
USACE / NAVFAC / AFCEA / NASA UFGS-31 62 19.00 20 (April 2006)

Preparing Activity: NAVFAC Replacing without change
 UFGS-02458N (September 1999)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 19 March 2007

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TIMBER PILES

04/06

NOTE: This guide specification covers the requirements for procurement, installation, and testing of land and fresh water construction timber piles.

Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.

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

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).

NOTE: Requirements for materials and procedures for special or unusual design should be added as necessary to fit specific projects. Marine piling for waterfront and other marine type structures should be specified in another section of the project specification.

NOTE: The following information shall be shown on the project drawings:

Subsurface data: Subsurface-soil-data logs should be shown on the drawings. The subsoil investigation report and samples of material taken from subsurface investigations may be examined in the office where

bids are received, the office of the Resident
Officer in Charge of Construction, and the
Architect/Engineer's office.

PART 1 GENERAL

1.1 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 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 WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C1	(2003) All Timber Products - Preservative Treatment by Pressure Processes
AWPA C3	(2003) Piles - Preservative Treatment by Pressure Processes
AWPA M4	(2002) Standard for the Care of Preservative-Treated Wood Products
AWPA M6	(1996) Brands Used on Forest Products

ASTM INTERNATIONAL (ASTM)

ASTM D 1143	(1981; R 1994e1) Piles Under Static Axial Compressive Load
ASTM D 25	(1999; R 2005) Round Timber Piles

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-S-331	(Rev D) Shoes: For Wood Piles
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1.2 SUBMITTALS

NOTE: Review submittal description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

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, Air Force, and NASA projects.

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" 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 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Driving equipment

Cap or cushion block

Pile shoes

SD-04 Samples

Test piles

SD-06 Test Reports

Test piles

Load tests

Submit test pile results, and load test data and results as specified in PART 3.

SD-07 Certificates

Timber piles

Submit the inspection report of an independent inspection agency, approved by the Contracting Officer, stating that offered products comply with applicable AWP Standards. Identify treatment on each piece by the quality mark of an agency accredited by the Board of Review of the America Lumber Standard Committee.

SD-11 Closeout Submittals

NOTE: Delete these paragraphs if load testing is not required. Insert the number of test piles to be load tested or indicate on drawings. When it is desirable to show analysis for determination of allowable pile capacities from load tests and for relating load test capacities to allowable loads, the following shall be included:

1. Test measurements: The ultimate test load (200 percent of allowable design load) shall be maintained for a minimum 24 hours and then released.

Broomed heads shall be cut to sound wood before making settlement measurements. The safe or allowable 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 0.25 mm per metric ton 0.01 inch per ton of total test load.

(b) One-half the load that causes a maximum gross settlement of one inch provided that the load settlement curve shows no sign of failure.

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

For single-acting hammers

$$[R = \frac{2 WH}{85.678 W} (\frac{s}{W} + 0.1P)]$$

$$[R = 2 WH / (S + 0.1 P/W)]$$

For double-acting hammers

$$[R = 2.71E / (\frac{s}{85.678} + 0.1P) W]$$

$$[R = 2E / (S + 0.1 P/W)]$$

Where R is the allowable static pile load in **kg pounds**, W is the weight of the striking part of the hammer in **kg pounds**, H is the effective height of fall in **meters feet**, E is the actual energy delivered by the hammer per blow in **joule 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 **one m 3 feet** for friction piles), and P is the weight of the pile in [kg] [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.

Pile driving **records**

Submit complete and accurate pile driving records of installed piles to Contracting Officer within 15 calendar days after completion of pile driving. Make pile driving records available to the Contracting Officer at the job site, within 24 hours after each day of pile driving. Pile records shall be as specified in Part 3.

1.3 QUALITY ASSURANCE

Each treated pile shall be branded, by the producer, in accordance with **AWPA M6**. Submit the inspection report of an independent inspection agency, approved by the Contracting Officer, stating that offered products comply with applicable AWPA Standards.

1.4 PLANT INSPECTION

The Government, at its discretion, reserves the right to inspect the treating process. Notify the Contracting Officer at least 3 weeks prior to beginning the treatment, stating where preservative treatment will be done. Allow Government inspector access to all parts of the plant. Allow inspection of all facets of the treating process.

