
USACE / NAVFAC / AFCEA UFGS-02457A (February 1998)

Preparing Activity: USACE Replacing without revision
CEGS of same number and date

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 25 June 2004

SECTION TABLE OF CONTENTS

DIVISION 02 - SITE CONSTRUCTION

SECTION 02457A

ROUND TIMBER PILES

02/98

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 BASIS FOR PAYMENT
- 1.4 EXPERIENCE
- 1.5 SUBSURFACE DATA

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Pressure Treated Piles
 - 2.1.1.1 Marine Piling
 - 2.1.1.2 Land or Fresh Water Piling
 - 2.1.2 Untreated Piles
 - 2.1.3 Pile Shoes
- 2.2 INSPECTION FOR PRESERVATIVE TREATMENT

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Handling
 - 3.1.2 Pile Driving
 - 3.1.3 Tolerances in Driving
 - 3.1.4 Jetting
 - 3.1.5 Splices
 - 3.1.6 Surface Treatment
- 3.2 PILE DRIVING EQUIPMENT
 - 3.2.1 Pile Hammers
 - 3.2.2 Driving Helmets and Pile Cushions
 - 3.2.3 Capblocks
- 3.3 FIELD TESTS AND INSPECTIONS
 - 3.3.1 Test Piles
 - 3.3.2 Load Tests
- 3.4 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

-- End of Section Table of Contents --

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SECTION 02457A

ROUND TIMBER PILES 02/98

NOTE: This guide specification covers the requirements for round timber piles for fresh water and for marine use.

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.

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.

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 WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C3	(1999) Piles - Preservative Treatment by Pressure Processes
AWPA M4	(2001) Standard for the Care of Preservative-Treated Wood Products

ASTM INTERNATIONAL (ASTM)

ASTM A 569/A 569M	(1998) Steel, Carbon (0.15 Maximum Percent), Hot-Rolled Sheet and Strip, Commercial
ASTM D 1143	(1981; R 1994e1) Piles Under Static Axial Compressive Load
ASTM D 1760	(2001) Pressure Treatment of Timber Products
ASTM D 25	(1999e1) Round Timber Piles

1.2 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.

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

SD-02 Shop Drawings

Installation

Drawings, including shop and erection details, collars, shoes, and splices as required, prior to commencing the 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), diameter, driven length, embedded length, final elevations of tip and top, collars, shoes, number of splices and locations, blows required for each 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 pile cushion used. Any unusual conditions encountered during pile installation shall be recorded and immediately reported to the Contracting Officer.

SD-03 Product Data

Pile Driving Equipment

Descriptions of all pile driving equipment to be employed in the work, prior to commencement of pile installations. This shall include details of the pile hammer, power plant, leads, cushion material, and helmet.

SD-06 Test Reports

Field Tests and Inspections

A complete report of the load test within [7] [____] days of completion of 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. 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, provided and paid for by the Contractor. A minimum of [14] [____] days from submission of the report shall be allowed.

1.3 BASIS FOR PAYMENT

NOTE: Where the basis for bidding is based on unit price, paragraph BASIS OF PAYMENT should be deleted

and the following paragraphs substituted in lieu thereof.

BASIS OF PAYMENT

Unit Price: The Contracting Officer will reserve the right to increase or decrease the 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 price per linear foot (including test piles), multiplied by the total linear meters feet of acceptable piles actually installed.

Full Compensation: Payment in accordance with the above paragraph, Unit Price, shall constitute full compensation for furnishing, delivering, handling, and/or 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, nor (except for control test piles) for a portion of any pile remaining above the cut-off point.

Load Tests: The contract includes [] pile load tests. The Contracting Officer reserves the right to increase or decrease the number of pile tests. Adjustments in the contract price will be made for each such increase or decrease in the amounts bid for "Additional Pile Load Test" or "Omitted Pile Load Test."

For load-supporting piles, payment will be based on the number and spacing of piles as indicated, and on lengths from tip to cutoff as follows:

Number of Piles	Length, meters
<hr/>	<hr/>
[]	[]
[]	[]
[]	[]
Number of Piles	Length, feet
<hr/>	<hr/>
[]	[]
[]	[]
[]	[]

Fender piles shall be [] meters feet in length from tip to cutoff.
Dolphin piles shall be [] meters feet in length from tip to cutoff.
From the data obtained as a result of driving the test piles and load tests specified, the Government will determine and will list for the Contractor

the "calculated" pile tip elevations and the driving resistances for all piles. This list shall be used as the basis for ordering piles. Payment will be on the basis of length of piling from cutoff elevation to final tip elevation, established by the requirements specified elsewhere in this section. Should the total number of piles or number of each length vary from that specified, an adjustment in the contract price and the time for completion will be made. If excavation is made adjacent to piling and below the grade indicated and if piling is driven before backfilling of over-excavation, no payment will be made for the length of piling equal to the depth of the over-excavation. No additional payment will be made for cutting off piles, for any portion of a pile remaining above the cutoff elevation, or for broken, damaged, or rejected piles. The contract price shall include [_____] pile load tests.

