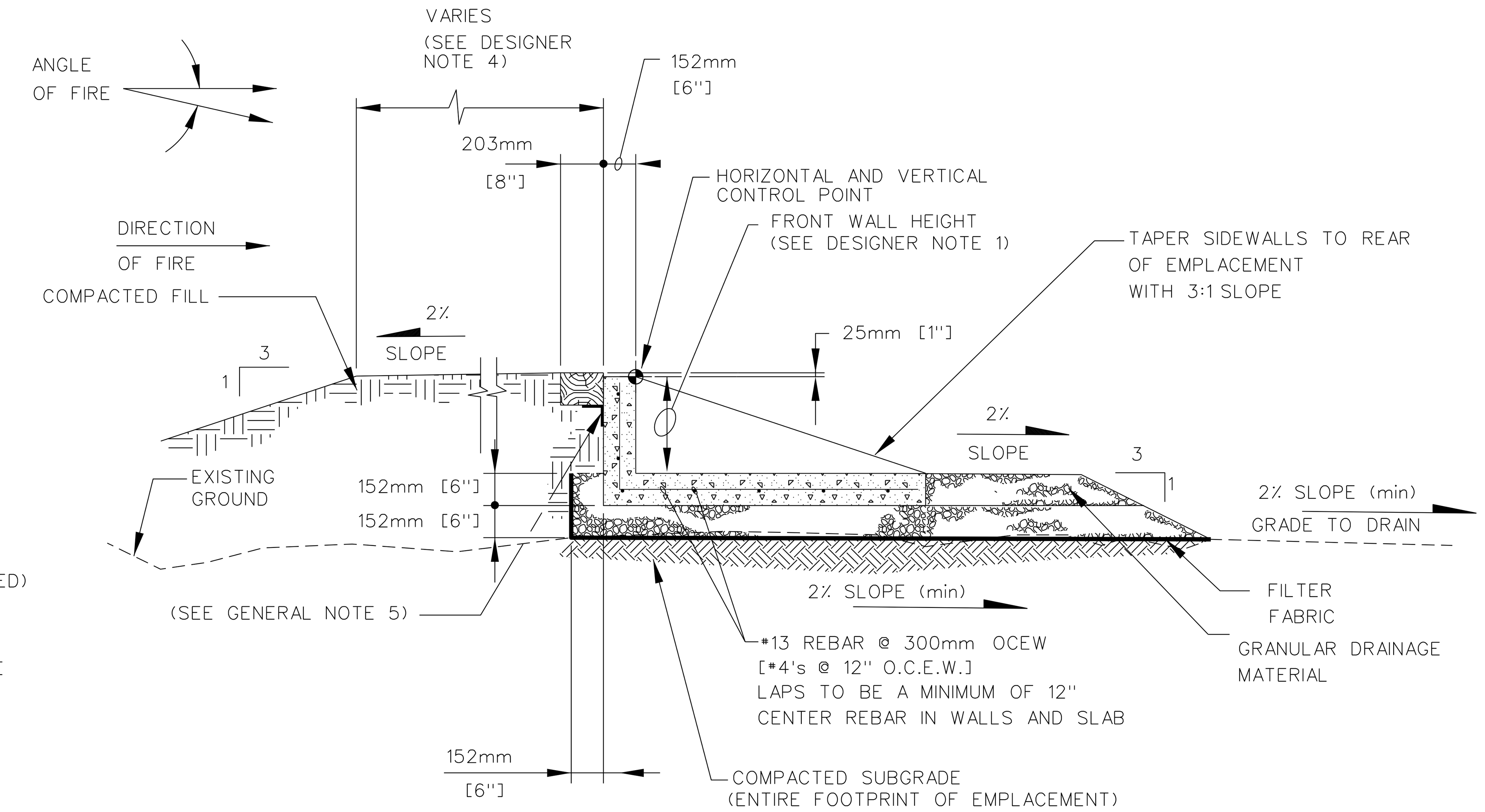
A
CD-01 CD-01

SECTION

SCALE: 1" = 2'

NOTE:

THIS EMPLACEMENT DETAIL ALSO APPLIES FOR BATTLE POSITION SENSORS, BATTLE EFFECTS SIMULATORS, MORTAR SIMULATION DEVICES, AND SOUND EFFECTS SIMULATORS.



