UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2023
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DIVISION 31 - EARTHWORK

SECTION 31 63 26.60

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[GROUTED] HELICAL PILES
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****
NOTE: This guide specification covers the requirements for [grouted] helical piles.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).
****

****
NOTE: To download UFGS Forms, Graphics, and Tables, go to: http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables
****

****
NOTE: The extent and location of the work to be accomplished should be indicated on the project drawings or included in the project specification.
****

****
NOTE: Show the following information on the drawings:

1. Locations and design loads of piles. If both tension and compression piles are contained in

design, identify by type.

2. Size, shape, and length of piles.

3. Locations of test piles, if required.

4. Soil data, where required.

5. Identify piles as vertical or battered.

****

PART 1 GENERAL

****

NOTE: Structural engineer must confirm the structural capacity of piles and provide specific bending moments, lateral loads and other design requirements for pile design.

****

1.1 DESCRIPTION

Design, furnish, install and test [grouted] helical piles at the locations indicated on the drawings and specified herein.[Test piles that meet performance requirements can be incorporated into the permanent work.]

1.1.1 Definitions

a. Helical Pile (helical pier or screw pile): Consists of 1) one or more helix plates attached to a central shaft and 2) load transfer device for attachment to a structure. May also include surface coating or other corrosion protection means.

b. Torque: The measure of the rotational force times the moment arm needed to overcome the shear strength of the soil N-m ft-lb. Torque is used in an empirical approach for predicting the ultimate capacity of a helical pile.

c. Minimum Installation Torque: Minimum torque necessary to attain the required pile capacity.

d. Maximum Torque Rating: Torque which if exceeded may cause damage to the pile or equipment.

1.2 REFERENCES

****

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature

to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

****

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.

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 301	(2016) Specifications for Structural Concrete
ACI 301M	(2016) Metric Specifications for Structural Concrete

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2023) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM C31/C31M	(2022) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2021) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C109/C109M	(2021) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C144	(2018) Standard Specification for Aggregate for Masonry Mortar
ASTM C939/C939M	(2022) Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
ASTM C942/C942M	(2021) Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C1077	(2017) Standard Practice for Agencies Testing Concrete and Concrete Aggregates

	for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1157/C1157M	(2020a) Standard Performance Specification for Hydraulic Cement
ASTM C1611/C1611M	(2021) Standard Test Method for Slump Flow of Self-Consolidating Concrete
ASTM D942	(2019) Standard Test Method for Oxidation Stability of Lubricating Greases by the Oxygen Pressure Vessel Method
ASTM D1143/D1143M	(2007; R 2013) Piles Under Static Axial Compressive Load
ASTM D3689	(2007; E 2013; R 2013) Standard Test Methods for Deep Foundations Under Static Axial Tensile Load
ASTM D3966/D3966M	(2007; R 2013; E 2013) Standard Test Methods for Deep Foundations Under Lateral Load
ASTM D4945	(2017) Standard Test Method for High-Strain Dynamic Testing of Deep Foundations
ASTM E329	(2021) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-220-01	(2012; with Change 1, 2021) Geotechnical Engineering

[1.3 SUBSURFACE DATA

Subsurface soil data logs are[indicated][appended to the special contract requirements][provided on the project drawings].[The subsoil investigation report may be examined at [_____].]

]1.4 BASIS OF BID

****
NOTE: Select one of the following options:
****

****
NOTE: Use "Lump Sum" paragraph below for lump (principal) sum bidding of piles. Use this in all projects except those where exact pile lengths cannot be practically determined prior to the actual work. Clearly show number of piles, pile capacity, pile locations, and tip and cutoff elevations on the drawings.

Use "Unit Price" paragraph for unit price bidding of

piles. Specify unit price bid items for piles only for projects where exact quantities cannot be practically determined prior to the actual work. Lengths of piles must be determined as accurately as possible, prior to bidding, since the unit price per meter foot of the piles varies as the length increases or decreases. Refer to Standard Test Method for High-Strain Dynamic Testing of Deep Foundations (ASTM D4945).

****

1.4.1 Production Pile Acceptance Criteria

Safe design capacity for piles is [_____] KN kips. Install piles to [minimum tip elevation] [a minimum depth of [_____] m feet below cut-off elevation], and to such additional depth as required to obtain a bearing capacity of not less than [_____] KN kips. The Contractor's Geotechnical Consultant will determine the terminal installation criteria based on results of [dynamic pile installation tests] [static load tests].

[For cases where allowable pile loads are less than 355 kN 80 kips (determined using a factor of safety of 3 for individual piles and 4 for pile groups, the end bearing geotechnical capacity of [grouted] helical piers may be estimated during installation by monitoring and recording the final installation torque and[applying torque correlation factors provided by the designer][applying default torque correlation factors for the central steel shaft per well-document correlations].[Verify with the manufacturer that the correlation factors apply to their products.] The allowable end bearing capacity may be estimated as:

Qall = Kt X T

Where Qall is the approximate allowable end bearing pile load in Kn kips; T equals the final installation torque defined as the last torque reading taken during helical pile installation which must not exceed the maximum installation torque rating of the helical pile; and Kt is the torque correlation factor. Allowable skin friction resistance must be provided by the designer determined through a generally accepted method of analysis in accordance with UFC 3-220-01.

][1.4.2 Lump Sum Payment

****

NOTE: Use this paragraph for lump-sum contracts, consult with Contracting Officer's Technical Representative (Geotechnical Branch) on applicability of use prior to selection. This paragraph will be typically used when there are 1) relatively small quantity of piles, 2) allowable pile loading is less than 355 kN 80 kips (and 3) the subsurface conditions are well defined. Fill in Table I as required selecting columns applicable to project. Generally, pile capacity, location, and minimum tip elevation are shown on plans. Test piles and load tests are not incorporated on lump sum contracts. Delete this paragraph for unit-price contracts.

****

Base bids upon providing the number, size, capacity, and length of piles as indicated on the [drawings.] [following Table 1:

Table 1						
[Location]	Number	Size	[Capacity]	[Length (Tip to Cut-Off)]	[Maximum Bending Moment]	[Maximum Shear Force]

]

Include the cost of all necessary equipment, tools, material, labor, and supervision required to: [design,] deliver, handle, install, cut-off, dispose of any cut-offs, and meet the applicable contract requirements. Include mobilization, pre-drilling, and reinstallation of heaved piles. If, in reinstallation, it is found that any pile is not of sufficient length to provide the capacity specified, notify the Contracting Officer, who reserves the right to increase or decrease the total length of piles to be provided and installed by changing the pile locations or elevations, requiring the installation of additional piles, or directing the omission of piles from the requirements shown and specified. If total number of piles or number of each length vary from that specified as the basis for bidding, an adjustment in the contract price or time for completion, or both, will be made in accordance with the contract documents. Payment for piles will be based on successfully installing piles to both the minimum tip elevation and satisfying the acceptance criteria identified herein. No additional payment will be made for: damaged, rejected, or misplaced piles; withdrawn piles; any portion of a pile remaining above the cut-off elevation; back installation; cutting off piles; splicing; build-ups; any cut-off length of piles; or other excesses beyond the assumed pile length indicated for which the Contractor is responsible.[Include payments for vibration monitoring, sound monitoring and precondition construction surveys].