1.5 BASIS OF BID

NOTE: Choose one of the following options.

NOTE: Use this option if unit pricing IS NOT required. Where more than one length of pile is required, numbers of piles and their lengths shall be clearly designated on the drawings.

[Base bids on the number, circumference, and length of piles from tip to cutoff as indicated. Test piles shall be [1.5 m] [5 feet] [_____] longer than bid length piles. From the data obtained as a result of driving the test piles [and conducting load tests], the Government will determine and list the calculated pile tip elevations [and the driving resistances] for all piles. The Government reserves the right to take up to 3 working days to review test pile driving records and take up to 3 additional working days to review and approve the contractor prepared schedule of pile lengths and locations. Use this list as the basis for ordering piles. Do not order production piles to receipt of the above information from the Government. Should the total number of piles or number of each length vary from that specified as the basis for bidding, the contract will be adjusted in accordance with "FAR 52.243-4, Changes." Adjustment in contract price will not be made for cutting off piles; for any portion of a pile remaining above the cutoff elevation; or for broken, damaged, or rejected piles.]

NOTE: Use this option if unit pricing IS required.
Specify unit price bid items for piling only where exact quantities cannot be practically determined prior to the actual work. For SOUTHDIV, use the reference to SF 1442; do not use references to Section 00 41 00 or document titled "Supplementary Instructions to Bidders" for SOUTHDIV. For LANTDIV, use option for the document titled "Supplementary Instructions to Bidders."

NOTE: See paragraph entitled "Payment and Measurement" and related technical notes for requirements regarding quantity variations.

[Payment will be at contract unit price per unit length, including test piles, multiplied by the total length of acceptable piles actually installed. Test piles shall be [1.5 m] [5 feet] [_____] longer than bid length piles. Base bids on the number of piles with pile length from tip to cutoff, as indicated, and on total linear footage of piling from tip to cutoff, including test piles, as specified in the [document titled "Supplementary Instructions to Bidders."] [Section 00 41 00 BID SCHEDULES.] [SF 1442, "Solicitation, Offer and Award" and "Schedule of Bid Items."] Include in bid a unit price per [load test and] unit length of piling based on the quantity stated in [document titled "Supplementary Instructions to Bidders."] [Section 00 41 00 BID SCHEDULES.] [SF 1442, "Solicitation, Offer and Award" and "Schedule of Bid Items."] From the requirements, the contractor shall prepare a schedule of the number of piles of each length to be used and their location. Submit schedule for approval before any piles, except test piles, are ordered. The Government reserves the right to take up to 3 working days to review test pile driving records and take up to 3 additional working days to review and approve the contractor prepared schedule of pile lengths and locations. The excess pile length ordered over the tip to the cutoff length listed in the schedule as finally approved shall be the responsibility of the contractor. Use this list as the basis for ordering piles. The contractor shall not order production piles prior to receipt of the above information from the Government. [Adjustments in contract price will also be made for each increase or

decrease in number of pile tests.]]

[1.5.1 Payment and Measurement

NOTE: For unit pricing situations, enter the tip to cutoff pile length in the three blank spaces provided. Use tip to cutoff lengths 300 mm one foot less than standard ordering lengths, to allow for a 300 mm one foot broomed test.

Requirements of "FAR 52.211-18, Variations in Estimated Quantity" shall not apply to payment for piles. Each job pile and test pile acceptably provided from tip to cutoff will be paid for at the applicable contract unit price per unit length, which price shall include all items incidental to furnishing and driving the piles including mobilization and demobilization; [jetting]; [spudding]; [predrilling]; [shoes and] collars where necessary; redriving uplifted piles; cutting off piles at the cutoff grade line; 300 mm one foot broomed and removed from each driven pile; treatment of the pile head exclusive of any capping; and additional 1.5 m 5 feet in furnished length for any test pile not driven beyond estimated pile length; and retapping of piles.

NOTE: Regarding the text and table below, for unit pricing situations, enter the tip to cutoff pile length in the three blank spaces provided. Use tip to cutoff lengths 300 mm one foot less than standard ordering lengths, to allow for a 300 mm one foot broomed end.

Payment for piles driven in lengths, as required, up to and including [_____] meters feet in place below the cutoff elevation, will be at the basic contract unit price bid. Payment for piles driven in lengths, as required, greater than [_____] meters feet below the cutoff elevation will be made at an adjusted unit price. Obtain the adjusted unit price by multiplying the basic contract unit price bid by the applicable factor shown in the table below.