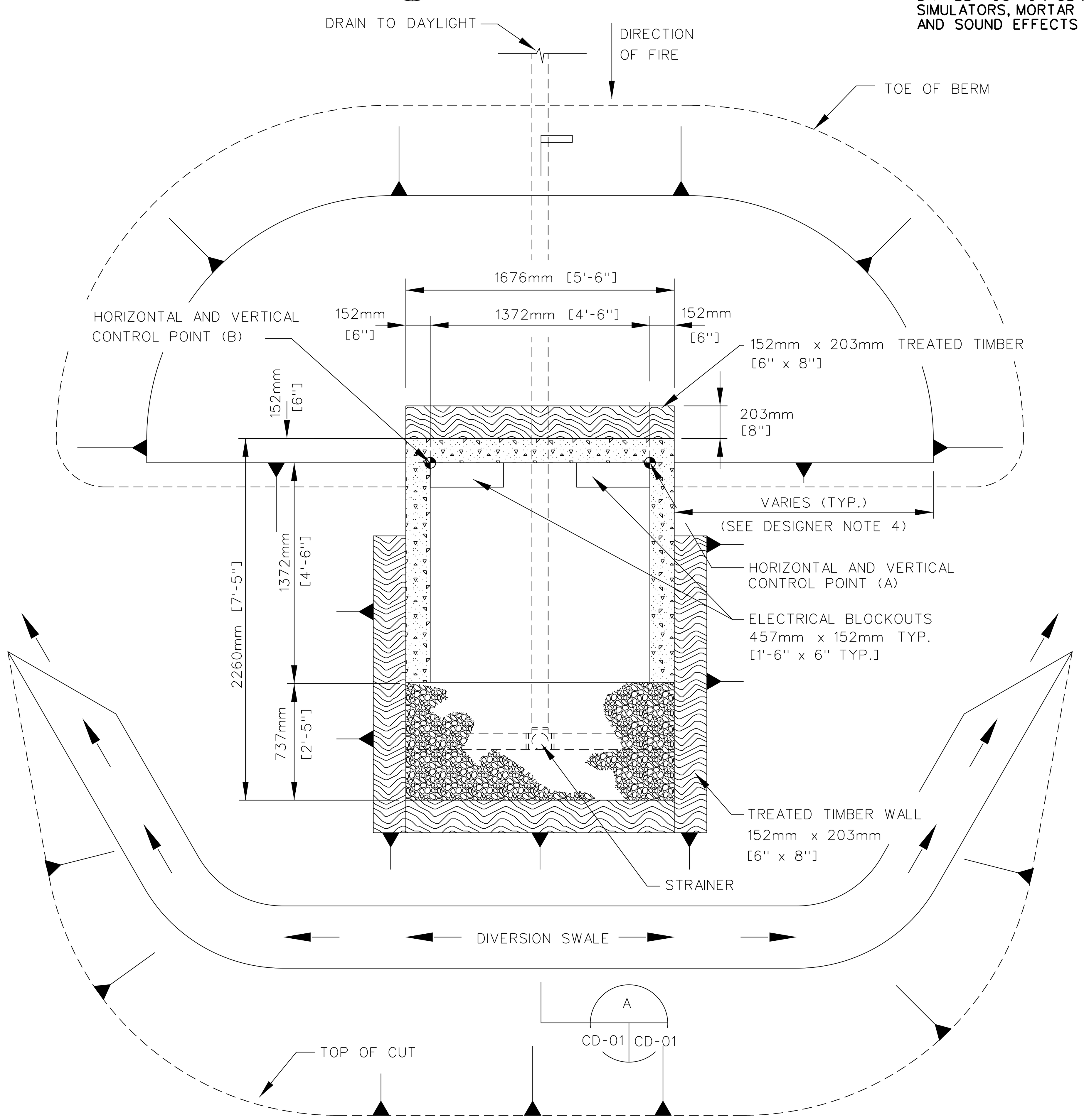
B
CD-01 CD-01

SECTION

SCALE: 1" = 2'

GENERAL NOTES:

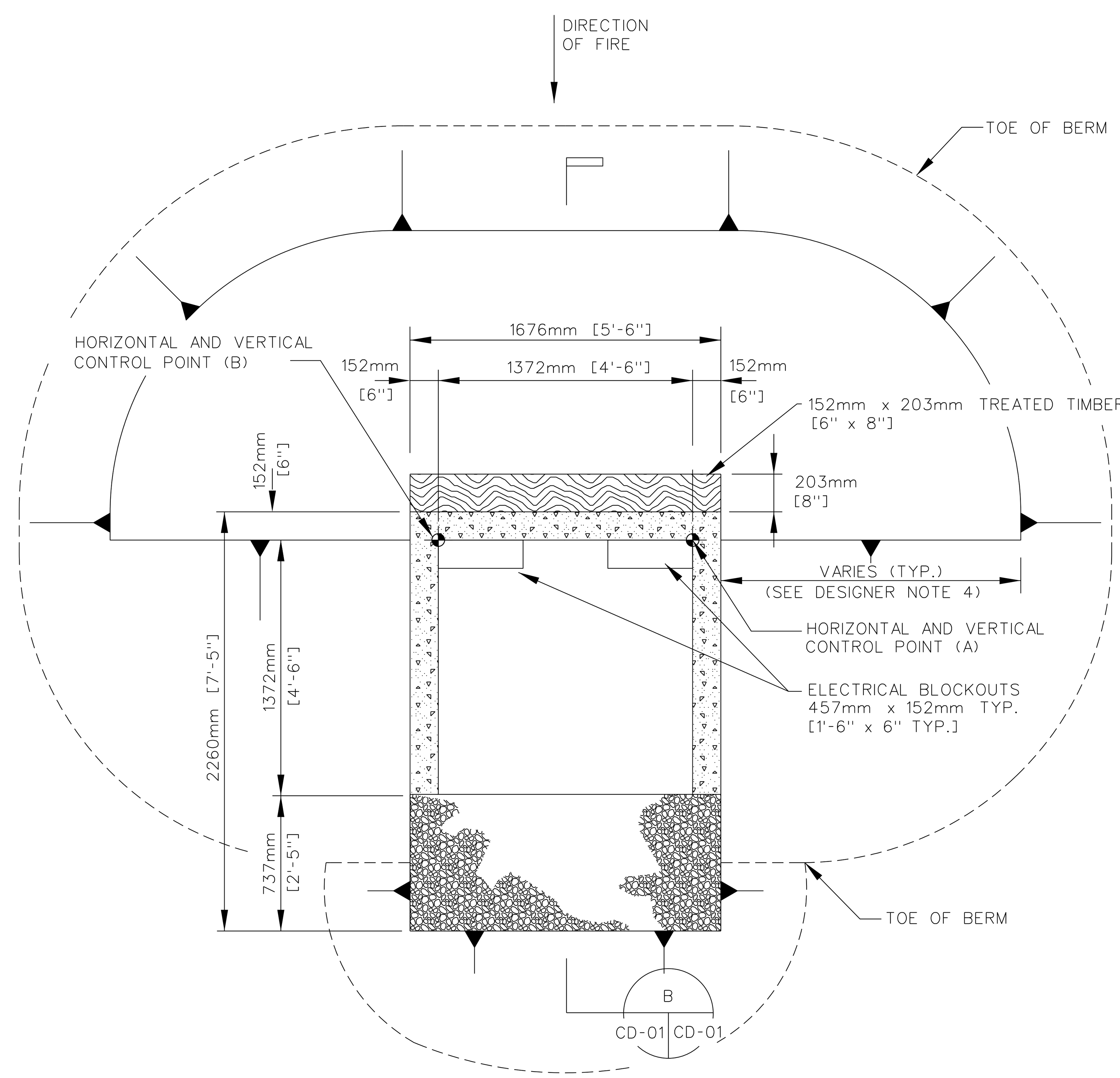
1. CONCRETE SHALL DEVELOP A MINIMUM COMPRESSIVE STRENGTH OF 28MPa (4000psi) IN 28 DAYS.
2. EMPLACEMENTS SHALL BE CONSTRUCTED OF REINFORCED CONCRETE; CONCRETE STRUCTURES SHALL BE PRECAST OR CAST-IN-PLACE.
3. ALL REINFORCING STEEL SHALL BE PER ASTM A615, GRADE 60.
4. AREAS DISTURBED BY CONSTRUCTION ACTIVITIES SHALL BE REVEGETATED OR RESURFACED CONSISTENT WITH THE NATURAL SURROUNDINGS. GROUND COVER SHALL NOT REDUCE TARGET VISIBILITY.
5. PLACE RAILROAD TIES, OR TIMBERS, AGAINST CONCRETE WALL ON L102mm x 102MM x 12.7mm x 102mm [4"x4"x1/2"x 4"] STEEL ANGLES SPACED A MAXIMUM OF 914mm [3'] ON CENTER. ATTACH ANGLE TO CONCRETE WITH CONCRETE ANCHORS.
6. ALL DIMENSIONS ARE INDICATED AS FOLLOWS: METRIC UNITS [ENGLISH] FOR INSTANCE, 1372mm [4'-6"]
7. HORIZONTAL CONTROL POINT (A) IS LOCATED ON THE LEFT SIDE OF TARGET AS VIEWED FROM THE FIRING POSITION.
8. PROVIDE 13mm [1/2"] CHAMFER ON ALL EXPOSED CONCRETE SURFACES.
9. LABEL EACH EMPLACEMENT. COORDINATE WITH RANGE CONTROL FOR NUMBERING SCHEME.