][1.4.3 Unit Price

****

NOTE: Delete this paragraph for lump-sum contracts.

For NAVFAC PAC projects: Where there is unit pricing for piles, use this paragraph and edit applicable attachments in price schedule for inclusion in Standard Form 1442, "Solicitation, Offer and Award" and "Schedule of Bid Items."

For NAVFAC Southeast projects, where there is a need for unit pricing of piles, include this paragraph. Refer to NAVFAC SE Instruction 00010, "Instructions for Preparing Basis of Bid Statement With Unit-Priced Items," for method of specifying unit price bid items.

****

For unit price bid, see SF 1442, "Solicitation, Offer and Award" and "Schedule of Bid Items."

****

NOTE: For NAVFAC LANT projects, use the following paragraph for measurement and payment and subsequent sub-parts.

****

Requirements of FAR 52.211-18 Variation in Estimated Quantity do not apply to payment for piling. Each pile and test pile acceptably provided will be paid for at the bid unit price per unit length, which will include items incidental to furnishing and installation of the piles including mobilization and demobilization, [jetting] [predrilling] [probing], reinstallation of uplifted piles, [an additional 1.5 m 5 feet in furnished length for any test pile not installed beyond estimated pile length,] and cutting off piles at the cut-off elevation.[Include the cost for additional length for the test piles in the total unit price cost for the job.] Payment will be made for production [and test piles] at the bid unit price for the length of pile, from tip to final cut-off, actually provided, excluding buildups and splices directed by the Contracting Officer to be made. If the actual cumulative pile length installed (tip to cut-off) varies more than 25 percent from the total pile length specified as a basis for bidding, at the direction of the Contracting Officer, the unit price per unit length will be adjusted in accordance with provisions of FAR 52.236-2 Differing Site Conditions.[Payments will be made per each at the respective bid unit price for pile cut-offs, pile build-ups, pile load tests and pile splices.][Include payments for vibration monitoring, sound monitoring, construction instrumentation and monitoring, and precondition construction surveys].

][1.5 PAYMENT

****

NOTE: Delete this paragraph for lump-sum contracts.

If Section 01 20 00 PRICE AND PAYMENT PROCEDURES is included in the project specifications, this paragraph title (UNIT PRICES) should be deleted from this section and the remaining appropriately edited subparagraphs below should be inserted into Section 01 20 00 PRICE AND PAYMENT PROCEDURES.

****

1.5.1 Furnishing and Delivering [Grouted] Helical Piles

1.5.1.1 Payment

Payment will be made for costs associated with furnishing and delivering the required lengths of permanent [grouted] helical piles, [including H-pile extensions,]which includes costs of furnishing and delivering piles to the work site. No payment will be made for the installation head or lengths of piles exceeding required lengths. No payment will be made for piles damaged during delivery, storage, or handling to the extent that they are rendered unsuitable for the work, in the opinion of the Contracting Officer.

1.5.1.2 Measurement

Furnishing and delivering permanent [grouted] helical piles will be measured for payment by the linear meter foot of piles required below the cut-off elevation as [determined by the Contracting Officer and furnished to the Contractor][indicated].

1.5.1.3 Unit of Measure

Linear meter foot.

1.5.2 Installation of [Grouted] Helical Piles

1.5.2.1 Payment

Payment will be made for costs associated with installation of permanent [grouted] helical piles, which includes costs of handling, installation, [and splicing of piles,] [performing dynamic testing, interpreting data and submitting reports,] measuring heave, reinstallation of heaved piles, removal of [build-ups] installation of heads or cutting off piles at the cut-off elevation and removing from the work site, compiling and submitting pile installation records, backfilling voids around piles, and any other items incidental to installation of piles to the required elevation.

1.5.2.2 Measurement

Permanent [grouted] helical piles will be measured for payment for installation on the basis of lengths, to the nearest hundredth tenth of a linear meter foot, along the axis of each pile acceptably in place below the cut-off elevation shown.

1.5.2.3 Unit of Measure

Linear meter foot.

1.5.3 Pulled [Grouted] Helical Piles

1.5.3.1 Payment

Payment will be made for costs associated with piles pulled at the direction of the Contracting Officer and found to be undamaged. The cost of furnishing and delivering pulled and undamaged piles will be paid for at the applicable contract unit price for payment item "Furnishing and Delivering [Grouted] helical Piles". The cost of installation pulled and undamaged piles will be paid for at the applicable contract unit price for payment item "Installation of [Grouted] Helical Piles". The cost of pulling undamaged piles will be paid for at twice the applicable contract unit price for payment item "Installation of [Grouted] Helical Piles", which includes backfilling any remaining void. The cost of reinstallation of pulled and undamaged piles will be paid for at the applicable contract unit price for payment item "Installation of [Grouted] Helical Piles". No payment will be made for furnishing, delivering, installation, pulling, and disposing of piles, including piles pulled and found to be damaged and backfilling voids. New piles replacing damaged piles will be paid for at the applicable contract unit price for payment items "Furnishing and Delivering [Grouted] Helical Piles" and "Installation of [Grouted] Helical Piles".

1.5.3.2 Measurement

Furnishing and delivering pulled and undamaged permanent [grouted] helical piles will be measured for payment as specified in paragraph UNIT PRICES, subparagraph FURNISH AND DELIVER [GROUTED] HELICAL PILES. Pulling undamaged [grouted] helical piles will be measured for payment as specified in paragraph UNIT PRICES, subparagraph INSTALLATION OF [GROUTED]

HELICAL PILES. Reinstallation pulled undamaged [grouted] helical piles will be measured for payment as specified in paragraph UNIT PRICES, subparagraph INSTALLATION OF [GROUTED] HELICAL PILES. New piles replacing damaged piles will be measured for payment as specified in paragraph UNIT PRICES, subparagraphs FURNISH AND DELIVER [GROUTED] HELICAL PILES and INSTALLATION OF [GROUTED] HELICAL PILES.

1.5.3.3 Unit of Measure

Linear meter foot.

[1.5.4 [Grouted] Helical Pile Installation Tests

1.5.4.1 Payment

Payment will be made for costs associated with furnishing, delivering, installation, pulling, and disposing of installed test piles, [including [pile installation points][and][splices];] conducting pile installation tests; backfilling voids around piles; compiling pile installation test records[; performing dynamic testing; interpreting data; and submitting reports].

1.5.4.2 Measurement

[Grouted] helical pile installation tests will be measured for payment on the basis of the applicable contract unit price per pile installation test.

1.5.4.3 Unit of Measure

Each.