NOTE: Use the following adjustment factors to establish unit price factors for piles which are driven in lengths longer than the tip to cut-off lengths specified. Use a base factor of 1.00 for the tip to cutoff length specified for the project. or other lengths of piles, adjust the base factor by adding (or subtracting) the cumulative total of the adjustment factors listed below (i.e., to adjust the factor from a 10 m 34 foot pile with the butt circumference specified to a 13.5 m 44 foot pile with the butt circumference specified, subtract 0.08 from 1.00).

[Ordered Pile Length (meter)	Tip to Cut-Off Length (m)	Butt Circum- ference Specified	Tip Circum- ference Specified
------------------------------------	---------------------------------	---	--

6	5.79	-	-
7.62	7.31	-0.04	+0.05
9.14	8.84	-0.04	+0.05
10.67	10.36	-0.04	+0.05
12.19	11.89	-0.04	+0.05
13.71	13.41	-0.04	+0.05
15.24	14.93	-0.04	+0.05
16.76	16.46	+0.10	+0.05
18.29	17.98	+0.15	+0.05
19.81	19.51	+0.15	+0.10
21.33	21.03	+0.15	+0.15
22.86	22.55	+0.35	+0.35]
[Ordered Pile Length (ft)]	Tip to Cut-Off Length (ft)	Butt Circum- ference Specified	Tip Circum- ference Specified
20	19	-	-
25	24	-0.04	+0.05
30	29	-0.04	+0.05
35	34	-0.04	+0.05
40	39	-0.04	+0.05
45	44	-0.04	+0.05
50	49	-0.04	+0.05
55	54	+0.10	+0.05
60	59	+0.15	+0.05
65	64	+0.15	+0.10
70	69	+0.15	+0.15
75	74	+0.35	+0.35]

Increase in Length	Factor
[_____] meters	1.00
Over 0.0 to 1.5 meters, inclusive	[_____]
Over 1.5 to 3.0 meters, inclusive	[_____]
Over 3.0 to 4.5 meters, inclusive	[_____]
Over 4.5 to 6.0 meters, inclusive	[_____]
Over 6.0 to 7.5 meters, inclusive	[_____]

Increase in Length	Factor
[_____] feet	1.00
Over 0.0 to 5.0 feet, inclusive	[_____]
Over 5.0 to 10.0 feet, inclusive	[_____]
Over 10.0 to 15.0 feet, inclusive	[_____]
Over 15.0 to 20.0 feet, inclusive	[_____]
Over 20.0 to 25.0 feet, inclusive	[_____]

When the Contracting Officer directs that a pile shall be cut off before the tip has reached the specified depth of tip penetration, payment will be made for that remaining length of pile not driven to the required minimum depth at the rate of 80 percent of the basic contract unit price bid, except when the Contractor is directed to order piles at a longer length

which will be paid for at 80 percent of the adjusted unit price. No other payments for such cutoffs will be paid. Should the total tip to cutoff length of piles under run that specified by more than 25 percent, the unit price per foot for such piles will be adjusted in accordance with "FAR 52.236-2, Differing Site Conditions." Any pile required to be pulled at no fault of the Contractor will be paid for at the applicable contract unit price for furnishing and driving the pile to the tip to cutoff length specified, plus 50 percent of that amount to cover the cost of pulling. Such pulled piles when redriven will be paid for at 50 percent of the applicable contract unit price for the length driven. [Payment for each complete test loading of a single pile will be made at the contract unit price per test, which price shall include furnishing, placing, and removing testing equipment, and placing and removing test loads. At the direction of the Contracting Officer, load tests may be waived at a credit to the Government of the unit price bid therefor.] Authorized splices will be paid for at 30 times the unit price per unit length bid for piles. Off-site disposal for cutoffs shall be the Contractor's responsibility.]

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Piles

 NOTE: Choose one of the following options.

 NOTE: The option below covers piles pressure treated with a preservative for land or fresh water. Specify or indicate on the drawings the minimum butt or tip circumference of the pile. Use butt circumference for a friction pile and tip circumference for an end-bearing pile.