1.4 EXPERIENCE

The work shall be performed by a firm specializing in the specified foundation system and having experience installing the specified foundation system under similar subsurface conditions.

1.5 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

NOTE: Requirements for materials should be edited
or expanded as necessary to include only those
materials to be used for the project.

2.1.1 Pressure Treated Piles

NOTE: This paragraph covers pressure-treated piles
for marine use or for land or fresh water. Insert
class of piles required: friction or end bearing.
Give elevation below which splices are to be
located. Delete portions not applicable to the
project.

Pressure treated piles shall be Douglas fir or Southern pine, clean-peeled, conforming to ASTM D 25. [Piles shall be in one piece] [Splices will be permitted] [Splices will not be permitted] [Splices shall be below elevation [_____]].

2.1.1.1 Marine Piling

NOTE: This paragraph covers preservatives and
preservative treatment for marine piling. Wherever
conditions of high limnoria and pholad hazard exist,

or where oil slicks in harbors may contribute to marine borer attack, the dual treatment (copper-arsenic-creosoted) as covered in ASTM D 1760, Table 4 will be used. Otherwise use ASTM D 1760, Table 3.

Preservative treatment of piles exposed to seawater shall be in accordance with [ASTM D 1760, Table 4] [ASTM D 1760, Table 3, Waterborne Preservatives] [or] [ASTM D 1760, Table 3, Creosote or Creosote-Coal Tar Solution].

2.1.1.2 Land or Fresh Water Piling

NOTE: This paragraph covers preservatives and preservative treatment for land or fresh water piling.

Preservative treatment of piles not exposed to seawater shall be in accordance with the applicable requirements of AWPA C3.

2.1.2 Untreated Piles

NOTE: This paragraph covers piles for use in construction where preservative treatment is not required. Insert class of piles. Give elevation below which splices are to be located. Delete portions not applicable to the project.

Untreated piles shall be Douglas fir or Southern pine, [clean-peeled] [rough-peeled] [unpeeled], conforming to ASTM D 25. [Piles shall be in one piece] [Splices will be permitted] [Splices will not be permitted] [Splices shall be below elevation [____]].

2.1.3 Pile Shoes

Pile shoes, where required as indicated on the drawings, shall be manufactured from steel conforming to ASTM A 569/A 569M. Welding procedures shall be in accordance with a nationally recognized welding code. Shoes shall be cleaned and painted with at least one coat of paint. The color and paint shall be the manufacturer's standard. Point-type shoes shall conform to the requirements of Table I. The length of the joints formed by the intersection of the sides shall not be less than one half of the height of the shoe and shall be fully welded.

TABLE I

POINT-TYPE STEEL SHOE FOR TIMBER PILE

Size	Pile Tip Diameter	Dimensions (mm)			Thickness
		Height	Width	Joint Length	
A	127 to 254	229	241	114	4.8
B	203 to 305	279	279	140	4.8

TABLE I

POINT-TYPE STEEL SHOE FOR TIMBER PILE

Size	Pile Tip Diameter	Dimensions (mm)			Thickness
		Height	Width	Joint Length	
C	279 to 381	330	343	165	4.8

TABLE I

POINT-TYPE STEEL SHOE FOR TIMBER PILE

Size	Pile Tip Diameter	Dimensions (inches)			Thickness
		Height	Width	Joint Length	
A	5 to 10	9.0	9.5	4.5	3/16
B	8 to 12	11.0	11.0	5.5	3/16
C	11 to 15	13.0	13.5	6.5	3/16

1. Dimensions shall be within 5 percent of values shown.
2. Boot-type shoes shall conform to the requirements of Table II.

TABLE II

BOOT-TYPE STEEL SHOE FOR TIMBER PILE

Size	Pile Tip Diameter	Dimensions (mm)		Height	Thickness
		Top Diameter	Bottom Diameter		
D	152	152	143	86	4.8
E	178	178	168	89	4.8
F	203	203	194	92	4.8
G	229	229	219	95	4.8

TABLE II

BOOT-TYPE STEEL SHOE FOR TIMBER PILE

Size	Pile Tip Diameter	Dimensions (inches)		Height	Thickness
		Top Diameter	Bottom Diameter		
D	6	6.0	5.625	3.375	3/16
E	7	7.0	6.625	3.500	3/16
F	8	8.0	7.625	3.625	3/16
G	9	9.0	8.625	3.750	3/16

1. Dimensions shall be within 5 percent of values shown.

2.2 INSPECTION FOR PRESERVATIVE TREATMENT

NOTE: Delete this paragraph where preservative treatment is not required.

