CHAPTER 11.0
SPECIFICATIONS

11.1 INTRODUCTION

The following sample specification for timber piles is provided to illustrate the type of information that should be considered for inclusion in a specification. The traditional approach of a method and material specification is presented. The method approach requires that a site specific timber pile design be performed by the owner's engineer.

11.2 MATERIAL SPECIFICATION

SECTION 02459 - TIMBER PILES

PART 1—GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

[Note: Drawings should indicate the plan layout and spacing of piles, pile design loads, size and length of piles, butt or tip circumference of piles, cutoff elevation of piles, details of pile shoes, location and depth of pre-excavated holes for piles, location of test piles if in permanent locations.]

1.02 SUMMARY

A. This Section includes specifications for furnishing, installing, and testing of driven piles for structures. Piles shall be end-bearing piles, friction load-bearing piles or both as indicated.

B. Supply piles of the following types as indicated:
1. Timber piles, peeled and treated, driven.

C. Related Sections:
For bracing, pile caps and framing, see Division 6, Rough Carpentry, or Heavy Timber Construction.

1.03 DEFINITIONS

A. Test Pile: An individual pile which is observed to determine its behavior during driving and under static axial compression load.

B. Reaction Pile: An individual pile which provides the reaction load required to perform the load test on a test pile. During this process the reaction pile can be subjected to either an axial compression load or an axial tension load.

1.04 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO).

AASHTO M-133. Specification for Preservative and Pressure Treatment Process for Timber.

B. American Society for Testing and Materials (ASTM).

ASTM D25 Specification for Round Timber Piles
ASTM D1143 Method of Testing Piles Under Static Axial Compressive Load
ASTM D3689 Method of Testing Individual Piles Under Static Axial Tension Load

C. American Wood Preservers' Association (AWPA)

AWPA C3. Piles - Preservative Treatment by Pressure Processes.
AWPA C14. Wood for Highway Construction - Preservative Treatment by Pressure Processes.
AWPA C18. Standard for Pressure treated Material in Marine Construction.
AWPA M4. Standard for the Care of Preservative Treated Wood Products.

1.05 SUBMITTALS

A. General: Refer to Contract Requirements for Submittals, Shop Drawings, Product Data and Samples.

B. Shop Drawings: Submit shop drawings of pile types as follows:

1. Show any structural connections such as for uplift loads.

C. Pile Driving Sequential Layout:

1. Submit layout drawings showing the proposed sequence of driving the piles.

2. On the sequential layout, show each pile identification as indicated on the Contract Drawings, its driving sequence number, type, size, load bearing capacity and pile tip elevation planned.

D. Pile Driving Record: Maintain a pile driving record during pile driving and submit it to the Project Engineer upon completion of pile driving. On the record indicate, for each pile driven, the information specified in C above, and the following: type and rating of driving equipment, overall blow count per foot, number of blows per inch penetration for the last 12 inches, and any unusual conditions encountered during driving.

E. Equipment Review and Drawings:

1. Submit complete list of the equipment proposed for use, including a description of the characteristics of each piece of driving equipment.

   a. The Project Engineer will review the proposed driving equipment, accessories, and methods of adequacy for the conditions expected to be encountered. However, the adequacy of the equipment and accessories shall remain the responsibility of the Contractor. Should the equipment used by the Contractor prove inadequate to drive the scheduled types of piles in the locations indicated, or should the use rate of accessories show damage to the piles, or should the Progress Schedule not be maintained, the Contractor shall replace, or use different types of equipment.

2. Submit shop drawings of driving accessories showing compatibility with the size configuration, handling, and driving requirements of each type of pile indicated on the Contract Drawings.

3. Submit shop drawings showing the methods and equipment proposed for loading test piles.

F. Submit data on round timber pile treatment data, including certification by treating plant stating type of preservative solution and pressure process used, net amount of preservative retained, and compliance with applicable standards.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handling, storage and field fabrication, including treating of cut ends, shall be in accordance with AWPA M4.