A
CD-01 CD-01

PLAN
ASCENDING SLOPE OR BELOW GRADE EMPLACEMENT

SCALE: 1" = 2'



B
CD-01 CD-01

PLAN
SURFACE / FILL EMPLACEMENT

SCALE: 1" = 2'

NOTES TO DESIGNER:

1. MINIMUM FRONT WALL HEIGHT IS 457mm [18"]. THE FRONT WALL MUST BE HIGH ENOUGH TO PROTECT THE TARGETRY EQUIPMENT WHILE STILL ALLOWING A MINIMUM OF 90% OF THE TARGET TO BE VISIBLE FROM THE FIRING POSITION. THE MINIMUM WALL HEIGHT OF 457mm [18"] PROVIDES TARGET EQUIPMENT PROTECTION UP TO A 10° ANGLE OF FIRE. (THE TARGET ARMS AND CLAMP ARE NOT PROTECTED ABOVE 10°.) IT ALSO ALLOWS 90% VISIBILITY DOWN TO A -2° ANGLE OF FIRE. A GEOMETRIC ANALYSIS WILL BE REQUIRED FOR ANGLES OF FIRE GREATER THAN 10° OR LESS THAN -2°. EXCESSIVE ANGLES OF FIRE MAY REQUIRE INCREASING THE HEIGHT OF THE FRONT WALL OR INSTALLING THE EMPLACEMENT OFF-LEVEL AT AN ANGLE THAT MATCHES THE ANGLE OF FIRE. ANGLES OF FIRE LESS THAN -2° MAY REQUIRE RAISING THE TARGET LIFTER, INSTALLING LONGER TARGET ARMS OR INSTALLING THE EMPLACEMENT OFF-LEVEL AT AN ANGLE THAT MATCHES THE ANGLE OF FIRE.THE DESIGNER MUST DEMONSTRATE DURING THE COURSE OF DESIGN THAT THE TARGETS ARE VISIBLE AND THAT THE ENTIRE CONCRETE EMPLACEMENT IS PROTECTED FROM DIRECT FIRE. ON RANGES WHERE TARGETS ARE ENGAGED FROM MULTIPLE POINTS, THE DESIGNER MUST COORDINATE CLOSELY WITH THE INSTALLATION AND THE TARGETRY PROVIDER TO DETERMINE THE CORRECT FRONT WALL HEIGHT.
2. RETAINING WALLS SHALL BE CONSTRUCTED OF ADEQUATELY CONNECTED TIMBERS OR RAILROAD TIES (MAY BE PREFABRICATED). FILTER FABRIC SHALL BE INSTALLED BEHIND ALL WOOD RETAINING WALLS. FILTER FABRIC SHALL EXTEND THE FULL HEIGHT OF THE WALL.
3. THE DESIGNER HAS THE OPTION TO USE THE BELOW GRADE EMPLACEMENT DESIGN TO PROVIDE MORE REALISTIC TRAINING. IF THE SITE CONDITIONS ARE NOT ADEQUATE TO SUPPORT POSITIVE DRAINAGE OF THE TARGET EMPLACEMENT, THE TOP OF THE SUBGRADE SHOULD HAVE A MINIMUM LONGITUDINAL SLOPE OF 2% TOWARD THE FRONT OF THE EMPLACEMENT.
4. REFER TO THE BERM THICKNESS FIGURES LOCATED IN THE DESIGN MANUAL TO DETERMINE REQUIRED BERM THICKNESS.
5. BERM SLOPES SHOWN AS 3:1 ARE TYPICAL. DIFFERENT SLOPES MAY BE REQUIRED BY THE SITE SPECIFIC GEOTECHNICAL REPORT.
6. WHERE EMPLACEMENT IS SITED IN FRONT OF AN ARMOR TARGET, USE LARGER PROJECTILE TO DESIGN EMBANKMENT.

GRAPHIC SCALE:

2 0 2 4

SCALE: 1" = 2'

STATIONARY INFANTRY TARGET EMPLACEMENT

US Army Corps of Engineers

Rev. #	Description	Date	Approved

Designed by: | Date: | Rev.
Dwn by: | Ckd by: | Design file no.
Reviewed by: | Drawing code:
Submitted by: | File name: Plot date: Plot scale:

U. S. ARMY ENGINEERING AND SUPPORT CENTER, HUNTSVILLE
HUNTSVILLE, ALABAMA

FEBRUARY 2010

RANGE AND TRAINING LAND PROGRAM
STANDARD DESIGN MANUAL

STATIONARY INFANTRY TARGET EMPLACEMENT

Sheet reference number:

CD -01

Sheet of

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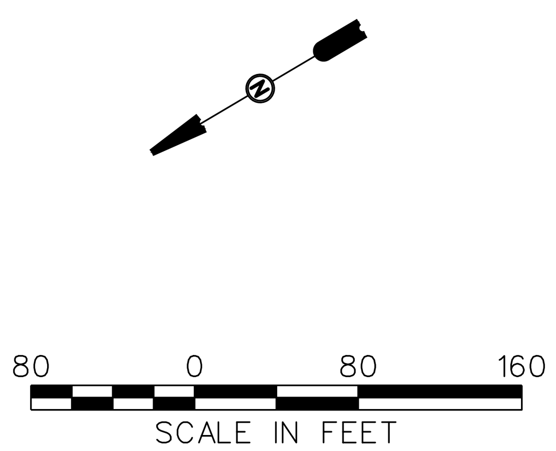


