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USACE / NAVFAC / AFCESA **UFGS-02456A (August 2004)**

Preparing Activity: USACE **Superseding UFGS-02456A (February 1998)**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 25 June 2004

Latest change indicated by CHG tags
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DIVISION 02 - SITE CONSTRUCTION

SECTION 02456A

STEEL H-PILES

08/04

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SECTION 02456A

STEEL H-PILES
08/04

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NOTE: This guide specification covers the requirements for procurement, installation, and testing of steel H-piles.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.
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PART 1 GENERAL

1.1 REFERENCES

****
NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest guide specification. Use of SpecsIntact automated reference checking is recommended for projects based on older guide specifications.
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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 WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2002) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A 36/A 36M	(2003a) Carbon Structural Steel
ASTM A 572/A 572M	(2003a) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(2003) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 690/A 690M	(2000a) High-Strength Low-Alloy Steel H-Piles and Sheet Piling for Use in Marine Environments
ASTM D 1143	(1981; R 1994e1) Piles Under Static Axial Compressive Load

1.2 BASIS FOR BIDS AND PAYMENT

****

NOTE: The following paragraphs anticipate bids on a lump sum price for piling covered by this section, with directed changes being in accordance with the CONTRACT CLAUSES or in accordance with unit prices. Where the basis for bidding is based on unit price, these paragraphs should be deleted and paragraph BASIS OF PAYMENT used.

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1.2.1 Principal Sum

The bid price for piling shall be a principal sum based on TABLE 1 (including [_____] test piles) having a total aggregate length of [_____] meters feet and shall include [_____] [_____]-kN [_____]-ton load tests and [_____] test pile withdrawals, as specified.

TABLE 1. PILE SCHEDULE FOR BIDDING

Location	Number	Size	Capacity	Length
[_____]	[_____]	[_____]	[_____]	[_____]

1.2.2 Variations in Pile Quantities

From the results of laboratory tests on soil samples and data obtained as a result of driving and loading the test piles specified herein, the Contracting Officer will determine and will list for the Contractor "calculated" pile tip elevations and the minimum driving resistances for all piles. The Contracting Officer reserves the right to increase or decrease the aggregate length of piles to be furnished 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. Should the total pile length installed vary from that

specified as the basis for bidding because of added or omitted piles or variations in the pile lengths, the principal sum shall be adjusted [in accordance with the CONTRACT CLAUSES] [by the amount bid per meter foot for "Additional Pile Length" or "Omitted Pile Length" multiplied by the actual length added or omitted].

1.2.3 Variations in the Number of Pile Load Tests

The Contracting Officer reserves the right to increase or decrease the number of pile load tests from that specified. For changes in the number of load tests required, the principal sum price shall be adjusted [in accordance with the CONTRACT CLAUSES] [by the amount bid for "Each Additional Pile Load Test" or "Each Omitted Pile Load Test" multiplied by the number of pile load tests added or omitted].

1.2.4 Variations in Test Pile Withdrawals

Should the number of test pile withdrawals be increased above the specified number at the direction of the Contracting Officer, the principal sum shall be adjusted [in accordance with the CONTRACT CLAUSES] [by the amount bid for "Each Additional Test Pile Withdrawn" multiplied by the number of additional test pile withdrawals].

1.2.5 Payment

The Contractor shall furnish a price which includes all necessary equipment, tools, material, labor, and supervision required to: deliver, handle, install, and cut off the piles (including test piles); conduct the load tests; and meet the applicable contract requirements. Payment for piles will be on the basis of the lengths of the piles measured from cut off elevations to final tip elevations. No additional payment will be made for: damaged, rejected, or misplaced piles; withdrawn piles other than test piles withdrawn as directed; any portion of a pile remaining above the cut off elevation; backdriving; cutting off piles; splicing; build-ups; or any cut off length of piles. Payment for load tests will be made for each load test satisfactorily performed.