 NOTE: For LANTNAVFACENGCOM projects only, the following minimum circumferences normally apply:

Capacity (metric tons)	Minimum Butt Circumference for Friction Piles (Use Table 1. ASTM D 25) (mm)	Minimum Tip Circumference for End-Bearing Piles (Use Table 2. ASTM D 25) (mm)
(18)	(965 mm)	(483 mm)
(23)	(965 or 1041 mm) *	(559 mm)
(27)	(1041 mm)	(635 mm)

*Depends on specific soil conditions encountered at the site.

Capacity (tons)	Minimum Butt Circumference for Friction Piles Use Table 1. ASTM D 25) (inches)	Minimum Tip Circumference for End-Bearing Piles (Use Table 2. ASTM D 25) (inches)
(20)	(38 inches)	(19 inches)
(25)	(38 or 41 inches)	(22 inches)
(30)	(41 inches)	(25 inches)

*Depends on specific soil conditions encountered at the site.

[Provide pressure treated Douglas fir or southern pine clean-peeled piles conforming to ASTM D 25. Minimum [butt circumference measured at 900 mm 3 feet from the butt] [tip circumference] shall be [[_____] mm inches] [as indicated]. Piles must be in one piece. Splices will not be permitted.]

NOTE: The option below covers piles for use in construction where preservative treatment is not required. Specify or indicate on the drawings the minimum butt or tip circumference of the pile. Use butt circumference for friction piles and tip circumference for an end-bearing pile.

[Provide untreated Douglas fir or southern pine [clean-peeled] [rough-peeled] [unpeeled] piles conforming to ASTM D 25. Minimum [butt circumference measured at 900 mm 3 feet from the butt] [tip circumference] shall be [[_____] mm inches] [as indicated]. Piles must be in one piece. Splices will not be permitted.]

2.1.2 Preservative Treatment

NOTE: This paragraph covers preservative and preservative treatment for land or fresh water piling. Compliance with treatment standards must be confirmed, by an inspection report from an approved independent inspection agency, on each pile. Select appropriate treatment for intended use. Do not use CCA, ACA, or ACZA treatment for round timber piles when significant bending or impact loads are expected.

Treat piles with [creosote], [or] [creosote-coal tar solution] [or] waterborne preservative either, Ammoniacal Copper Arsenate (ACA), Ammoniacal Copper Zinc Arsenate (ACZA), or Chromated Copper Arsenate (CCA) in accordance with AWP Standards AWP C1 and AWP C3 - For Land and Fresh Water Piles, which shall be confirmed by the report of an approved independent inspection agency.

[2.1.3 Pile Shoes

FS RR-S-331. Boot type or point type specially fabricated for the purpose

and the product of a manufacturer regularly engaged in the manufacture of pile fittings. Provide size to fit tip [specified] [indicated]. Fabricate boot-type of 5 mm 3/16 inch carbon steel fully welded, with minimum three straps, each with 5 mm 3/16 inch nail hole. Fabricate point type of four 5 mm 3/16 inch steel plates, fully welded and sized to adequately cover full pointed area of pile; provide each plate with 5 or 6 mm 3/16 or 1/4 inch nail hole.

]PART 3 EXECUTION

3.1 EXAMINATION

Examine piles when delivered and when in the leads immediately before driving.

3.2 PREPARATION

Where the protective shell of treated wood is impaired at a point which after installation will be not less than 3 m 10 feet below the ground, make repairs in accordance with AWPA M4 unless the pile is damaged to such extent that it is rejected.

3.3 INSTALLATION

Cut piles at cut-off grade with pneumatic tools, sawing, or other approved method. Bolt holes shall be of a size that will ensure a driving fit.

3.3.1 Test Piles

Shall be of the same diameter and type and driven in the same manner as specified for production piles. Keep a record for each test pile and every unusual occurrence during pile driving. Record every increase or decrease of driving resistance and bring it to the attention of the Contracting Officer. Properly located test piles may be used in the finished work. Drive test piles in locations indicated.

[3.3.1.1 Load Tests

NOTE: Delete these paragraphs if load testing is not required. Insert the number of test piles to be load tested or indicate on drawings. When it is desirable to show analysis for determination of allowable pile capacities from load tests and for relating load test capacities to allowable loads, the following shall be included:

1. Test measurements: The ultimate test load (200 percent of allowable design load) shall be maintained for a minimum 24 hours and then released. Broomed heads shall be cut to sound wood before making settlement measurements. The safe or allowable 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 0.25 mm per metric ton

0.01 inch per ton of total test load.