ELECTRICAL EXTERIOR LEGEND

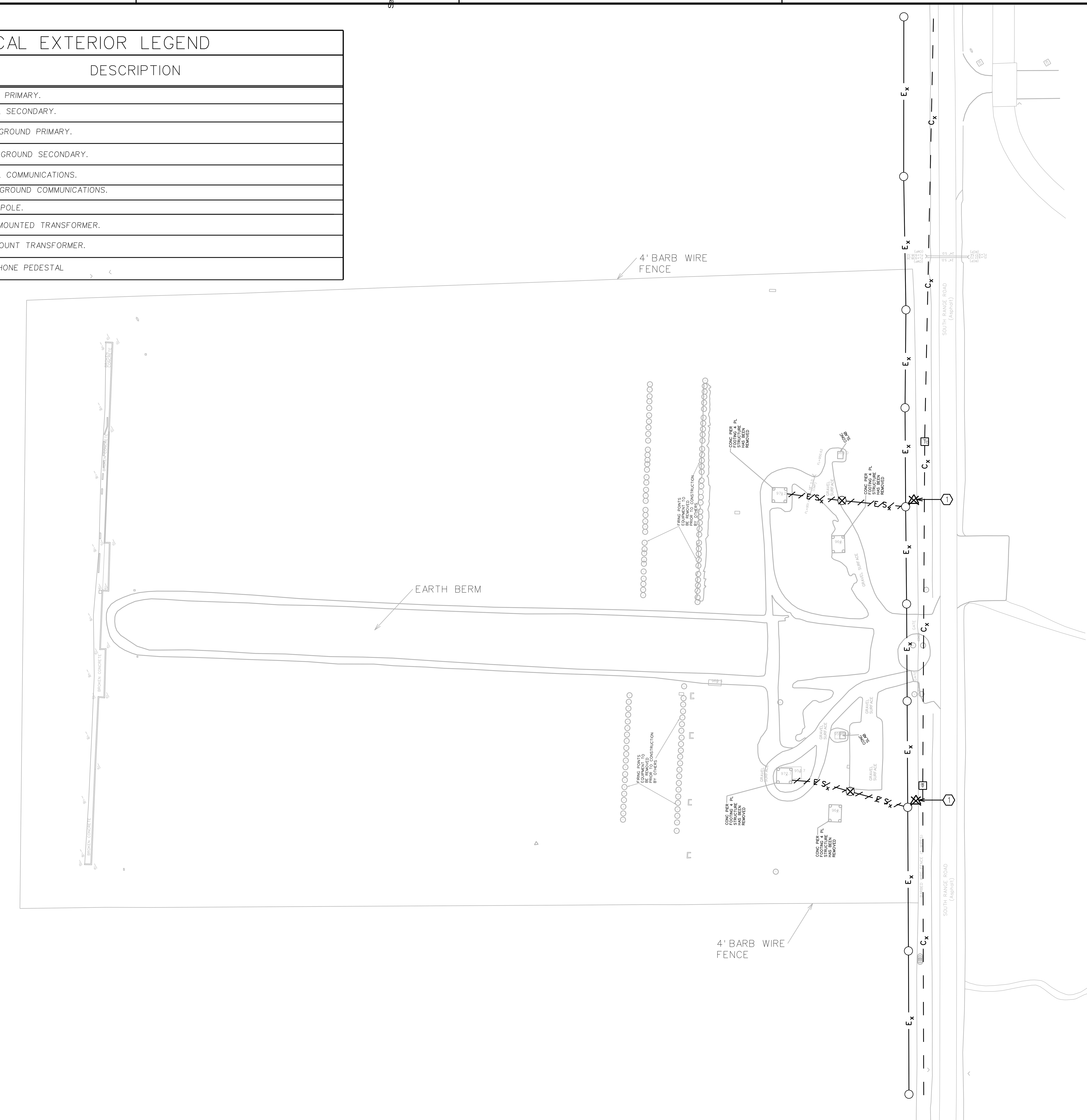
NEW	SYMBOL: EXISTING TO REMAIN	SYMBOL: EXISTING TO BE REMOVED	DESCRIPTION
	—— E$_x$ ——		AERIAL PRIMARY.
	—— ES$_x$ ——	—/— ES$_x$ —/—	AERIAL SECONDARY.
- - - - E - - - -			UNDERGROUND PRIMARY.
- - - - ES - -			UNDERGROUND SECONDARY.
	—— C$_x$ ——		AERIAL COMMUNICATIONS.
- - - - C - - - -	- - - - C$_x$ - - - -		UNDERGROUND COMMUNICATIONS.
●	○	⊠	WOOD POLE.
			POLE MOUNTED TRANSFORMER.
			PAD MOUNT TRANSFORMER.
	T		TELEPHONE PEDESTAL

GENERAL NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL OTHER CONTRACT DOCUMENTATION.