][1.5.5 [Grouted] Helical Piles for Load Tests

1.5.5.1 Payment

Payment will be made for costs associated with furnishing, delivering, installation, pulling, and disposing of load test piles [and] [splices]; backfilling voids around piles; compiling pile installation records[; furnishing, fabricating, and mounting of strain rods and protective assembly][; furnishing, fabricating, and mounting of inclinometer and inclinometer protective assembly][; performing dynamic testing; interpreting data; and submitting reports]. No additional payment will be made for load test piles incorporated in the permanent work other than as provided.

1.5.5.2 Measurement

[Grouted] helical piles for load tests will be measured for payment on the basis of the applicable contract unit price per load test pile.

1.5.5.3 Unit of Measure

Each.

][1.5.6 [Grouted] Helical Pile Static Axial Compressive Load Tests

1.5.6.1 Payment

Payment will be made for costs associated with [grouted] helical pile

static axial compressive load tests in accordance with ASTM D1143/D1143M, including material and labor for fabricating and furnishing load frames; calibrating load cells and hydraulic jacks; furnishing specified test equipment; installing strain rods; placing and removing test loads and test equipment; recording, reducing, and submitting test data; and compiling and submitting pile load test reports. No payment will be made for rejected pile static axial compressive load tests.

1.5.6.2 Measurement

[Grouted] helical pile static axial compressive load tests will be measured for payment on the basis of the applicable contract unit price per load test.

1.5.6.3 Unit of Measure

Each.

][1.5.7 [Grouted] Helical Pile Static Tensile Load Tests

1.5.7.1 Payment

Payment will be made for costs associated with [grouted] helical pile static tensile load tests in accordance with ASTM D3689, including material and labor for fabricating and furnishing load frames; calibrating load cells and hydraulic jacks; furnishing specified test equipment; installing strain rods; placing and removing test loads and test equipment; recording, reducing, and submitting test data; and compiling and submitting pile load test reports. No payment will be made for rejected pile static tensile load tests.

1.5.7.2 Measurement

[Grouted] helical pile tensile load tests will be measured for payment on the basis of the applicable contract unit price per number of tensile load test.

1.5.7.3 Unit of Measure

Each.

][1.5.8 [Grouted] Helical Pile Lateral Load Tests

1.5.8.1 Payment

Payment will be made for costs associated with [grouted] helical pile lateral load tests in accordance with ASTM D3966/D3966M, including material and labor for fabricating and furnishing load frames; calibrating load cells and hydraulic jacks; furnishing specified test equipment; installing inclinometers; placing and removing test loads and test equipment; recording, reducing, and submitting test data; and compiling and submitting pile load test reports. No payment will be made for rejected pile lateral load tests.

1.5.8.2 Measurement

[Grouted] helical pile lateral load tests will be measured for payment on the basis of the applicable contract unit price per lateral load test.

1.5.8.3 Unit of Measure

Each.

][1.5.9 Pulled Load Test [Grouted] Helical Piles

1.5.9.1 Payment

Payment will be made for costs associated with load test [grouted] helical piles pulled prior to load testing at the direction of the Contracting Officer and found to be undamaged. The cost of furnishing, delivering, installation, and pulling undamaged load test piles will be paid for at the applicable contract unit price for payment item "[Grouted] Helical Piles for Load Tests". The cost of pulling undamaged load test piles the second time after reinstallation and testing will be paid for at twice the applicable contract unit price for payment item "Installation of [Grouted] Helical Piles". The cost of reinstallation pulled undamaged load test piles will be paid for at the applicable contract unit price for payment item "Installation of [Grouted] Helical Piles". No payment will be made for furnishing, delivering, installation, pulling, and disposing of load test piles pulled at the direction of the Contracting Officer and found to be damaged. New load test piles replacing damaged piles will be paid for at the applicable contract unit price for payment item "[Grouted] Helical Piles for Load Tests".

1.5.9.2 Measurement

Pulled undamaged load test [grouted] helical piles will be measured for payment as specified in paragraph UNIT PRICES, subparagraph [GROUTED] HELICAL PILES FOR LOAD TESTS. Pulling undamaged load test [grouted] helical piles the second time after reinstallation and testing will be measured for payment as specified in paragraph UNIT PRICES, subparagraph INSTALLATION OF [GROUTED] HELICAL PILES. Reinstallation of pulled undamaged [grouted] helical piles will be measured for payment as specified in paragraph UNIT PRICES, subparagraph INSTALLATION OF [GROUTED] HELICAL PILES. New load test [grouted] helical piles replacing damaged piles will be measured for payment as specified in paragraph UNIT PRICES, subparagraph [GROUTED] HELICAL PILES FOR LOAD TESTS.

1.5.9.3 Unit of Measure

as specified in paragraph UNIT PRICES, subparagraphs INSTALLATION OF [GROUTED] HELICAL PILES and [GROUTED] HELICAL PILES FOR LOAD TESTS, respectfully.

][1.5.10 [Grouted] Helical Pile Splices

1.5.10.1 Payment

Payment will be made for costs associated with [grouted] helical pile splices, including all plant, labor, and material required to make the splice.

1.5.10.2 Measurement

[Grouted] helical pile splices will be measured for payment on the basis of the applicable contract unit price per pile splice.

1.5.10.3 Unit of Measure

Each.

][1.5.11 Vibration Monitoring

1.5.11.1 Payment

Payment will be made for costs associated with vibration monitoring.

1.5.11.2 Measurement

Vibration monitoring will be measured for payment on the basis of the applicable contract unit price per vibration monitoring point.

1.5.11.3 Unit of Measure

Each.

][1.5.12 Sound Monitoring

1.5.12.1 Payment

Payment will be made for costs associated with sound monitoring.

1.5.12.2 Measurement

Sound monitoring will be measured for payment on the basis of the applicable contract unit price per vibration monitoring point.

1.5.12.3 Unit of Measure

Each.

][1.5.13 Preconstruction Condition Survey

1.5.13.1 Payment

Payment will be made for costs associated with preconstruction condition surveys.

1.5.13.2 Measurement

Preconstruction condition survey will be measured for payment on the basis of the applicable contract unit price per structure to be surveyed.

1.5.13.3 Unit of Measure

Each.

][1.5.14 Construction Instrumentation and Monitoring

1.5.14.1 Payment

Payment will be made for costs associated with construction instrumentation and monitoring.

1.5.14.2 Measurement

Construction instrumentation and monitoring will be measured as a single pay item.

1.5.14.3 Unit of Measure

One.

