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USACE / NAVFAC / AFCESA **UFGS-02460N (September 1999)**

Preparing Activity: NAVFAC **Replacing without revision NFGS of same number and date**

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 25 June 2004
****

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DIVISION 02 - SITE CONSTRUCTION

SECTION 02460N

STEEL H PILES

09/99

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SECTION 02460N

STEEL H PILES
09/99

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NOTE: This guide specification covers the requirements for procurement, installation, and testing of steel section 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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NOTE: Requirements for materials and procedures for special or unusual design should be added as necessary.
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NOTE: The following information shall be shown on the project drawings:

1. Location, size, and cutoff elevation of project piles.

2. Location, size, cutoff elevation, and identification of test piles.

3. Subsurface soil data logs should be shown on the drawings. Other subsurface data is design information and should not be part of the contract. Data should be available for examination by the bidders at appropriate locations.

4. Staging area.

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PART 1 GENERAL

1.1 REFERENCES

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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 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 SUBMITTALS

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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.][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

[Pile reinforcing tips or steel points]

[splices]

[Pile encasements]

SD-04 Samples

Test piles

SD-06 Test Reports

Test piles data

[Load tests]

SD-11 Closeout Submittals

Pile driving records

Submit [to the Contracting Officer] complete and accurate job pile records as specified in paragraph entitled "Records" of this section, within 15 calendar days after completion of driving.

1.3 BASIS FOR BIDS

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NOTE: Select one of the following options:

****

****
NOTE: Use first option below for lump sum bidding of piles. This option should be used in all projects except those where exact quantities cannot be practically determined prior to the actual work. Number of piles, pile capacity, pile locations, and tip and cutoff elevations shall be clearly shown on the drawings. Use second option 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.
****

[Base bids on the number, size, and length of piles from tip to cutoff as indicated. [Test piles shall be [1.5] [_____] meter [5] [_____] feet longer than bid length piles. From the data obtained as a result of driving the test piles [and load tests] specified herein, the Government will determine and will list for the Contractor the calculated pile tip elevations, the driving resistance for piles, or both. The information will be given to the Contractor no later than 10 calendar days after receipt of complete test pile data. The list shall be used as the basis for ordering piles. The Contractor shall not order production piles prior 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 price will be adjusted in accordance with Contract Clause entitled "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 damaged or rejected piles.]

****
NOTE: For PACNAVFACENGCOM projects: Edit applicable attachments from Document 00101 for inclusion in Standard Form 1442, "Solicitation, Offer and Award" and "Schedule of Bid Items." Select first bracketed text.
****

[For unit price bid, see [SF 1442, "Solicitation, Offer and Award" and "Schedule of Bid Items."] [Section 00101 BID SCHEDULES.]]

****
NOTE: For LANTDIV projects, use the following basis for bids.
****

[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 length of piling from tip to cutoff, including test piles, as specified [in the document titled "Supplementary Instructions to Bidders."]. Include in bid a unit price per [load test[s] and] linear foot of piling based on the quantity [indicated] [stated in document titled "Supplementary Instructions to Bidders."]. From the data

obtained as a result of driving the test piles [and load tests] specified herein, the Government will determine and list for the Contractor the calculated pile tip elevations, the driving resistance for piles, or both. Information will be given to the Contractor no later than 3 calendar days after receipt of complete test pile data. The list shall be used as the basis for ordering piles. The contractor shall not order production piles prior to receipt of the above information from the Government. If the Contracting Officer requires an increase or a decrease in the length of piles furnished and installed, the contract will be adjusted in accordance with "FAR 52.211-18, Variations in Estimated Quantities." [Adjustment in contract price will also be made for each increase or decrease in number of pile load tests.]]

PART 2 PRODUCTS

2.1 PILES

****

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 350 MPa through 448 MPa 42 ksi through 65 ksi; however, 350 MPa 50 ksi is the most available grade. ASTM A 588/A 588M has twice the atmospheric resistance of ASTM A 36/A 36M steel with 20 percent copper added.