(b) One-half the load that causes a maximum gross settlement of one inch provided that the load settlement curve shows no sign of failure.

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

For single-acting hammers

$$[R = 2 \text{ WH} / (\frac{s}{85.678} + 0.1P)]$$

$$[R = 2 \text{ WH} / (S + 0.1 P/W)]$$

For double-acting hammers

$$[R = 2.71E / (\frac{s}{85.678} + 0.1P)]$$

$$[R = 2E / (S + 0.1 P/W)]$$

Where: R is the allowable static pile load in **kg pounds**, W is the weight of the striking part of the hammer in **kg pounds**, H is the effective height of fall in **meters feet**, E is the actual energy delivered by the hammer per blow in **joule 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 **one m 3 feet** for friction piles), and P is the weight of the pile in **kg 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.

Perform load tests on [_____] test piles [as indicated] in accordance with **ASTM D 1143**, as modified herein. Use the method for either 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. Make load tests at locations directed by Contracting Officer. Additional load tests may be required by the Contracting Officer. If additional load tests are required, the contract will be adjusted in accordance with the clause entitled "Changes" of the Contract Clauses. Loading, testing, and recording and analysis of data must be under the direct supervision of a Registered Professional Engineer.

]3.3.2 Driving Piles

Drive without interruption to the ["calculated"] [indicated] tip elevation

[to reach a driving resistance in accordance with the schedule that the Government will prepare from the test pile driving data]. If a pile fails to reach the ["calculated"] [indicated] pile tip elevation [or if the required driving resistance is reached before the ["calculated"] [indicated] pile tip elevation], notify the Contracting Officer who will determine the procedure to be followed. Drive production piles with the same hammer, cap block, and cushion materials and use the same operating conditions as test piles. Safe design capacity for each pile is [_____] metric tons tons.

3.3.3 Driving Equipment

Select and use a pile hammer of sufficient weight and energy to suitably install the specified pile without damage into the soils [as indicated] [expected to be encountered.] Place driving helmet or a cap and cushion block combination capable of protecting the head of the pile between the top of the pile and the ram to prevent impact damage to the pile. If block is damaged, split, highly compressed, charred or burned or has become spongy or deteriorated in any manner, replace with a new block. The helmet or block shall uniformly transmit energy to the pile and minimum loss of energy.

3.4 JETTING OF PILES

NOTE: Jetting should generally not be permitted for:

1. 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
2. Piles subject to uplift
3. Piles adjacent to existing structures
4. 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 [may be used] [will not be permitted]. [Discontinue jetting when the pile tip is approximately [1.5] [_____] meters [5] [_____] feet above the ["calculated"] [indicated] pile tip elevation. Drive the pile the final [1.5] [_____] meters [5] [_____] feet of penetration.]

3.5 PRE-AUGERING OR SPUDGING OF PILES

NOTE: Pre-augering or spudding should generally 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.

Pre-augering or spudding of piles [may be used] [will be required] [will not be permitted]. [Discontinue pre-augering or spudding approximately

[_____] meters feet above the ["calculated"] [indicated] pile tip elevation. Drive the pile the final [_____] meters feet of penetration.]

3.6 TREATMENT

Treat cut, bored, dapped, and damaged surfaces as specified in AWP4 M4.

3.7 TOLERANCES IN DRIVING

A variation of not more than 6 mm per 300 mm 0.25 inch per foot of pile length from the vertical for plumb piles or more than 13 mm per 300 mm 0.50 inch per foot of pile length from the required angle for batter piles will be permitted. The center of butts must be within 100 mm 4 inches of the location indicated. Manipulation of piles will not be permitted. In addition to complying with the stated tolerances, the clear distance between the heads of piles and the edges of pile caps shall be a minimum of 125 mm 5 inches. With prior approval of the Contracting Officer, provide additional reinforcement and concrete to maintain the required minimum clear distance. Any redesign of pile caps or additional work required due to improper location of piles shall be the responsibility of the Contractor and shall be approved by the Contracting Officer. Heaved piles shall be redriven to the required tip elevation. Remove and replace with new piles those damaged, mislocated, or driven out of alignment or provide additional piles, driven as directed.