]]1.6 SUBMITTALS

****
NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

Choose the first bracketed item for Navy, Air Force, and NASA projects, or choose the second bracketed item for Army projects.
****

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification 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

Installation Procedures; G[, [_____]]

[Contractor's Geotechnical Consultant; G[, [_____]]

][Wave Equation Analysis; G[, [_____]]

] Order List; G[, [_____]]

Manufacturer's Quality Control Procedures; G[, [_____]]

Contractor Certification For Helical Pile Installation; G[, [_____]]

Testing Agency Qualifications; G[, [_____]]

SD-02 Shop Drawings

Piles; G[, [_____]]

Pile Connections and Splices; G[, [_____]]

Pile Placement; G[, [_____]]

As-Installed Survey; G[, [_____]]

Pile Load Test; G[, [_____]]

SD-03 Product Data

Piles; G[, [_____]]

[Grouted] Helical Pile; G[, [_____]]

Installation Equipment and Testing Equipment; G[, [_____]]

Torque Monitoring Equipment; G[, [_____]]

SD-05 Design Data

Calibration Report; G[, [_____]]

[Pile Grout Mix Design; G[, [_____]]

] [Grouted] Helical Pile Design; G[, [_____]]

SD-06 Test Reports

Load Test Report; G[, [_____]]

[Grouted] Helical Pile Installation Records; G[, [_____]]

1.7 DELIVERY, STORAGE, AND HANDLING

Use methods for handling, transporting and storage of piles such that the piles are not subjected to excessive bending stress, cracking, spalling, or other damage. Follow the handling instructions of the manufacturer.

1.7.1 Damaged Piles

Inspect each pile for structural damage before transporting them to the project site and immediately prior to installation. Bring any damage to

the attention of the Contracting Officer. Piles which are damaged during delivery, storage, or handling to the extent they are rendered unsuitable for the work, in the opinion of the Contracting Officer, will be rejected and removed from the project site, or may be repaired, if approved, at no cost to the Government.

Any pile damaged by reason of internal defects or by improper installation must be corrected by one of the following methods approved by the Structural Engineer of Record for the pile in question:

a. The pile is withdrawn, if practicable, and replaced by a new and, if necessary, longer pile.

b. One or more replacement piles are installed adjacent to the defective pile.

c. A Pile Dynamic Analysis and low integrity testing must be performed by the Contractor's Geotechnical Consultant to assess the structural integrity of the installed pile(s).

A pile installed below the specified butt elevation must be corrected by one of the following methods approved by the Engineer:

a. The pile is spliced (if approved).

b. A sufficient portion of the footing is extended down to properly embed the pile.

A pile installed out of its proper location or out of plumb as approved by the Engineer, must be corrected by one of the following methods approved by the engineer:

a. One or more replacement piles are installed next to the pile in question.

b. As directed by the structural engineer.

1.8 QUALITY CONTROL

1.8.1 Piles

Prepare and submit shop drawings. Indicate placement of piles. Indicate location of special embedded or attached lifting devices, employment of pick-up points, support points other than pick-up points, and any other methods of pick-up. Submit product designations for pile sections and connections.

1.8.2 [Grouted] Helical Pile Design

Submit data including: type material, and size of grout and helical system; maximum torque rating of system, calculations determining minimum installing torque, minimum and maximum pile depth requirements[, location and inclination tolerance requirements] and pile capacity. Design must be stamped by a Professional Engineer registered in the state of [_____] who is experienced with [grouted] helical pile foundations.

[1.8.3 Pile Grout Mix Design

Submit copies of laboratory test reports showing that the pile grout mix

has been successfully tested to produce grout with the properties specified and that the mix must be suitable for the job conditions. Include mill tests and all other tests for cement, aggregates, and admixtures in the laboratory test reports. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Submit test reports along with the grout mix design. Obtain approval before grout placement.

]1.8.4 Manufacturer's Quality Control Procedures

Submit the pile manufacturer's quality control procedures.

1.8.5 Installation Procedures

a. Submit information on the type of equipment proposed to be used, proposed methods of operation, pile installation plan including proposed sequence of installation, and details of all pile installation equipment and accessories. Submit pile placement plans at least 30 calendar days prior to delivery of piles to the job site.

[b. Provide detailed procedures for conducting the dynamic pile load test and equipment to be used for conducting the load test. The detailed description must explain how specific information of pile performance will be evaluated.

]1.8.6 Contractor Certification for Helical Pile Installation

[Grouted] helical piles must be installed by a contractor with a minimum of 5 years of experience with the installation of [grouted] helical pile foundations in similar soil conditions of the project site. Contractor must submit past project lists indicating their experience with such foundation systems. The Contractor must be trained and certified by a helical pile manufacturer in the proper methods of design and installation of [grouted] helical pile foundations. The Contractor must submit a copy of their current certification for helical pile foundation Installation. Data must include a list and description of equipment to be used, including manufacturer's catalog data and sufficient information to show compliance with the requirements specified.

[1.8.7 Contractor's Geotechnical Consultant

Hire the services of an independent, Registered Professional Geotechnical Engineer, experienced in [grouted] helical pile foundation system, soil mechanics and Pile Dynamic Analysis, to observe test pile installation and production pile installation as specified herein. The Contractor's Geotechnical Consultant must be independent of the Contractor and must have no employee of employer relationship which could constitute a conflict of interest.Submit consultant qualifications and documentation at least 28 calendar days prior to pile installation.

][1.8.8 Load Test Supporting Data

Submit Jack calibration records, a testing arrangement description and diagram, and the proposed loading sequence.

][1.8.9 Silica Fume Manufacturer's Representative

Provide statement that the manufacturer's representative will be present at plant to ensure proper mix, including high range water reducer (HRWR),

and batching methods.

]PART 2 PRODUCTS

2.1 [GROUTED] HELICAL PILE SYSTEM

The shaft of the [grouted] helical pile system must consist of a solid, steel square bar with one to four steel helical plates welded to the shaft, as required. The helical extension shafts, if required, must consist of steel square bar shafts with one or two steel helical formed plates. A coupling method is to be provided for the helical extensions by the contractor. The same square section bar material is to be used for helical pile extensions as is used for the lead extensions. Each extension is to be provided with a means of coupling to a lead section or to another extension. Each coupling may be forged integral to the extension or a separate sleeve type. Each coupling is to be supplied with proper bolts(s) and nut(s) to develop the rated strength. Termination must consist of the bar material being cut off to the proper elevation and a steel termination plate field welded or bolted to the end of the bar material. All steel components of the [grouted] helical pile system must be steel with an ASTM A153/A153M or ASTM A123/A123M hot dipped galvanizing. Displacement plates (lead or extension plates) must be fabricated from steel or other material that will not affect the structural integrity of the central steel shaft[or grout column]. Displacement plates must not be made out of timber.[All grout components of [grouted] helical piles must have a 28 day compressive strength of 28,000 kPa 4,000 psi or greater. For purposes of bidding, pile capacity must be as indicated on the drawings.]

Submit details and material data for pile connections and splices.

[2.2 GROUT

2.2.1 Cement

ASTM C1157/C1157M, [Type G].

2.2.2 Water

Provide fresh, clean, potable water free from injurious amounts of sewage, oil, acid, alkali, salts, or organic matter.