1.3 BASIS OF PAYMENT

****
NOTE: Use the following paragraph when bidding is based on unit price. Where basis for payment is based on lump sum price, use paragraph BASIS FOR BIDS AND PAYMENT.
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1.3.1 Unit Price

The Contracting Officer reserves the right to increase or decrease the aggregate length of piles to be furnished and installed by changing the foundation pile locations or elevations, requiring the installation of additional piles, or requiring omission of piles from the requirements shown and specified. Whether or not such changes are made, the Contractor will be paid at the contract unit price per meter foot (including control test piles), multiplied by the total length in meters feet of acceptable piles actually installed.

1.3.2 Full Compensation

Payment in accordance with the above paragraph, Unit Price, shall constitute full compensation for furnishing, delivering, handling, and installing (as applicable) all material, labor, and equipment necessary to meet contract requirements applicable to the foundation piles. The Contractor will not be allowed payment for withdrawn, broken, or rejected piles or (except for control test piles) for a portion of any pile remaining above the cut-off point.

1.3.3 Load Test

The Contractor will be paid for [_____] [_____] -kN -ton pile load tests. The Contracting Officer reserves the right to increase or decrease the number of load tests. Adjustments in the contract price shall be made [in accordance with the CONTRACT CLAUSES] [for such increases or decreases by the amounts bid for "Additional Pile Load Tests" or "Omitted Pile Load Test"].

1.3.4 Pile Withdrawals

The Contractor will be paid for [_____] pile withdrawals. The Contracting Officer reserves the right to increase or decrease the number of withdrawals. Adjustments in the contract price shall be made [in accordance with the CONTRACT CLAUSES] [for such increases or decreases by the amounts bid for "Additional Pile Withdrawal" or "Omitted Pile Withdrawal"].

1.3.5 Splices

The Contractor will be paid for work required to make each authorized pile splice at the applicable contract price for "Steel H-Pile Splices."

1.4 SUBMITTALS

****

NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation 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 projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

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Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabricated Additions[; G][; G, [_____]]

Detail drawings of required fabricated additions to plain pile, prior to commencing work or ordering materials.

Pile Driving

A complete and accurate record of each driven pile, within 3 days of completion of driving. The record shall indicate the pile location (as driven), size, driven length, embedded length, final elevations of tip and top, pile weight, number of splices and locations, blows required for each 305 mm foot of penetration throughout the entire length of the pile and for the final 150 mm 6 inches of penetration, and the total driving time. The record shall also include the type and size of the hammer used, the rate of operation, and the type and dimensions of driving helmet and cushion block used. Any unusual conditions encountered during pile installation shall be recorded and immediately reported to the Contracting Officer.

SD-03 Product Data

Equipment

Description of pile driving equipment to be employed in the work, prior to commencement of pile installations; including details of the pile hammer, power plant, leads, cushion material, and helmet.

SD-06 Test Reports

Field Tests and Inspections

A complete report on the load test, including, but not limited to, a description of the pile driving equipment, driving records for both test piles and reaction piles, complete test data, analysis of test data, and recommended allowable design loads based on the load test results, within [7] [_____] days of completion of load test. The report shall be prepared by or under

the direct supervision of a registered professional engineer experienced in pile load testing and load test analysis.

SD-07 Certificates

Materials

Certified copies of mill test reports for structural steel prior to commencement of pile installations.

1.5 EXPERIENCE

The work shall be performed by a general contractor or a specialty subcontractor specializing in the specified foundation system and having experience installing the specified foundation system under similar subsurface conditions.

1.6 SUBSURFACE DATA

Subsurface soil data logs are shown [on the drawings] [in the specifications]. The subsurface [investigation reports] [and] [samples of materials as taken from subsurface investigations] are available for examination at [_____].