The Contractor shall notify the Contracting Officer not less than 2 weeks prior to the start of preservative treatment, stating the place where treatment will be done. Arrangements for access and facilities in this regard shall be made by the Contractor. In lieu of the inspection specified above, the Contracting Officer may elect to accept manufacturer's certificates stating that marine piling conforms to the requirements of AWPAC3.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Handling

Each pile shall be fitted on the tip with a metal shoe, where required as indicated on the drawings. Piles shall be inspected in the leads, and where the protective shell or treated wood is impaired, between cutoff and a point which will be not less than 3 meters 10 feet below the ground; the piles shall be repaired in accordance with AWPAC4, unless the pile is damaged to such extent that it is rejected. Pile shall be laterally supported during driving, but shall not be unduly restrained from rotation in the leads. Where pile orientation is essential, the orientation shall be maintained during driving. Battered piles shall be supported to prevent excess bending stresses in the pile. When necessary, collars shall be placed around the pile head to prevent brooming. Cant hooks shall not be used in handling treated piles. Cutting of piles shall be with pneumatic tools, sawing, or other means approved by the Contracting Officer. Holes for bolts shall be sized to ensure a driving fit. Where indicated, holes shall be counterbored for the bolt heads and washers.

3.1.2 Pile Driving

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. Permanent piles shall be driven without interruption to the "calculated" tip elevation to reach a driving resistance in accordance with the schedule which the Government will prepare from the test-pile driving data. The pile hammer used for driving shall be the same type and 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 hammer so that [for 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] [for single-acting hammer, there is a full upward stroke of the ram] [for differential-type hammer, there is a slight rise of the hammer base during each upward stroke]. The pile cushion or capblock shall be replaced whenever it becomes damaged, split, highly compressed, charred or burned, or has become spongy or deteriorated in any manner. The use of small wood blocks, wood chips, rope, or other material permitting excessive loss of hammer energy will not be permitted. The Contracting Officer shall be notified, and will determine what procedure shall be followed, if a pile reaches the "calculated" pile tip elevation without reaching the required driving resistance; or if the required driving resistance is reached before the "calculated" pile tip elevation.

3.1.3 Tolerances in Driving

Piles shall be driven with a variation of not more than 20 mm per meter 1/4 inch per foot of pile length from the vertical for plumb piles or more than 40 mm per meter 1/2 inch per foot of pile length from the required angle for batter piles. Butts shall be within 100 mm 4 inches of the location indicated. Manipulation of piles to force them into position will not be permitted. All piles shall be checked by the Contractor for heave. Piles found to have heaved shall be redriven to the required tip elevation. Piles damaged, mislocated, or driven out of alignment shall be replaced or additional piles driven as directed.

3.1.4 Jetting

NOTE: Jetting should generally not be permitted for:

- a. 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.
- b. Piles subject to uplift.
- c. Piles adjacent to existing structures.
- d. Piles in closely spaced clusters unless the load capacity is confirmed by test and unless all jetting is done before final driving of any pile in the cluster.

Jetting of piles [may be used when permitted by the Contracting Officer] [will be permitted by the Contracting Officer as indicated] [will not be permitted]. [Jetting shall be discontinued when the pile tip is approximately 1.5 meters 5 feet above the "calculated" pile tip elevation and the final 1.5 meters 5 feet of penetration shall be made by driving. Before commencing with the driving of the final 1.5 meters, 5 feet, the pile shall be firmly seated in place by the application of a number of reduced energy hammer blows.]

3.1.5 Splices

Pile splices shall consist of steel pile having a wall thickness of not less than 6 mm (1/4 inch), 1/4 inch, a diameter approximating that of the pile at the plane of splicing but a minimum of 225 mm, 9 inches, and a

length of not less than 450 mm 1.5 feet above and below the joint. Before the sleeves are driven on them, piles to be spliced shall be trimmed sufficiently to preclude the slivers or shavings cut by the sleeve producing objectionable shakes or splinters. Full bearing of timber on timber shall be provided and air pockets or cushions in the sleeves avoided. Correction of damage or impairment to the protective treated shell, as a result of trimming or driving the sleeve, shall be in accordance with AWPA M4.