2.2.3 Aggregates

Fine aggregate for sand-cement grout must conform to ACI 301M ACI 301 and [ASTM C33/C33M for grout for backfilling holes] [or ASTM C144 for grout for pregrouting]. Aggregates must not contain substances which may be deleteriously reactive with alkalis in the cement.

[2.2.4 Admixtures

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NOTE: Accelerators are not permitted because of concern that they may cause corrosion of the steel. Only plasticizers or retarders should be permitted when necessary for hot conditions or long pumping distances.

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Admixtures which control bleed, improve flowability, reduce water content and retard set may be used in the grout subject to the approval of the Contracting Officer. Any admixtures used must be compatible with the prestressing steel and must be mixed in accordance with the manufacturer's recommendations.

]]2.3 EQUIPMENT

2.3.1 Installation Equipment

Equipment must be capable of providing continuous measurement of applied torque throughout the installation process. Equipment must be capable of applying sufficient down pressure to install the pile and must include appropriate gauges to indicate the down pressure applied. Equipment must have sufficient capacity to reverse rotation and uplift to withdraw pile. Percussion drilling equipment is not permitted. Install head must be capable of multiple positioning to accommodate adjustments in pile alignment.

2.3.2 Installation Tooling

Sufficient wrench extensions must be provided to advance the lead section a distance not less than 50 percent greater than the pile length indicated on the drawings. All installation tooling must be capable of transmitting the maximum torque of the installation machinery.

2.3.3 Torque Monitoring Equipment

Submit a calibration report (performed by an independent testing agency) for each torque indicator to be used. The report must include: the name, address, and phone number of testing agency; name of the project; name of the contractor; identification of torque indicator; date of calibration; and calibration data. The equipment calibration must be performed within six months from the start of the installation.

Device must be capable of providing continuous measurement of applied torque throughout the installation process in increments of 680 Newton meter 500 foot pounds or less. Torque indicators which are internal with respect to installation equipment must be calibrated on-site. Torque indicators which measure torque as a function of the hydraulic pressure of the installation equipment must be calibrated at normal operation temperatures. Devices must be protected from shock, impact, or other adversities that may affect their operation. A torque indicator must be recalibrated if, in the opinion of the Contracting Officer, it has been exposed to conditions which may adversely influence the accuracy of the torque measurements.

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NOTE: Suggestions for improvement of this specification are welcomed and should be submitted as a Criteria Change Request (CCR). To submit a Criteria Change Request, click on the CCR link next to the specific document located at: https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs

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PART 3 EXECUTION

3.1 PRELIMINARY WORK

3.1.1 Order List

Submit to the Contracting Officer for approval, an itemized list for piles prior to placing the order with the supplier. Indicate the pile lengths required at each location as shown on the plans and the corresponding ordered length of each pile in the list.[Complete load testing and refined wave equation analysis and submit to Government for review and approval prior to submission of an order list.]

3.2 INSTALLATION PROCEDURES

It is the responsibility of the contractor to determine the location of any buried utilities before starting construction. If underground obstructions are encountered during installation, the contractor must stop work immediately and contact the Contracting Officer who will decide whether the obstruction is to be removed or the [grouted] helical pile relocated. The contractor must resume work only upon receipt of the Contracting Officer's decision.

3.2.1 Pre-Drilling

Pre-drilled starter holes will be required for penetrating through hard natural strata or fills. Omitting drilling or augering will be permitted only with the approval of the Contracting Officer. The hole must be no greater than two-thirds of the average helices diameter. The drilling or augering must not be deeper than required to bypass the obstructing layer. Drilling deeper than 3 meters 10 feet above the estimated pile tip elevation is not permitted. Field modification of pre-drilling operations will be permitted based on the recommendations of the Owner's Geotechnical Consultant and with the approval of the Contracting Officer.

3.2.2 Positioning, Alignment, and Advancing the Helical Lead Section

The pile must be positioned at the location indicated. Advance the helical lead section in a smooth and continuous manner. Avoid abrupt starts after interruptions. Apply sufficient down pressure to advance the lead section approximately 75 mm 3 inches per revolution. Maintain the penetration rate by adjusting the rate of rotation and magnitude of down pressure for different soil condition and depths.

A lead displacement plate of appropriate diameter must be positioned on the central steel shaft at the location necessary to install the grout column as shown on the drawings. The lead displacement plate must not be located closer than 300 mm 12 inches above the top helical plate. Extension displacement plates must be positioned on the central steel shaft at a minimum of every coupling joint. Displacement plates must not be spaced more than 2 meters 7 feet apart. Displacement plates must permit the free flow of grout without misalignment of the central steel shaft.

[Grout must be mixed with equipment capable of providing a steady supply at the required level of production. The grout must be placed via a gravity fed reservoir located at the surface. The reservoir must consist of a temporary casing or form, which is capable of containing liquid grout. The reservoir must be appropriately sized (diameter and length) to

accommodate the soil conditions and grout column diameter. The grout must be placed in the reservoir immediately prior to the advancement of the first lead displacement plate into the soil. The volume of grout contained in the reservoir must be maintained at a level sufficient to maintain positive hydrostatic pressure on the grout column.

Grout placement must continue until the minimum grout column length has been achieved as shown on the working drawings. Volume measurements must be taken throughout the installation in order to determine the actual grout column diameter. Grout must be allowed to attain the minimum design strength prior to being loaded.

]3.2.3 Rejected Piles

Withdraw piles damaged or impaired for use during handling or installation, mislocated, or installed out of alignment beyond the maximum tolerance. Replace with new piles or cut-off and abandon damaged or impaired piles and install new piles as directed. Remove excess cut-off from piles and unacceptable piles from the work site. Perform all work in connection with withdrawing and removing rejected piles from the site at no additional cost to the Government.

3.2.4 As-Installed Survey

After the installation of each pile group is complete and before concrete is placed, provide the Contracting Officer with an as-installed survey showing actual location and top elevation of each pile. Submit survey within [7] [_____] calendar days of completing the test and production pile installation. Do not proceed with placing concrete until the Contracting Officer has reviewed the survey and verified the safe load for the pile group installed. Present a survey in such form that it gives deviation from plan location in two perpendicular directions and elevations of each pile to nearest 13 mm half inch. Survey must be prepared and certified by a licensed land surveyor.

3.2.5 Termination Criteria

If the required minimum installation torque is reached before the minimum length is achieved, the installation must continue until the minimum length is attained. However, the installation torque must not exceed the maximum torque rating (refer paragraph DEFINITIONS in PART 1) of the pile or equipment. If the maximum torque rating is reached before the minimum length is achieved, the Contractor must stop torquing operations and contact the Contracting Officer. The average torque for the last meter 3 feet of penetration must be used as a basis of comparison with the minimum installation torque.