3.8 RECORDS

Keep a complete and accurate record of each pile driven. Indicate the pile location, butt diameter, original length, ground elevation, tip elevation, cutoff elevation, penetration in blows per meter foot for the entire length of penetration for test piles, penetration in blows per meter foot for the last 3 m 10 feet for job piles, hammer data including make and size, and any unusual pile behavior or circumstances experienced during driving such as re-driving, heaving, weaving, obstructions, jetting, spudding, and unanticipated interruptions which may occur. The following log is a preprinted form for recording pile driving data.

PILE DRIVING LOG

CONTRACT NO. _____ CONTRACT NAME _____
 CONTRACTOR _____ TYPE OF PILE _____
 PILE LOCATION _____ PILE SIZE: BUTT/TIP: _____ LENGTH _____
 GROUND ELEVATION _____ CUT OFF ELEVATION _____
 PILE TIP ELEVATION _____ VERTICAL (_____) BATTER 1 ON (_____)
 SPLICES ELEVATION _____ COMPANY _____

HAMMER: MAKE & MODEL _____ WT. RAM _____
 STROKE _____ RAM RATED ENERGY _____
 DESCRIPTION & DIMENSIONS OF DRIVING CAP _____
 CUSHION MATERIALS & THICKNESS _____

INSPECTOR _____

"DEPTH" COLUMN OF PILE DRIVING RECORD REFERENCED TO:
 _____ CUT-OFF ELEVATION
 _____ FINISH FLOOR ELEVATION

TIME: START DRIVING _____ FINISH DRIVING _____ DRIVING TIME _____
 INTERRUPTIONS (TIME, TIP ELEV. & REASON) _____
 JET PRESSURE & ELEVATIONS _____

DRIVING RESISTANCE

DEPTH M	NO. OF BLOWS	DEPTH M	NO. OF BLOWS	DEPTH M	NO. OF BLOWS
0	_____	5.4	_____	10.8	_____
0.3	_____	5.7	_____	11.1	_____
0.6	_____	6.0	_____	11.4	_____
0.9	_____	6.3	_____	11.7	_____
1.2	_____	6.6	_____	12.0	_____
1.5	_____	6.9	_____	12.3	_____
1.8	_____	7.2	_____	12.6	_____
2.1	_____	7.5	_____	12.9	_____
2.4	_____	7.8	_____	13.2	_____
2.7	_____	8.1	_____	13.5	_____
3.0	_____	8.4	_____	13.8	_____
3.3	_____	8.7	_____	14.1	_____
3.6	_____	9.0	_____	14.4	_____
3.9	_____	9.3	_____	14.7	_____
4.2	_____	9.6	_____	15.0	_____
4.5	_____	9.9	_____	15.3	_____
4.8	_____	10.2	_____	15.6	_____
5.1	_____	10.5	_____	15.9	_____

SHEET 1 OF 2

PILE DRIVING LOG

16.2	_____	23.1	_____	29.7	_____
16.5	_____	23.4	_____	30.0	_____
16.8	_____	23.7	_____	30.3	_____
17.1	_____	24.0	_____	30.6	_____
17.4	_____	24.3	_____	30.9	_____
17.7	_____	24.6	_____	31.2	_____
18.0	_____	24.9	_____	31.5	_____
18.3	_____	25.2	_____	31.8	_____
18.6	_____	25.5	_____	32.1	_____
18.9	_____	25.8	_____	32.4	_____
19.2	_____	26.1	_____	32.7	_____
19.5	_____	26.4	_____	33.0	_____
19.8	_____	26.7	_____	33.3	_____
20.1	_____	27.0	_____	33.6	_____
20.4	_____	27.3	_____	33.9	_____
20.7	_____	27.6	_____	34.2	_____
21.0	_____	27.9	_____	34.5	_____
21.3	_____	28.2	_____	34.8	_____
21.6	_____	28.5	_____	35.1	_____
21.9	_____	28.8	_____	35.4	_____
22.2	_____	29.1	_____	35.7	_____
22.5	_____	29.4	_____	36.0	_____
22.8	_____				

Driving resistance in blows per 25 mm for last 0.30 m of penetration:

DEPTH_____ DEPTH_____

25mm___ 50mm___ 100mm___ 125mm___ 150mm___ 175mm___ 200mm___ 225mm___ 250mm___

275mm___ 300mm___

ELEV. _____ ELEV. _____

REMARKS _____

CUT OFF ELEVATION: FROM DRAWING _____

TIP ELEVATION = GROUND ELEVATION - DRIVEN DEPTH = _____

DRIVEN LENGTH = CUT OFF ELEVATION - TIP ELEVATION = _____

CUT OFF LENGTH = PILE LENGTH - DRIVEN LENGTH = _____

SHEET 2 OF 2

PILE DRIVING LOG

CONTRACT NO. _____ CONTRACT NAME _____
 CONTRACTOR _____ TYPE OF PILE _____
 PILE LOCATION _____ PILE SIZE: BUTT/TIP: _____ LENGTH _____
 GROUND ELEVATION _____ CUT OFF ELEVATION _____
 PILE TIP ELEVATION _____ VERTICAL (_____) BATTER 1 ON (_____)
 SPLICES ELEVATION _____ COMPANY _____

HAMMER: MAKE & MODEL _____ WT. RAM _____
 STROKE _____ RAM RATED ENERGY _____
 DESCRIPTION & DIMENSIONS OF DRIVING CAP _____
 CUSHION MATERIALS & THICKNESS _____

INSPECTOR _____

"DEPTH" COLUMN OF PILE DRIVING RECORD REFERENCED TO:
 _____ CUT-OFF ELEVATION
 _____ FINISH FLOOR ELEVATION

TIME: START DRIVING _____ FINISH DRIVING _____ DRIVING TIME _____
 INTERRUPTIONS (TIME, TIP ELEV. & REASON) _____
 JET PRESSURE & ELEVATIONS _____

DRIVING RESISTANCE

DEPTH FT.	NO. OF BLOWS	DEPTH FT.	NO. OF BLOWS	DEPTH FT.	NO. OF BLOWS
0	_____	18	_____	36	_____
1	_____	19	_____	37	_____
2	_____	20	_____	38	_____
3	_____	21	_____	39	_____
4	_____	22	_____	40	_____
5	_____	23	_____	41	_____
6	_____	24	_____	42	_____
7	_____	25	_____	43	_____
8	_____	26	_____	44	_____
9	_____	27	_____	45	_____
10	_____	28	_____	46	_____
11	_____	29	_____	47	_____
12	_____	30	_____	48	_____
13	_____	31	_____	49	_____
14	_____	32	_____	50	_____
15	_____	33	_____	51	_____
16	_____	34	_____	52	_____
17	_____	35	_____	53	_____

SHEET 1 OF 2

PILE DRIVING LOG

54	_____	77	_____	99	_____
55	_____	78	_____	100	_____
56	_____	79	_____	101	_____
57	_____	80	_____	102	_____
58	_____	81	_____	103	_____
59	_____	82	_____	104	_____
60	_____	83	_____	105	_____
61	_____	84	_____	106	_____
62	_____	85	_____	107	_____
63	_____	86	_____	108	_____
64	_____	87	_____	109	_____
65	_____	88	_____	110	_____
66	_____	89	_____	111	_____
67	_____	90	_____	112	_____
68	_____	91	_____	113	_____
69	_____	92	_____	114	_____
70	_____	93	_____	115	_____
71	_____	94	_____	116	_____
72	_____	95	_____	117	_____
73	_____	96	_____	118	_____
74	_____	97	_____	119	_____
75	_____	98	_____	120	_____
76	_____				

DRIVING RESISTANCE IN BLOWS PER INCH FOR LAST FOOT OF PENETRATION:

DEPTH _____ DEPTH _____

1" _____ 2" _____ 3" _____ 4" _____ 5" _____ 6" _____ 7" _____ 8" _____ 9" _____ 10" _____ 11" _____ 12" _____

ELEV. _____ ELEV. _____

REMARKS _____

CUT OFF ELEVATION: FROM DRAWING _____

TIP ELEVATION = GROUND ELEVATION - DRIVEN DEPTH = _____

DRIVEN LENGTH = CUT OFF ELEVATION - TIP ELEVATION = _____

CUT OFF LENGTH = PILE LENGTH - DRIVEN LENGTH = _____

SHEET 2 OF 2

-- End of Section --