KEY NOTES: ⬡

1. CONTRACTOR SHALL TURN OVER TRANSFORMER TO FT. HOOD EXTERIOR ELECTRIC SHOP. COORDINATE WITH EXTERIOR ELECTRIC SHOP THRU COR.



US Army Corps of Engineers
Fort Worth District

Symbol | Description | Tracking No. | Action | Date

Rev. | Date: | Sol No. | Contr No.

Designed by: K. LE, P.E.
Dwn by: K. LE, P.E.
Reviewed by: PAUL GRINDEL, P.E.
Submitted by: PAUL J. GRINDEL, P.E. CHIEF, ELECTRICAL SECTION

Plot date: 9/13/2012

U.S. ARMY ENGINEER DISTRICT, CORPS OF ENGINEERS FORT WORTH, TEXAS

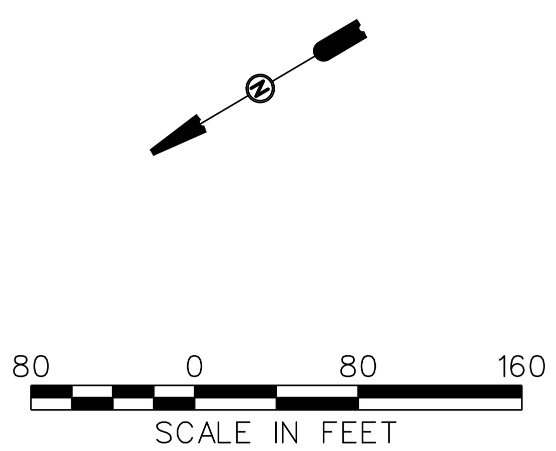
ENGINEERING/ CONSTRUCTION DIVISION ENGINEERING BRANCH

FORT HOOD, TEXAS
MODIFIED RECORD FIRE RANGE
PN 67020

ELECTRICAL DEMOLITION PLAN

SHEET SEQUENCE NUMBER

ED101



GENERAL NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL OTHER CONTRACT DOCUMENTATION.
2. CONTRACTOR SHALL COORDINATE DUCT BANK WITH ALL OTHER UTILITIES.

KEY NOTES: ⬡

1. AERIAL TO UNDERGROUND TRANSITION POLE. LOCATION SHOWN IS PROPOSED ONLY.
2. PAD-MOUNTED TRANSFORMER AND PANEL BOARD. LOCATIONS SHOWN ARE PROPOSED ONLY. CONTRACTOR SHALL PROVIDE SECONDARY UNDERGROUND FROM PANEL BOARD TO EACH NEW BUILDING.
3. UNDERGROUND DIRECT-BURIED. PROVIDE 3#1 15-KV & 1#2/0 GND. IN 4" CONDUIT.
4. CONTRACTOR SHALL PROVIDE NEW 12-STRAND AERIAL FIBER OPTIC CABLE FROM EXISTING AERIAL MAINTENANCE LOOP LOCATED AT 53RD STREET AND SOUTH RANGE ROAD TO THIS NEW POLE AND THEN UNDERGROUND IN 2-4" CONDUIT TO THE RANGE OPERATIONS TOWER. THE DISTANCE FROM THIS POLE TO EXISTING AERIAL MAINTENANCE LOOP IS APPROXIMATELY 2,700 FT. CONTRACTOR MAY UTILIZE THE EXISTING POWER LINE ALONG SOUTH RANGE ROAD TO RUN THE NEW AERIAL FIBER OPTIC CABLE. CONTRACTOR SHALL COORDINATE WITH NEC FOR LOCATION AND TERMINATION AT THE CONNECTION POLE PRIOR TO INSTALLATION. THE NEW POLE LOCATION SHOWN IS PROPOSED ONLY.
5. CONTRACTOR SHALL PROVIDE NEW 12-PAIR TELEPHONE CABLE FROM THIS EXISTING PEDESTAL AND RUN UNDERGROUND IN 2-4" CONDUIT TO SERVE TELEPHONE REQUIREMENT FOR RANGE OPERATIONS TOWER. CONTRACTOR SHALL ALSO PROVIDE 12-PAIR EACH TELEPHONE UNDERGROUND IN 2-4" CONDUIT RUNNING FROM THE RANGE OPERATIONS TOWER TO OPERATIONS/STORAGE AND CLASSROOM BUILDING.