3.2.6 [Grouted] Helical Pile Installation Records

For each pile installed, provide a formal record including the following:

a. Name of project, contractor and contractors superintendent.

b. Date and time of installation.

c. Name and model of installation equipment and operator name.

d. Type of torque indicator.

e. Location of pile.

f. Time and duration of pile installation.

g. Elevation of lead pile.

h. Total length of installed pile.

i. Identification of lead section (manufacturer's description and catalog number).

j. Identification of extensions (manufacturer, diameter, minimum ultimate strength).

k. Number of displacement plates/centralizers and their location.

l. Down pressure applied.

m. Installation torque [and grout flow] at one-foot intervals.

n. Effective torsional resistance and calculated geotechnical capacity based on the effective torsional resistance and as derived from the pre-production test program.

o. Comments pertaining to interruptions, obstructions or other pertinent information.

3.2.7 Protection of Existing Structures

****

NOTE: Include this paragraph only when protection of existing structures from pile installation activities is required.

The designer must indicate on the drawings all structures and facilities for which protection is required. The designer must also provide a project specific document that details design criteria, requirements for preconstruction condition surveys, post construction condition surveys, geotechnical instrumentation to measure ground movements and any other requirements.

Add any additional requirements as necessary.

****

Mitigate impact on existing facilities due to pile installation activities in accordance with the [project specific document] [_____].

3.2.8 Disposal of Excavated Material

Do not leave any piles partially completed overnight. Completely[grout and] protect piles at the termination of each day's operation. Dispose of excavated material, resulting from augering, [within the area indicated] [off Government property] [_____].

3.3 FIELD TESTS

3.3.1 Test Piles

****

NOTE: Select the second bracketed option when soil conditions dictate the use of a test pile longer than production piles. The ordered pile length for test piles should be 1.5 m 5 feet longer than ordered length for production piles to allow additional penetration if installation conditions dictate. Indicate location and number (if required) of test piles on plans, or list appropriate soil boring test hole numbers.

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[Use test piles of specified type, and install as specified for piling elsewhere in this section.][Order test piles [_____] meters feet longer in length than production piles. Install the additional test pile length only at the direction of the Contracting Officer.] The [Contractor's Geotechnical Consultant] [Contracting Officer] will use test pile data to determine "calculated" pile tip elevation or necessary installation criteria. Install test piles [at the locations indicated] [in vicinity of soil boring test holes Nos. [_____], [_____], and [_____]]. Install test piles to [indicated tip elevation] [indicated bidding lengths] [required installation criteria]. Use test piles, if located properly and offering adequate installation resistance in finished work.[Pre-drilling or jetting is permitted only when test piles clearly establish validity of its use, or as directed by the Contracting Officer.] Provide and operate a pile driving analyzer as specified in paragraph DYNAMIC PILE ANALYSIS during the installation of each test pile. Modify installation as required based upon recommendation of [Contracting Officer] [Contractor's Geotechnical Consultant and approval of the Contracting Officer]. Submit test set-up and procedures.

[3.3.1.1 Dynamic Pile Analysis

Dynamic testing provides supplemental information for evaluating pile integrity, hammer and install system performance, assess pile installation stresses, and pile capacities. Perform dynamic testing on [_____] percent of the [test] piles during the full length of the pile installation and during restrike a minimum of [_____] days after initial installation. Dynamic pile testing must also be performed on [_____] production piles as chosen by the Contracting Officer. Use [test] piles of type as specified elsewhere in this section. Provide equipment to obtain dynamic measurements, record, reduce and display its data that meet the requirements of ASTM D4945. The equipment must have been calibrated within [6] [_____] months prior to the start of the testing operations and thereafter throughout the contract duration. Install [test] piles at the locations indicated or at the locations selected by the Contracting Officer. Employ an independent inspection firm, hereinafter referred to as the "Contractor's Geotechnical Consultant", experienced in the pile installation process[, monitoring of test pile installation,] and in the use of the Pile Driving Analyzer and its related equipment. Perform dynamic pile analysis as follows:

][3.3.1.2 Pile Analyzing

[_____] working days prior to installation the [test] piles, submit the

pile and complete installation equipment data to the Contracting Officer. The Contractor's Geotechnical Consultant must use the submitted information to perform wave equation analyses and must prepare a summary report of the wave equation results. The wave equation analysis using GRLWEAP software by Pile Dynamics, Inc. or equivalent must be used to assess the ability of the proposed installation system to install the pile to the required capacity and desired penetration depth within the allowable installation stresses. Approval of the proposed installation system by the Contracting Officer must be based upon the wave equation analyses indicating that the proposed installation system can develop a pile capacity of [_____] kN kips.

][3.3.1.3 CAPWAP

Signal matching analysis by CAPWAP software of the dynamic pile testing data must be performed on data obtained from the end of initial installation and the beginning of restrike of all control piles. CAPWAP analyses must be performed by an engineer who has achieved Advanced Level or better on the PDI / PDCA Dynamic Measurement and Analysis Proficiency Test for Providers of PDA Testing Services.

Upon completion of [test] pile installation, allow the piles to set-up for at least [72 hours] [_____ days]. After evaluation of pile, hammer and soil performance by the Contractor's Geotechnical Consultant, the second step of the dynamic pile analysis may proceed. This portion of the evaluation requires striking the set-up piles a minimum of 20-50 times, or as directed by the Contractor's Geotechnical Consultant "Warm up" the hammer and make it optimally ready prior to restriking, in order to avoid capacity losses during evaluation of restrike data. Apply maximum hammer energy during restrike in order to fully mobilize the soil resistance. However, exercise care so as to not overstress the pile. In addition to those items listed above, selected restrike installation records (as directed by the Contractor's Geotechnical Consultant are to be subjected to rigorous computer analysis by the Case Pile Wave Analysis Program (CAPWAP) for determination of resistance distribution, soil resistance and properties, and plot of applied load vs. average pile displacement based on the calculated soil properties.

][3.3.1.4 Dynamic Load Test Reporting

a. Upon satisfactory completion of each dynamic load test, submit[a minimum of three copies of] a Pile Performance Report for the Contractor by the Contractor's Geotechnical Consultant. The submittal must be prepared and sealed by a Professional Engineer registered in [_____].

b. The report for the Dynamic Pile Analysis must contain the following information:

   (1) Capacity of pile from Case Pile Wave Analysis Program (CAPWAP). Information resulting from analysis of a selected restrike blow.

   (2) Maximum and final transferred energy, hammer system efficiency during pile installation.

   (3) Maximum compressive stress, velocity, acceleration and displacement.

   (4) Maximum tensile stress in pile.

(5) Pile structural integrity, damage detection, extent and location.

(6) Blows per minute and blow number.

(7) Input and reflection values of force and velocity, upward and downward traveling force wave with time.

(8) Pile skin friction and toe resistance distribution.

(9) Maximum energy transferred to pile.

c. The maximum allowable pile design load must be proposed by the Contractor's Geotechnical Consultant based upon the results of a satisfactory pile load test conducted on a pile installed as specified herein and must include the effects of load transfer to the soil above the foundation stratum.