PART 2 PRODUCTS

2.1 MATERIALS

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NOTE: Selection of material should be based on a comprehensive study of strength, cost, and corrosion-resistance requirements. ASTM A 36/A 36M and ASTM A 572/A 572M steels have the same corrosion resistance; ASTM A 572/A 572M can be obtained in yield strengths of 290 MPa through 415 MPa (42 ksi through 60 ksi). ASTM A 588/A 588M has twice the atmospheric resistance of ASTM A 36/A 36M steel with 0.20 percent copper added. ASTM A 690/A 690M steel (345 MPa (50 ksi) yield strength) has twice to three times greater resistance to seawater "splash zone" corrosion than ordinary ASTM A 36/A 36M steel. Since ASTM A 690/A 690M steel offers little or no advantage from a corrosive standpoint over carbon steel when totally immersed in water or buried in the mud, the designer may want to think in terms of composite H-pile with the section exposed to salt spray made of ASTM A 690/A 690M steel.

****

Piles shall be of sections, sizes, materials, and weights indicated. Pile tips as driven shall be square and blunt as received from the mill. Pile tip reinforcements or cast steel points occasionally may be required to obtain the required penetration. Steel shall conform to [ASTM A 36/A 36M] [ASTM A 572/A 572M, Grade [_____]] [ASTM A 588/A 588M] [ASTM A 690/A 690M]. The Contractor shall submit for approval details of fabricated additions required for the piles. Test piles shall be identical to those used elsewhere in the project.

2.2 EQUIPMENT

2.2.1 Pile Hammers

The hammer used shall have a delivered energy suitable for the total weight of the pile, the character of subsurface material to be encountered, and the pile capacity to be developed. The driving energy of the hammer shall be not less than 20,350 J (15,000 foot-pounds) 15,000 foot-pounds.

2.2.2 Driving Helmets and Pile Cushions

A driving helmet or cap, including a pile cushion, shall be used between the top of the pile and the ram to prevent impact damage to the pile. The driving helmet, or cap and pile cushion combination, shall be capable of protecting the head of the pile, minimizing energy absorption and dissipation, and transmitting hammer energy uniformly over the top of the pile. The driving helmet or cap shall fit loosely around the top of the pile so that the pile is not restrained by the driving cap if the pile tends to rotate during driving. The pile cushion may be made of solid wood or of laminated construction using plywood, softwood, or hardwood boards or other cushion material as approved by the Contracting Officer. The pile cushion shall completely cover the top surface of the pile and shall be retained by the driving helmet. The minimum thickness of the pile cushion shall be 75 mm 3 inches and the thickness shall be increased so as to be suitable for the size and length of pile, character of subsurface material encountered, hammer characteristics, and required driving resistance.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Pile Driving

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NOTE: The last sentence, concerning tip elevation and driving resistance, should be edited to conform to subsurface conditions and type of pile (friction or end bearing).

****

Excavation shall be stopped at 305 mm 1 foot above foundation grade before piles are driven. When pile driving is completed, excavation shall be completed to lines and grades shown. Piles shall be driven to or below the "calculated" tip elevation to reach a driving resistance in accordance with the schedule which the Contracting Officer will prepare from the load test results. The pile hammer used for driving shall be the same type, operated at the same rate and in the same manner, as that used for driving the test piles. Diesel-powered hammers shall be operated at the rate recommended by the manufacturer throughout the entire driving period. Sufficient pressure shall be maintained at the steam hammer so that: for a [double-acting hammer, the number of blows per minute during and at the completion of driving of a pile is equal approximately to that at which the hammer is rated;] [single-acting hammer, there is full upward stroke of the ram;] [differential type hammer, there is a slight rise of the hammer base during each upward stroke.] A new pile cushion shall be used at the start of driving for each pile and the cushion shall be replaced whenever it has become highly compressed, charred, burned, or deteriorated in any manner during driving. Each pile shall be driven continuously and without interruption until the required depth of penetration and penetration rate

per blow have been attained. If a pile fails to reach the "calculated" tip elevation or if a pile reaches the "calculated" tip elevation without reaching the required driving resistance, the Contractor shall notify the Contracting Officer and perform directed corrective measures.