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 ENGINEERING BRANCH

Designed by: K. LE, P.E.
Dwn by: K. LE, P.E.
Reviewed by: PAUL GRINDEL, P.E.
Submitted by: PAUL J. GRINDEL, P.E. CHIEF, ELECTRICAL SECTION
Date:
Sol No.
Contr No.
Rev.
File name: FH_MRFR-ES101---.dgn
Plot date: 10/4/2012
Plot scale:

FORT HOOD, TEXAS
MODIFIED RECORD FIRE RANGE
PN 67020

EXTERIOR ELECTRICAL PLAN

SHEET SEQUENCE NUMBER
ES101

Contr No.

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REFERENCE FILES:
bogen.dgn
S_FD_PAZ_LN.dgn
trveh.dgn
wetlnd.dgn

Appendix K

FORT HOOD CURRENT UTILITY RATES

UTILITIES RATES FOR FORT HOOD

Utilities	Cost	Unit	Terminates	Comments
Electricity	$0.0506	kWh	Jan 2013	New rates Jan 2013, awaiting renegotiation
Nat Gas	$3.4632	MCF	Monthly	Varies monthly and adjusted by the State periodically IAW rate change request by the utility provider
Water (SFH)	$0.090	KGAL	Sep 2012	New rates Oct 2012, awaiting KO approval
Water (NFH)	$1.100	KGAL	Sep 2012	New rates Oct 2012, awaiting KO approval
Sewer (SFH)	$1.140	KGAL	Sep 2012	New rates Oct 2012, awaiting KO approval
Sewer (NFH)	$1.320	KGAL	Sep 2012	New rates Oct 2012, awaiting KO approval
Notes:				

Mr. Bobby, IMWE-HOD, Bobby.Lynn@us.army.mil, (254) 287-8716

APPENDIX L

LEED Project Credit Guidance

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**
SUSTAINABLE SITES				
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		Bike racks are prohibited at certain facilities, as indicated in Statement of Work. 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 AND LOW IMPACT DESIGN.
SS6.2	Stormwater Design: Quality Control	Rqd		See paragraph STORMWATER MANAGEMENT AND LOW IMPACT DESIGN.
SS7.1	Heat Island Effect: Non-Roof			
SS7.2	Heat Island Effect: Roof	Pref		See paragraph SITE SELECTION
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	Water Efficient Landscaping:	Rqd		See paragraph IRRIGATION. 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	Rqd		See paragraph PLUMBING AND WATER CONSUMING

				EQUIPMENT.
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	On-Site Renewable Energy	Pref		See paragraph ENERGY CONSERVATION.
EA3	Enhanced Commissioning			See paragraph COMMISSIONING.
EA4	Enhanced Refrigerant Management			See paragraph MATERIALS AND RESOURCES.
EA5	Measurement & Verification	Rqd		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	Construction Waste Management:	Rqd		See paragraph CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT.
MR3	Materials Reuse			
MR4	Recycled Content:	Pref		See paragraph MATERIALS AND RESOURCES.
MR5	Regional Materials			See paragraph MATERIALS AND RESOURCES.
MR6	Rapidly Renewable Materials	Pref		See paragraph MATERIALS AND RESOURCES.
MR7	Certified Wood	Pref		See paragraph MATERIALS AND RESOURCES.
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			See paragraph BUILDING INTERIOR.
EQ2	Increased Ventilation			
EQ3.1	Construction IAQ Management Plan: During Construction	Pref		See paragraph BUILDING ENVELOPE SEALING PERFORMANCE REQUIREMENT.
EQ3.2	Construction IAQ Management Plan: Before Occupancy	Pref		See paragraph BUILDING ENVELOPE SEALING PERFORMANCE REQUIREMENT.
EQ4.1	Low Emitting Materials: Adhesives & Sealants	Pref		See paragraph DAYLIGHTING AND LOW EMITTING MATERIALS
EQ4.2	Low Emitting Materials: Paints & Coatings	Pref		See paragraph DAYLIGHTING AND LOW EMITTING MATERIALS
EQ4.3	Low Emitting Materials: Carpet/Flooring Systems	Pref		See paragraph DAYLIGHTING AND LOW EMITTING MATERIALS
EQ4.4	Low Emitting Materials: Composite Wood & Agrifiber Products	Pref		See paragraph DAYLIGHTING AND 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	Rqd		See paragraph DAYLIGHTING AND LOW EMITTING MATERIALS.
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 AND LOW EMITTING MATERIALS.
EQ8.2	Daylight & Views	Pref		
<u>INNOVATION & DESIGN PROCESS</u>				
IDc1.1	Innovation in Design			See paragraph INNOVATION AND DESIGN CREDITS AND REGIONAL PRIORITY 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's Project Requirements

Not Used

APPENDIX N

LEED Requirements for Multiple Contractor Combined Projects (29 Sep 09)

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 Multiple Contractor Responsibilities 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 Multiple Contractor Responsibilities 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 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 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 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 as follows:

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.
****
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: 4^{th} 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): Large Brigade HQ, Medium 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

Not Used

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://mrsi.usace.army.mil/rfp/Shared%20Documents/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.