Use either a model Model 8G as manufactured by Pile Dynamics, Inc., of Cleveland Ohio or approved equivalent, for dynamic load testing of the test pile. All equipment necessary for the dynamic monitoring such as sensors, cables or wireless transmitters, etc., must be furnished by the Contractor's Geotechnical Consultant. The equipment must conform to the requirements of ASTM D4945.

Pay for all services of the Contractor's Geotechnical Consultant. The Contractor's Geotechnical Consultant must be available throughout the pile installation operation to consult with the Contracting Officer when required by the Contracting Officer. The cost of changes in the Contractor's procedure, as required by evaluation of the results of the Pile Installation Analysis, will be at the Contractor's expense.

]3.3.2 Compression Tests

Perform load tests at the test pile locations indicated on the drawings. Perform "quick test" in accordance with ASTM D1143/D1143M. Provide apparatus for applying vertical loads as required by method, using load from weighted box or platform or reaction frame attached to sufficient uplift piles to safely take the required load applied to pile hydraulic jack. Increase load in increments until rapid progressive settlement takes place or until application of total load equals 200 percent of the design load, whichever occurs first. Equipment utilized to measure pile movements must be as outlined in ASTM D1143/D1143M Section 7. Maintain a data plot of load versus movement during the test procedures.[Determine the safe design capacity of a test pile as determined from the results of load tests according to UFC 3-220-01.][Safe design capacity will be based on the maximum axial deflection of [25 mm one inch] [5 percent of helix diameter] [the deflection criteria as stated on the plans or drawings].]

[3.3.3 Tensile Load Test

Perform tensile load tests on [_____] test piles in accordance with ASTM D3689, as modified [and] in paragraph LOAD TESTS. Apply a tensile load of [_____] kN kips to each tensile load test pile. In performing the tension load test, apply the ultimate load equal to one and one-half times the safe tension capacity, and employ the Standard Loading Procedure.

Perform dynamic measurements on [_____] piles designated as dynamic test

piles in accordance with ASTM D4945 during installation. During easy installation, ensure that damaging tension stresses do not develop in the pile. Signal matching must be performed by the Contractor's Geotechnical Consultant on representative data collected at the end of the initial installation and at the beginning of all restrike events. Additional signal matching analysis must be performed as determined by the Engineer.

][3.3.4 Lateral Load Test

Perform lateral load tests on [_____] piles in accordance with ASTM D3966/D3966M, as modified [and] in paragraph LOAD TESTS. Lateral load tests must consist of jacking two piles apart with a hydraulic jack, with one pile serving as the reaction pile for the other. Apply a lateral load of [_____] kN kips to each pair of lateral load test piles. Record required movement readings for each pile.

]3.3.5 Field Test Report

A Load Test Report must be submitted by the Contractor's Geotechnical Consultant upon satisfactory completion of each load test. The submittal must be prepared and stamped by a Professional Engineer registered in the State of [_____] and must be made within three working days of the completion of the load test. The Load Test Report must contain the following information at a minimum:

a. Name or project, contractor and contractor's superintendent.

b. Name of the third party testing agency.

c. Date, time, and duration of test.

d. Type of test.

e. Name of test equipment and description of test set-up.

f. Equipment calibration data.

g. Location of pile and identification number.

h. Pile installation record, reaction piles and test pile.

i. Load increments and duration of each increment.

j. Time and amount of each interval reading.

k. Cumulative pile movement after each increment.

l. Maximum applied load.

m. Data plot of load versus movement.

n. Comments pertaining to interruptions, equipment adjustments or other pertinent information.

3.3.6 Pile Records

****

NOTE: Omit reference to load test when not required in project. Omit reference to test piles and

"calculated tip elevation" when test piles are not installed. Where special or unusual soil conditions are expected, consultation with the Contracting Officer's Technical Representative (Geotechnical Branch) regarding special engineering supervision of installation, testing, recording and analysis of data for project may be useful.
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NOTE: The Specifier must attach the specifications pile installation log graphic (for all pile installation projects) and the pile installation equipment data form (for projects using PDA) to the end of this specification section.
****

Keep a complete and accurate record of each pile installed. Indicate the pile location, deviations from pile location, cross section shape and dimensions, original length, ground elevation, tip elevation, cut-off elevations[, batter alignment]. Include in the record the beginning and ending times of each operation during installation of pile. Record retap data and unusual occurrences during pile installation such as reinstallation, heaving, weaving, splicing, obstructions, [jetting,] and any installation interruptions.[Install an energy monitor on the hammers and record readings every 300 mm 12 inches of pile installation.] A preprinted pile installation log for recording pile installation data[and pile installation equipment data form], which can be downloaded at: http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables.

3.3.7 Testing Agency Qualifications

Engage an independent testing agency qualified according to ASTM C1077 and ASTM E329 for testing indicated. Submit testing agency qualifications to the Contracting Officer for approval.

3.3.8 Flow Cone Test

The quantity of water used shall produce a grout having a consistency of not less than 21 seconds when tested with a flow cone in accordance with ASTM C939/C939M.[For specified flow cone rates in the range of 10 to 25 seconds, the flow cone shall be modified by removal of the 13 mm 1/2 inch orifice allowing grout to pass through the 19 mm 3/4 inch hole in bottom of cone.][Water retentive grouts that demonstrate cohesive or thixotropic properties may be more accurately tested for workability with a standard slump cone using Slump Flow (commonly referred to as a "spread" test) as described in ASTM C1611/C1611M. The Slump Flow or "Spread" test employs the use of the standard concrete slump cone.]

Conduct tests at the beginning of grout injection and at subsequent intervals to ensure specification requirements are met.

3.3.9 Grout Specimens

Conduct grout tests in accordance with ASTM C31/C31M, ASTM C39/C39M and ASTM D942. Prepare test specimens of grout by pouring grout into 50 mm 2 inch cubes. Cure and test in accordance with ASTM C109/C109M. Cube specimens must be restrained from expansion as described in ASTM C942/C942M.[

Prepare test specimens of grout by pouring grout [150 mm by 300 mm 6 inch by 12 inch cylinders], [76 mm x 150 mm 3 inch by 6 inch], [50 mm by 100 mm 2 inch by 4 inch] cylinders. Provide molds with a top cover plate so designed as to restrain grout expansion and to permit escape of air and water.]

Not less than one set of cylinders shall be collected for each 38 m^3 50 cy of grout placed, or at least one set for each day during which piles are placed. Test 2 [_____] cubes at 7 [_____] days, 2 [_____] cubes tested at 28 [_____] days, and 2 [_____] cubes held in reserve. One set shall consist of six [_____] cubes [cylinders]. Any set of cubes [cylinders] of which one or more cylinders test at 10 percent or more below the required strength shall be cause for rejection of the pile group.

[3.4 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

****

NOTE: Include this paragraph only when special inspection and testing for seismic-resisting systems is required by the International Building Code (IBC).

This paragraph will be applicable to both new buildings designed and to existing building seismic rehabilitation designs done according to UFC 1-200-01, "General Building Requirements" and UFC 3-301-01 "Structural Engineering" and UFC 3-301-02, "Design of Risk Category V Structures, National Strategic Military Assets".