3.1.2 Pre-Drilling

[Pre-drilling of piles will not be permitted] [Pre-drilled starter holes may be required for penetrating through extra hard natural strata or rolled fills. Drilling or augering will be permitted only with the approval of the Contracting Officer. The hole shall be [_____] mm inches less in diameter than the diagonal dimension of the pile and shall be backfilled with granular material after installation of the pile. The drilling or augering shall not be deeper than required to bypass the obstructing layer].

3.1.3 Jetting of Piles

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NOTE: Jetting generally will not be permitted for piles dependent on side friction in fine-grained low-permeability soils (high clay or silt content), where considerable time is required for the soil to reconsolidate around the piles, for piles subject to uplift or lateral forces, for piles adjacent to existing structures, or for piles in closely spaced clusters unless the load capacity is confirmed by test.
****

[Jetting of piles will not be permitted] [When jetting of piles is permitted by the Contracting Officer, jetting shall be discontinued at a depth approximately 1.5 m 5 feet above the "calculated" tip elevation; the remaining penetration shall be achieved by driving. Before starting the driving of the final 1.5 m 5 feet, the pile shall be firmly seated in place by the application of a number of reduced-energy hammer blows].

3.1.4 Long Piles

Pile lengths of [_____] m feet or more shall be handled and driven carefully to prevent overstress or leaning from a true position. The pile-driving rig shall have sufficiently rigid supports so that the leads remain accurately aligned. Templates or guide frames shall be erected at or close to the ground or water surface.

3.1.5 Splices

Field splices shall be avoided for lengths under 18 m 60 feet. When authorized by the Contracting Officer, splices shall be of the full penetration butt-weld type. Unless otherwise authorized by the Contracting Officer, only one splice will be permitted per length of pile. Splices shall be designed and constructed to maintain the true alignment and position of the pile sections. Splices shall develop the full strength of the pile in both bearing and bending. Proprietary prefabricated splicer sleeves may be used upon prior approval by the Contracting Officer.

3.1.6 Welding

Shop and field welding, qualification of welding procedures, welders, and welding operators shall be in accordance with AWS D1.1/D1.1M.

3.1.7 Tolerances in Driving

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NOTE: Foundation piles should not be more than 75 mm to 150 mm (3 to 6 inches) from their intended plan position.
****

Top of pile at elevation of cut off shall be within [_____] mm inches of the location indicated. [Additionally, a variation in batter, as measured on the driven pile, of not more than 6 mm per m 1/4 inch per foot of longitudinal axis will be permitted.] Manipulation of piles to force them into position will not be permitted. Piles will be checked for heave. Piles found to have heaved shall be redriven to the required point elevation. Piles damaged or driven outside the above tolerances shall be replaced or additional piles driven at locations specified by the Contracting Officer at no expense to the Government.

3.1.8 Cutting of Piles

Piles shall be cut off at the elevations indicated by a method approved by the Contracting Officer.

3.1.9 Protection

****
NOTE: Choice of pile protection is ultimately based on economics; more than one type of protection usually will be used on a structure to provide the most economical, adequate protection. The following criteria apply:

a. Paint protection is usually low in initial cost but may require relatively frequent maintenance, and it is extremely difficult to renew in the tidal zone between mean tide and low tide.

b. Cathodic protection is low in initial cost and low in maintenance. It can be of value only where the piles are continually wet as in the submerged zone.

c. Concrete encasement or metal jacketing are relatively expensive in initial cost but require no maintenance if properly constructed. When concrete encasement is to be continuously submerged in water with low resistivity it should extend to the mud line or the steel should be coated to electrically insulate the concrete from the steel.
****

Where indicated, the steel H-piles shall be provided with [coatings] [cathodic protection] [and] [concrete encasement].