3.1.6 Surface Treatment

After piles have been driven and cut off, all cut, bored, and dapped surfaces shall be treated as specified in AWPA M4.

3.2 PILE DRIVING EQUIPMENT

3.2.1 Pile Hammers

The hammer furnished shall have a capacity at least equal to the hammer manufacturer's recommendation for the total weight of pile and character of subsurface material to be encountered. For piles of any length, the maximum driving energy of the hammer shall be 27.1 kilonewton-meters (20,000 foot-pounds). 20,000 foot-pounds.

3.2.2 Driving Helmets and Pile Cushions

A driving helmet or cap, including a pile cushion or cap block, 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 transmitting hammer energy uniformly and consistently during the entire driving period. The driving helmet or cap shall fit snugly on the top of the pile so that the energy transmitted to the pile is uniformly distributed over the entire surface of the pile head. During the test-pile period, the Contractor shall demonstrate to the Contracting Officer that the equipment to be used on the project performs the above functions. The pile cushion may be a solid or laminated softwood block with the grain parallel to the pile axis and enclosed in a close-fitting steel housing. The thickness of block shall be suitable for the length of pile to be driven and the character of subsurface material to be encountered. Generally, thicker blocks are required for longer piles and softer subsurface material.

3.2.3 Capblocks

The capblock used between the driving cap and the hammer ram may be of solid hardwood block with grain parallel to the pile axis and enclosed in a close fitting steel housing or may consist of aluminum and approved industrial type plastic laminate discs stacked alternately in a steel housing. Steel plates shall be used at the top and the bottom of the capblock. Where the block is other than that specified above, the Contractor shall submit to the Contracting Officer, at least 2 weeks before the start of test pile driving operations, detailed drawings of the proposed capblock accompanied by records of its successful use. If a wood capblock is used, it shall not be replaced during the final driving of any pile. The use of small wood blocks, wood chips, rope, or other material permitting excessive loss of hammer energy will not be permitted.

3.3 FIELD TESTS AND INSPECTIONS

3.3.1 Test Piles

Test piles shall be of the class, and shall be driven in the manner specified for all piling elsewhere in this section. A record shall be kept for each test pile, of the number of blows required for each 1/3 m 1 foot of penetration throughout the entire length of the pile, the penetration per blow at such intervals as directed and the number of blows for the final 150 mm 6 inches of penetration. The record shall include the type and size of the hammer used, the rate of operation, and the type and dimensions of driving helmet and pile cushion used. Any unusual occurrence during driving of pile and any increase and decrease of driving resistance shall be recorded by the Contractor and brought to the attention of the Contracting Officer. The Government will use load test and test pile data to determine the "calculated" pile tip elevation and the necessary driving resistance. [] test piles shall be driven in the locations indicated or directed by the Contracting Officer, with surrounding earth at the elevations shown. Test piles properly treated and driven without damage to the protective treated shell, and which are located properly, and have adequate driving resistance may be used in the finished work. Jetting will be permitted by the Contracting Officer only when test pile driving clearly establishes the validity of its use.

3.3.2 Load Tests

NOTE: 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.

Delete this paragraph for projects for which load testing is not specified. Insert the number of piles to be load tested. 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 should be included.

Test Measurements: The ultimate test load shall be maintained for not less than 24 hours and then released. Broomed heads shall be cut to sound wood before making penetration measurements. The safe design capacity of a test pile 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 0.23 mm per metric ton (0.01 inch per ton) 0.01 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 that the load settlement curve shows no sign of failure.

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

For single-acting hammers:

$R = (166.7HW) / (S + 2.54P/W)$; expressed in N

$R = 2HW / (S + 0.1P/W)$; expressed in pounds

For double-acting hammers:

$R = 166.7E / (S + 2.54 P/W)$; expressed in N

$R = 2 E / (S + 0.1 P/W)$; expressed in pounds

Where: R is the allowable static pile load in N pounds.

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

H is the effective height of fall in meters feet.

E is the actual energy delivered by the hammer per blow in N 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 1 meter 3 feet for friction piles).

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

Dynamic pile stresses should not exceed the crushing strength of piles.

Loads tests shall be in accordance with ASTM D 1143, [_____] loading method. The apparatus for applying the vertical loads shall be as given by the method, either for load supported directly by the pile, or load from weighted box or platform or reaction frame attached to sufficient uplift piles to take safely the required load applied to the pile by hydraulic jack. The load tests at locations shown or directed shall be made on test piles driven to the tip elevation used for establishing lengths of piles for bidding, except as otherwise directed. Additional load tests, at the expense of the Government, may be required.

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 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.

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 --