1. Marine environment: Steel section piles exposed to seawater should be evaluated on the basis of application, location, degree of exposure, type of structure, and required service life. Where additional service life in the splash zone is required over that provided by conventional steel grades, ASTM A 690/A 690M or ASTM A 588/A 588M may be considered. ASTM A 690/A 690M steel 350 MPa 50 ksi (yield strength) has two to three times greater resistance to seawater splash zone corrosion than ordinary ASTM A 36/A 36M steel.

2. Seawater protection: To obtain reasonably long life for a structure immersed in seawater, the steel piles shall be provided with coatings, cathodic protection, or concrete encasement. Choice of protection is ultimately based on economics; usually, more than one type of protection will be used on a structure for most economical, adequate protection. The following criteria applies:

a. The use of coating systems for protection is usually low in initial cost but may require relatively frequent maintenance; also, 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 is relatively expensive in initial cost but requires no maintenance if properly constructed. When concrete encasement is to be continuously submerged in water with low resistivity, it should (1) extend below the mudline, or (2) the steel should be coated to electrically insulate the concrete from the steel.

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[ASTM A 36/A 36M] [ASTM A 572/A 572M, Grade [_____]] [ASTM A 588/A 588M] [ASTM A 690/A 690M]. [Provide test piles identical to those used elsewhere in the project.] [Pile tips shall be square and blunt, as received from the mill.] [Provide pile tip reinforcements or cast steel points.] [Piles shall be coated in accordance with Section 09967 COATING OF STEEL WATERFRONT STRUCTURES.] [Piles shall be provided with concrete encasements in accordance with Section 03300N CAST-IN-PLACE CONCRETE.]

PART 3 EXECUTION

3.1 INSTALLATION

Inspect piles when delivered and when in the leads immediately before driving. [Piles shall be handled so as to protect pile coatings. Repair damage or defects in pile coatings as specified.] Cut piles at cutoff grade by an approved method. Where cutoff is below existing ground or mudline elevation, complete excavation, sheeting, dewatering, and backfilling before driving pile to cutoff elevation.

3.1.1 Test Piles

****

NOTE: Insert the number of test piles required. The number of test piles is normally between 5 and 10 percent of the total number of piles required, dependent upon the magnitude of the project. Test piles are furnished 1.5 m 5 feet longer than job piles to allow additional penetration if driving conditions dictate. Delete this paragraph if test piles are not required.

****

Provide [_____] test piles of the same size and type as specified for job piles. Drive test piles in the same manner as specified for job piles. Furnish test piles [1.5] [_____] meter [5] [_____] feet longer than length specified for job piles and drive the additional depth, if directed. Drive test piles in locations indicated or as directed. If approved after test completion, include properly located test piles in the finished work. [Withdraw [_____] test piles after reaching the specified tip elevation to provide for visual inspection of the pile.] Record driving data as specified in paragraph entitled "RECORDS."

[3.1.2 Load Tests

****

NOTE: Insert the number of test piles to be load tested. The safe design capacity of a test pile as determined from the results of load test shall be

the lesser of the two values computed according to the following:

1. One-half the test load which causes a settlement of 0.25 mm per 907 kg 0.01 inch per ton of test load.

2. One-half the test load that causes a gross settlement of 25 mm one inch provided the load-settlement curve shows no sign of failure.

****

Perform load tests on [_____] test piles in accordance with ASTM D 1143 as modified herein. Perform load tests at locations shown, or as directed. Provide testing and measuring equipment, perform loading, and provide observation facilities for the Contracting Officer to inspect, record, and analyze settlement and deflection of piles under test loads. Do not mobilize load test equipment until directed by the Contracting Officer.

]3.1.3 Driving Piles

Operate hammer at manufacturer's rated speed, and drive pile without interruption [to the [calculated] [indicated] tip elevation] [to reach a driving resistance and minimum depth of penetration in accordance with the schedule that the Contracting Officer will prepare from the test pile driving data]. Drive piles with the same hammer, cushion, or cap block, and use the same operating conditions as test piles. If, in driving, it is found that pile is not of sufficient length to give the capacity specified, notify the Contracting Officer, who will determine the procedure to be followed.