3.2 FIELD TESTS AND INSPECTIONS

3.2.1 Test Piles

Test piles shall be driven in the manner specified elsewhere in this section. The Government will use test pile and load test data, as well as test reports on soil samples, to determine "calculated" pile tip elevations and the necessary driving resistance. Test piles that are located within the tolerances indicated and that provide a safe design capacity, as determined by the results of a satisfactory load test, may be used in the finished work. The Contractor shall drive [_____] test piles [at the locations indicated] [in the vicinity of the soil boring test holes Nos. [_____]]. [If jetting is permitted, it will be permitted by the Contracting Officer only when test piles validate its use.] Test piles shall be driven to the tip elevation specified or indicated for bidding lengths. [_____] test piles shall be withdrawn as indicated after reaching the "calculated" tip elevation in order to provide for visual inspection of the pile.

3.2.2 Load Tests

****

NOTE: When it is desirable to show analysis for determination of pile capacities from load tests and for relating load test capacities to job capacities, the following shall be included in this paragraph:

Pile Capacity: The capacity, as driven, of single piles not in clusters in the structure shall be not less than [_____] kN tons. The capacity shall be determined by the following formulas, modified according to the data obtained by the load tests:

For single-acting hammers: R= (166.67WH)/ (S + 2.54P/W) R= (2WH)/ (S + 0.1 P/W).

And double-acting hammers: R= (166.67E)/ (S + 2.54 P/W) R= (2E)/ (S + 0.1 P/W).

Where:

R is the allowable static pile load in kN pounds.

W is the weight of the striking part of the hammer in kN pounds.

H is the effective height of fall in meters feet.

E is the actual energy delivered by the hammer per blow in kN-m foot-pounds.

S is the average net penetration in mm inches per blow for the last five blows after the pile has been driven to a depth where successive blows produce approximately equal net penetration (a minimum distance of 910 mm 3 feet for friction piles).

P is the weight of the pile in kN pounds. (If P is less than W, P/W shall be taken as unity.)

The provisions of ASTM D 1143, such as pile set-up time after driving, test load, method of applying load, loading and unloading procedures, instrumentation, etc., should be carefully examined and modified as necessary to fit the specific load test being conducted.

****

Load tests shall be in accordance with ASTM D 1143, [_____] loading method. The load tests at locations shown or directed shall be made on test piles placed to the tip elevation used for establishing lengths of piles for bidding, except as otherwise directed by the Contracting Officer. Loading, testing, and recording of data shall be under the direct supervision of a registered professional engineer. A report shall be submitted in accordance with paragraph SUBMITTALS. The installation of contract piles shall not proceed in a new area with substantially different subsurface conditions until a satisfactory load test has been performed in that area and the results approved by the Contracting Officer. A minimum of [14] [_____] days from submission of the report shall be allowed for approval.

3.2.3 Safe Design Capacity

Test piles shall be loaded to twice the anticipated working load unless failure occurs first. The safe design capacity of a load test as determined from the results of load tests shall be the lesser of the two values computed according to the following:

a. One-half the load that causes a net settlement after rebound of not more than 0.029 mm per kN 0.0l inch per ton of total test load.

b. One-half the load that causes a gross settlement of not more than 25 mm 1 inch provided the load settlement curve shows no sign of failure.

3.3 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 paragraph 3.2 of FEMA 302, NEHRP RECOMMENDED PROVISIONS FOR SEISMIC REGULATIONS FOR NEW BUILDINGS AND OTHER STRUCTURES.

This paragraph will be applicable to both new buildings designed according to TI 809-04, SEISMIC DESIGN FOR BUILDINGS, and to existing building seismic rehabilitation designs done according to TI 809-05, SEISMIC EVALUATION AND REHABILITATION FOR BUILDINGS.

The designer must indicate on the drawings all locations and all features for which special inspection and testing is required in accordance with Chapter 3 of FEMA 302. This includes indicating the locations of all structural components and connections requiring inspection.

Add any additional requirements as necessary.

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Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01452 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

-- End of Section --