2.0 PART 2 – PRODUCTS

2.01 TIMBER PILES

A. Round Timber Piles: Piles shall be Southern Pine or Douglas Fir and shall conform to ASTM D 25, unused, clean peeled, uniformly tapered, one piece from butt to tip.

[Note to Specifiers - Size: Specify butt or tip diameters from Tables 3-3 through 3-9.]

B. Pressure treatment shall be in accordance with the following Use Category Standards:
Foundation piles. AWPA C3.
Land and fresh water piles. AWPA C3.
Marine piles. AWPA C3 and C18.
Highway bridge piles. AWPA C14.

Marine, dual treatment. AWPA C3.
Field treatment of cut ends and holes. AWPA M4.

C. Preservatives and Retentions:

Creosote (pcf)	Waterborne (CCA or ACZA) (pcf)			
Use Category	Southern Pine	Douglas Fir	Southern Pine CCA	Douglas Fir ACZA
Foundation	12	17	0.8	1.0
Land & Fresh Water	12	17	0.8	1.0
Marine				
N. of Delaware[1] or San Francisco[1]	16	16	1.5	1.5
S. of New Jersey[2] or San Francisco[2]	20	20	2.5	2.5
Dual Treatment[3]	20	20	1.0	1.0

1. Where Teredo is expected and Limnoria tripunctata is not expected, creosote or creosote solutions provide adequate protection.
2. Where Teredo and Limnoria tripunctata are expected and where pholad attack is not expected, either dual treatment, or high retentions of CCA for Southern Pine or ACZA for Douglas fir provide maximum protection.
3. In those areas where Limnoria tripunctata and pholad attack is expected or known, dual treatment provides the maximum protection.

D. Fabrication

1. Field-Applied Wood Preservative: Treat field cuts, holes, and other penetrations in accordance with AWPA M4.

PART 3 - EXECUTION

3.01 PILE TYPES

Piles shall be end-bearing type or friction type as indicated. Drive end-bearing piles to the required bearing value. The bearing value for each pile shall be as determined in Article 3.04. Drive friction piles to the required penetration, as indicated.

3.02 DETERMINATION OF LENGTH

A. Provide piles of such length as required to develop the specified bearing value, to obtain the specified penetration, and to extend into the cap or footing block as indicated.

B. Assume responsibility for furnishing piles of sufficient length to obtain the penetration and bearing value indicated.

3.03 TEST PILES

A. The Contract Drawings indicate the required type of piling, the required bearing value, the minimum penetration, and the estimated pile tip elevation. Estimated tip elevations are approximate, based upon subsurface explorations, and are given only to show the basis for the estimated quantities indicated in the Bid Schedule and to indicate the required lengths of test piles.

B. Order and drive the test piles. Safe bearing capacities of the test piles will be determined by methods herein specified.

C. From the test pile data and behavior and the subsurface exploration data, the Design Engineer will determine the penetration required. The Design engineer may also determine the required penetration based upon settlement criteria or any other factors which in the opinion of the Design Engineer are applicable to the work. Submit the final data to the Project Manager for evaluation.

3.04 DRIVEN PILE CAPACITY

A. Design

1. The ultimate pile capacity will be determined by the Design Engineer. Drive piles with approved driving equipment to the ordered length or other lengths necessary to obtain the required ultimate pile capacity. Jetting, predrilling or other methods to facilitate pile penetration shall not be used unless specifically permitted by the Design Engineer.

2. Penetration per blow may be measured either during initial driving or during re-driving following a set period of time as determined by the Design Engineer.

B. Practical Refusal: Practical refusal will be determined by the Design Engineer, and will be a condition where the blow count exceeds either two times the number of blows required in 1 foot or three times the number of blows required in 3 inches to achieve the required bearing value, not to exceed 5 blows per inch. Piles reaching practical refusal shall not be driven further.

3.05 PILE LOAD TESTS FOR PILES UNDER AXIAL COMPRESSION LOAD

A. Install test piles and reaction piles, of the same type and kind as permanent piles, in the locations indicated by the Design Engineer. Install test piles vertically.