MEMORANDUM FOR RECORD 6/14/2011

SUBJECT: UXO Survey, FY13, Modified Record Fire (MRF), Project Number # 67020, Fort Hood, Texas

TO: CEHNC-OE-DC (Bill Sargent)
Huntsville Engineering & Support Center
Huntsville, AL

On June10, 2011, a formal UXO Survey was conducted at Fort Hood, Texas FY13 Proposed MRF footprint. As part of the range design process, a UXO survey was conducted due to the recommendation at the planning charrette.

The proposed Modified Record Fire (MRF) location is located at general grid coordinates of 168482. The proposed range is to be over-laid on two existing small arms ranges (12A and 12B).

This location is being used for small arms training with two existing small arms ranges. This area has been used for small arms training during the recent past. Early history is un-documented. There were no known EOD UXO incident reports for this location.

During the planning charrette site visit, the only evidence of military munitions or scrap that was noted was small arms debris associated with current small arms use. The planning charrette memo stated “UXO risk appears to be very low”. The proposed site has no evidence of being used as a dud producing weapons firing or impact area.

The site was swept at 50 meter increments by Team Lead Jason Burcham and OE Safety Specialist Chris Graber. Mr. Graber used a Schonstedt Magnetometer to assist in the sweep. No explosive hazards were encountered. The team did not encounter evidence that would suggest the potential for explosive hazards. Small Arms debris was observed throughout the site. The UXO Survey assessment agrees with the planning charrette assessment. The site is perceived as a very low risk. Standard contractor awareness training is recommended.

Jason A. Burcham
ENGINEER

FT HOOD AAF/KILLEEN TX	
Latitude = 31.10 N	WMO No. 722570
Longitude = 97.72 W	Elevation = 925 Feet
Period of Record = 1960 TO 2005	Average Pressure = 29.01 inches Hg

Design Criteria Data

Dry Bulb Temperature (T)	Design Value (°F)	Mean Coincident (Average) Values: Wet Bulb Temperature (°F)	Humidity Ratio (gr/lb)	Wind Speed (mph)	Prevailing Direction (NSEW)
Median of Extreme Highs	102	74	84	8.2	S
0.4% Occurrence	99	74	88	8.8	S
1.0% Occurrence	97	74	92	8.9	S
2.0% Occurrence	95	74	95	8.9	S
Mean Daily Range	18	-	-	-	-
97.5% Occurrence	34	31	21	7.9	N
99.0% Occurrence	29	26	15	8.8	N
99.6% Occurrence	25	22	12	9.5	N
Median of Extreme Lows	21	19	11	10.9	N

Wet Bulb Temperature (T_{wb})	Design Value (°F)	Mean Coincident (Average) Values: Dry Bulb Temperature (°F)	Humidity Ratio (gr/lb)	Wind Speed (mph)	Prevailing Direction (NSEW)
Median of Extreme Highs	80	92	135	8.1	S
0.4% Occurrence	78	90	125	9.2	S
1.0% Occurrence	77	89	121	9.4	S
2.0% Occurrence	76	88	116	9.3	S

Humidity Ratio (HR)	Design Value (gr/lb)	Mean Coincident (Average) Values: Dry Bulb Temperature (°F)	Vapor Pressure (in. Hg)	Wind Speed (mph)	Prevailing Direction (NSEW)
Median of Extreme Highs	146	87	0.94	9.5	S
0.4% Occurrence	136	83	0.88	7.6	S
1.0% Occurrence	130	82	0.84	7.7	S
2.0% Occurrence	127	81	0.82	7.9	S
Air Conditioning/ Humid Area Criteria		$T \geq 93°F$	$T \geq 80°F$	$T_{wb} \geq 73°F$	$T_{wb} \geq 67°F$
	# of Hours	378	2204	1466	3472

Other Site Data

Weather Region	Rain Rate 100 Year Recurrence (in./hr)	Basic Wind Speed 3 sec gust @ 33 ft 50 Year Recurrence (mph)	Ventilation Cooling Load Index (Ton-hr/cfm/yr) Base 75°F-RH 60% Latent + Sensible
10	N/A	N/A	2.5 + 2.0
Ground Water Temperature (°F) 50 Foot Depth *	Frost Depth 50 Year Recurrence (in.)	Ground Snow Load 50 Year Recurrence (lb/ft^2)	Average Annual Freeze-Thaw Cycles (#)
70.1	N/A	N/A	11

*Note: Temperatures at greater depths can be estimated by adding 1.5°F per 100 feet additional depth.