3.1.4 Driving Equipment

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NOTE: When specifying the minimum driving energy, an allowance shall be made for reduced penetration caused by shock absorption of pile caps. Enter the appropriate minimum allowable driving energy for the project. Minimum allowable driving energy shall be not less than the following:

Design Bearing Power Capacity for Single Pile (Metric Tons)	**Minimum Rated Hammer Driving Energy (Joules)**
Up to 60	**20,350**
Over 60	**25,750**

Design Bearing Power Capacity for Single Pile (Tons)	**Minimum Rated Hammer Driving Energy (Foot-Pounds)**
Up to 60	**15,000**
Over 60	**19,000**

****

Use an air-, steam-, or diesel-powered pile hammer of an approved type with 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. Minimum driving energy shall be not less than [20,350] [25,750] joules [15,000] [19,000] foot-pounds. Driving energy shall be obtained by use of a heavy ram and a short stroke with low impact velocity,

rather than a light ram and a long stroke with high impact velocity. Position a pile cap or drive cap between the pile and hammer. Place hammer cushion or cap block between ram and the pile cap or drive cap. Hammer cushion or cap block shall have consistent elastic properties, shall minimize energy absorption, and shall transmit hammer energy uniformly and consistently during the entire driving period. Do not use a pile cushion block.

3.2 TOLERANCES IN DRIVING

At cutoff elevation, butts shall be within [100] [_____] mm [4] [_____] inches of the location indicated. [Manipulation of piles will not be permitted.] [Manipulation to move piles into position will be permitted only within the forementioned tolerance to return the pile to the design location[, however, piles shall not be manipulated more than 1.5 percent of the exposed length above the [ground] [mudline] surface].] A variation of not more than 21 mm per meter 0.25 inch per foot of pile length from the vertical for plumb piles nor more than 42 mm per meter 0.50 inch per foot of pile length from the required angle for batter piles will be permitted. [In addition to complying with the tolerances stated herein, the clear distance between the heads of piles and the edges of caps shall be not less than 125 mm 5 inches. With prior approval of the Contracting Officer, the Contractor may provide additional concrete and reinforcement to maintain the required minimum clear distance. Redesign of pile caps or additional work required due to improper location of piles will be the responsibility of the Contractor.] Inspect piles for heave. Redrive heaved piles to the required tip elevation. Remove and replace with new piles those damaged, mislocated, driven below the design cutoff, or driven out of alignment, or provide additional piles, driven as directed.

3.3 JETTING OF PILES

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NOTE: Jetting shall not generally be permitted when:

1. Piles are 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 are subject to significant uplift.

3. Piles are adjacent to existing structures.

4. Piles are in closely spaced clusters, unless the load capacity is confirmed by test and unless jetting and spudding is completed before final driving of any pile in the cluster.

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Water jets [shall be permitted] [may be used in driving only when specifically authorized by the Contracting Officer] [shall not be permitted]. [Discontinue jetting when the pile tip is approximately 1.5 m 5 feet above the [calculated] [indicated] pile tip elevation. Drive pile the final 1.5 m 5 feet of penetration. Jetting method and equipment shall be approved by the Contracting Officer prior to commencing jetting operation.]

3.4 PREDRILLING

Predrilling [shall be permitted] [shall not be permitted] [shall be provided]. [Discontinue predrilling when the pile tip is approximately 1.5 m 5 feet above the [calculated] [indicated] pile tip elevation. Drive pile the final 1.5 m 5 feet of penetration.]

3.5 LONG PILES

Handle and drive piles of a high slenderness ratio carefully to prevent overstress. Provide pile driving rig with rigid supports so that leads remain accurately aligned. Where a high degree of accuracy is required, erect templates or guide frames at or close to the ground or water surface.

3.6 SPLICES

When approved, provide splices of the full penetration butt weld type [or proprietary prefabricated splicer sleeves]. Use only one splice per length of pile. Avoid field splices for lengths under 24 m 80 feet. Construct splices 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.

3.7 WELDING

AWS D1.1/D1.1M.

3.8 RECORDS

Keep a complete and accurate record of each pile driven. Indicate the pile location, deviations from design location, cross section shape and dimensions, original length, ground elevation, tip elevation, cutoff elevation, penetration in blows per meter foot for the entire length of penetration, hammer data including rate of operation, make, and size, and unusual pile behavior or circumstances experienced during driving such as redriving, heaving, weaving, obstructions, jetting, and unanticipated interruptions. Preprinted forms for recording pile driving data are attached below.

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 --