B. Test piles which pass the load test in an undamaged condition, may be utilized as permanent piles in the work. Reaction piles which were used to perform the pile load test may be utilized as permanent piles in the work, provided they are not damaged and that they are not moved upward.

C. Either extract damaged test piles and reaction piles and remove from the site, or cut them off 3 feet below any structure to be installed above.

D. Comply with ASTM D1143 for pile load test apparatus, for applying load and measuring movements, and for standard measuring procedures. Perform loading procedures as follows:

1. Apply the load in load increments of 10-15% of the design load to a maximum load of 300% or failure, whichever occurs first. Maintain each test load for 2.5 minutes.

2. Measure the settlement and rebound of the test pile to the nearest 0.01 inch.

E. Do not subject reaction piles which are to become permanent piles to uplift loads greater than 70 percent of the required bearing capacity. Test reaction piles in accordance with ASTM D3689.

F. Safe bearing capacity of the test pile shall be defined as 50% of the failure load. The failure load shall be defined as the load that produces a movement of the pile butt (S_f) equal to:

$$S_f = S + (0.15 + 0.008D)$$

Where:
S_f = Settlement at failure in inches
D = Pile diameter or width in inches
S = Elastic deformation of total unsupported pile length in inches

G. The Design Engineer may require additional load tests in the event that the behavior of the test pile or any other pile shows any peculiarity, erratic action, or otherwise causes suspicion as to the reliability of the safe bearing capacity.

H. Immediately following completion of load testing, submit two copies of the test report for each test pile to the Project Manager. Include in the test report the data required by ASTM D1143.

I. Following the completion of load tests, the Design Engineer will make a determination of the required penetration.

3.06 INSTALLATION OF PILES

A. General: Provide piles of the type indicated and of the length and configuration necessary to:

1. Achieve the required penetration determined by the Design Engineer;

2. Extend into the pile cap or structure footing to the location directed by the Design Engineer; and

3. Attain indicated bearing capacity.

B. Penetration and Bearing: Install piles to the required penetration, or to the required bearing, as indicated, except as specified in Article 3.04, C and D. Jetting will not be permitted unless specifically approved by the Design Engineer for the location.

C. Predrilled Holes:

1. When necessary to achieve the required penetration, drill holes of diameter not greater than 90 percent of the average cross-sectional dimension of the pile at the depth being drilled, and drive the pile therein to practical refusal.

D. Pile Driving:

1. Complete backfill to the required elevations in the area which piles are to occupy before starting to drive piles.

2. Do not drive piles within 20 feet of concrete less than seven days old.

3. Drive piles at interior of bases of footings before driving perimeter piles.

4. If necessary, provide adequate lateral support for installed individual piles to prevent excessive temporary flexural stresses or movement of the pile top out of tolerance.

5. Maintain the hammer coaxial with the pile during the driving operation by using a combination of driving cap and leads.

6. Investigate any sudden decrease in driving resistance for possible breakage of the pile. If sudden decrease in driving resistance cannot be correlated to boring data or some incident in the driving, and if the pile cannot be inspected, such decrease in driving resistance may be cause for rejection of the pile.

7. Re-drive any pile which is raised during driving of adjacent piles, to the original tip elevation.

8. Cut off piles at top elevation directed by the Design Engineer. Replace or repair piles which are damaged when cut off.

E. Installation Tolerances:

1. Deviation from plumb and angle of batter: ¼ inch per foot of pile length, but not more than 6 inches overall.
2. Deviation from location of pile top: 6 inches.

F. Piles not meeting ASTM D25 requirements will be rejected. Remove such piles from the site and replace with sound piles. Piles broken under driving stresses may be cut off and left in place if approved by the Design Engineer for the location. Otherwise they shall be extracted and removed from the site.

G. Fit timber piles with metal shoes on the tip as shown on the Contract Drawings (when specified). When the area of the head of a timber pile is greater than that of the face of the hammer, use a suitable cap to distribute the blows throughout the cross section of the pile.

After timber piles are cut off, treat cut surfaces in accordance with AWPA M4. Remove cutoff sections of piles from the site and legally dispose.