The designer must indicate on the drawings all locations and all features for which special inspection and testing is required in accordance with Chapter 17 of the IBC. This includes indicating the locations of all structural components and connections requiring inspection.

Add any additional requirements as necessary.

****

Perform special inspections and testing for seismic-resisting systems and components in accordance with Section 01 45 35 SPECIAL INSPECTIONS.

][3.5 VIBRATION CONTROL

****

NOTE: Include this paragraph when vibration monitoring is required. Add any additional criteria or requirements as necessary to the particular project. This section can normally be deleted for most [grouted] helical pile projects.

****

Perform vibration monitoring at the locations [shown in the plan] [decided by the Contracting Officer] during the pile installation operations. Perform vibration monitoring [using] [seismographs] [and geophones] within a distance of 61 meters 200 feet from the pile installation activity.[Engage the services of a qualified, independent vibration consultant, acceptable to the Government, to conduct the vibration monitoring. The vibration consultant must have minimum of [five] [_____] years of

experience in vibration monitoring. A minimum of [28] [_____] days before the installation of vibration monitors, submit to the Government the name of the vibration consultant and a list of at least [three] [_____] previously completed projects of similar scope and purpose.]

Prior to the pile installation activities, obtain baseline readings of ambient vibrations. The vibration during the pile installation activities must be limited to [a peak particle velocity of not more than 5 cm 2 inches per second] [the limits mentioned in the [contract documents]]. [Determine appropriate vibration limits as per [US Bureau of Mines] [American Association of State Highway and Transportation Officials (AASHTO)] guidelines.] During pile installation activities, monitor the vibrations to ensure the limits are not exceeded. If the limits are exceeded, cease the pile installation activity causing the vibration until [the Vibration consultant and the Contracting Officer] [_____] are on site to observe the structures nearest to the vibration monitor which has exceeded the limits.

The Contractor must be responsible for all damages resulting from the pile installation operations and must take whatever measures necessary to maintain peak particle velocity within the specified limit. After completion of the project, remove the vibration monitors off the site and off Government property and restore the monitoring locations back to their original condition.

][3.6 NOISE CONTROL

****

NOTE: Include this paragraph when noise monitoring is required. Add any additional criteria, references or requirements as necessary to the particular project. This section can normally be deleted for most [grouted] helical pile projects.

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Perform noise monitoring at the locations [shown in the plan] [decided by the Contracting Officer] [at noise sensitive public areas] during the pile installation operations.[Perform noise monitoring using [noise meters][, and] [_____].][Engage the services of a qualified, independent noise consultant, acceptable to the Government, to conduct the noise monitoring. The noise consultant must have minimum of [five] [_____] years of experience in noise monitoring. A minimum of [28] [_____] days before the installation of noise monitors, submit to the Government the name of the noise consultant and a list of at least [three] [_____] previously completed projects of similar scope and purpose.]

Prior to the pile installation activities, obtain baseline readings of ambient noise levels.[The noise limits are mentioned in the [plan] [contract documents].][Determine appropriate noise limits as per [local agency] [Occupation Safety and Health Administration] guidelines.] During pile installation activities, monitor the noise to ensure the limits are not exceeded. If the limits are exceeded, cease the pile installation activity and install noise mitigation measures.

The Contractor must be responsible for all damages resulting from the pile installation operations and must take whatever measures necessary to maintain noise within the specified limit. After completion of the project, remove the noise monitors off the site and off Government property and restore the monitoring locations back to their original

condition.

][3.7 PRECONSTRUCTION CONDITION SURVEY

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NOTE: Add any additional criteria, references or requirements as necessary to the particular project.
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Perform preconstruction condition survey of structures[and utilities] [within 61 meters 200 feet of the pile installation activity] [specified in the plans] [decided by the Contracting Officer]. Perform outreach to the owner of the structures [28] [_____] days before performing the preconstruction condition survey. The Contractor must obtain written permission from the owner of the structure prior to accessing the structure. The preconstruction condition survey must include video and photographic documentation of the exterior and interior of above ground structures and of the interior of underground structures. Video documentation must be in high definition, and show existing conditions and highlight, where possible, existing cracks, deteriorated concrete, exposed and corroded reinforcement, cracked or broken brick or mortar, and other signs of distress. For utilities, perform the survey when the greatest extent of the interior is exposed. Provide supplementary artificial lighting as needed. The video must include annotation with location and structure nomenclature which describes any areas of distress over the video and time code superimposed on the video. Photographs must be accompanied by sketches or descriptions that indicate the location and direction of each photograph. For each structure surveyed, provide a Pre-Construction Condition Survey Report following completion of the survey. The report must contain all documentation associated with the survey including DVD copies. In the report, include notes, sketches, photographs, and videos. Provide general information, such as location details and structure type, as well as particular information on materials, condition, existing damage, aperture and persistence of cracks, and disrepair observed during visual survey. Provide a graphical depiction of locations of damage or other features of concern. Submit the Preconstruction Condition Survey Reports no later than [28] [_____] days before the commencement of pile installation activity. Accept responsibility for damages to existing adjacent or adjoining structures created by pile installation work, and repair any damages to these structures without cost to the Government.

][3.8 CONSTRUCTION INSTRUMENTATION AND MONITORING PROGRAM

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NOTE: Include this section if instrumentation is to be installed due to concerns about vibration, settlement, lateral movement, etc. during pile installation activities. Instrumentation should be specified and included in the specification. This section can be deleted if there are no instrumentation requirements.

Add any additional criteria or requirements as necessary for the particular project.
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Prepare a geotechnical instrumentation program to monitor settlement[and lateral movement] of temporary and permanent structures, utilities,

[embankments][and excavations] during pile installation. The design and distribution of instrumentation must demonstrate an understanding of the need, purpose and application of each proposed type.[Perform noise and vibration monitoring in accordance with NOISE CONTROL and VIBRATION CONTROL sections.]

Monitoring must extend before, during and for a period after completion of construction activities related to pile installation when long-term performance issues are a concern. The monitoring plan must be designed to protect adjacent structures and utilities against damage due to the pile installation activities. Establish limiting values of vertical[and horizontal] movement [and angular distortion] [and vibration] for each structure and utility within the zone of influence, subject to review by the Government.

Prepare a report detailing the proposed program of instrumentation and monitoring, establishing threshold values of monitored parameters, and describing the response plans that will be implemented when threshold parameters are exceeded. The report must include details about instrumentation consultant's experience, appropriate types, quantities, locations and monitoring frequencies of the instruments.

Upon acceptance of the instrumentation and monitoring program, provide, install and monitor the instrumentation and interpret the data. Submit instrumentation data reports not less than every [_____] days after the monitoring program has begun. Take corrective actions, as necessary, based on the field instrumentation data and as defined in the instrumentation and monitoring program.

] -- End of Section --