

**SECTION M.09
SHEET PILING AND PILES**

M.09.01--Sheet Piling: The materials for this work shall conform to the following requirements:

1--Timber Sheet Piling: The timber, unless otherwise definitely noted on the plans or in the special provisions, may consist of any species which will satisfactorily stand driving. It shall be sawn or hewn with square corners and shall be free from worm holes, loose knots, wind shakes, decayed or unsound portions, or other defects which might impair its strength or tightness.

The piles shall be of the dimensions shown on the plans or as directed, either cut from the solid material or made by building up the piles of three planks securely fastened together. The piles shall be drift sharpened at their lower ends so as to wedge the adjacent piles tightly together.

2--Steel Sheet Piling: Steel sheet piles shall conform to the requirements of ASTM A 328.

M.09.02--Piles: The materials for this work shall conform to the following requirements:

1--Untreated Timber Piles: Timber piles shall conform to the requirements of AASHTO M 168, as supplemented by the following requirements:

All timber piles shall be cut from sound, live trees preferably during the winter season. Piles shall contain no unsound knots or other defects which may impair their strength and durability. All knots shall be trimmed close to the body of the piles. All measurements for piles shall be taken under the bark.

Piles shall have the following minimum dimensions:

Pile Length	Tip Dia. mm	Butt Dia. mm
6 m and under	200	280
6.5 m to 12 m	200	305
12.5 m to 18 m	175	330
Over 18 m	150	380

2--Treated Timber Piles: The timber piles shall be pressure-treated with wood preservatives of creosote oil or creosote solution types. Piles shall comply with the requirements of Article M.09.02(1) except that piles for treatment shall be Douglas fir, larch, Southern yellow pine, Norway pine or red oak. They shall be peeled of outer bark and inner skin soon after cutting so that the piles are smooth and clean. Piles shall contain as much sapwood as possible, and care shall be taken to minimize damage to the sapwood when peeling and cleaning the piles. After preparation, the minimum thickness of the sapwood ring at the butt end shall be 25 mm, except for Southern yellow pine which shall have 38 mm.

Conditioning, treatment and wood preservative shall conform to the requirements of AASHTO M 133, except that creosote petroleum solution shall not be used for treatment of piles to be utilized in coastal waters.

The minimum net final retention of preservative per cubic meter of wood shall be as follows:

For piles to be used on land or in fresh water:	192 kg
For piles to be used in brackish or salt water:	
Douglas fir and larch	224 kg

Southern yellow pine		320 kg
Red oak	(Full cell process)	refusal

Prior to furnishing the treated piles, the Contractor shall submit certification of the species, grade or class of pile material, the grade of wood preservative used, and the final net retention of the preservative in kilograms per cubic meter of wood.

Treated piles shall be subject to inspection by the Engineer at the site. No previous certifications or approval at the treatment plant shall bar rejection in the field for injury, breakage or defects in the piles prior to their installation. The use of "S" irons for repairing or preventing checks, splits or other defects will not be permitted. All treated timber piles shall be carefully handled and properly stored. Any surface breaks which do not warrant rejection shall be given three coats of hot creosote oil.

The heads of piles shall be treated as follows: The sawed surface shall be thoroughly brush-coated with three successive applications of hot creosote, followed by a thick application of a mixture of 30% creosote and 70% pitch. The application of the pitch coat will not be required to pile heads encased in concrete. All bolt holes made in the pile subsequent to treatment shall be treated with creosoted oil by means of an approved pressure bolt hole treater. After being so treated, all unfilled holes shall be plugged with creosoted plugs.

3--Steel Piles: Piles shall be rolled steel sections of the mass and shape called for on the plans or specified by the Engineer. Piles, splice plates and points shall be new material meeting the requirements of ASTM A 36. Stock Steel conforming to these requirements and free from surface imperfections will be accepted upon presentation of certified mill test reports as to the quality of the stock material and receipt of affidavit that the stock material furnished is a product of the open-hearth method manufacture. Immediately prior to driving, steel piles when placed in leads shall not exceed the camber and sweep permitted by allowable mill tolerance. Piles bent or otherwise injured shall be rejected.

4--Precast Concrete Piles: Precast concrete piles shall be in strict accordance with the details shown on the plans or in the special provisions. The materials shall conform to the following requirements:

(a) Concrete: The concrete for the piles shall be air-entrained concrete composed of portland cement, fine and coarse aggregates, admixtures and water. The air-entraining feature may be obtained by the use of either air-entraining portland cement or an approved air-entraining admixture. The entrained air content shall be not less than 4 percent or more than 6 percent.

The Contractor shall design and submit for the approval of the Engineer a concrete mix which shall attain a minimum 28-day compressive strength of 35 MPa, or as shown on the plans. The Contractor shall further provide a certified statement that the mix submitted shall meet the requirements.

Prior to any handling or pickup, after casting of piles the compressive strength shall be 25 MPa minimum.

(b) Coarse Aggregate shall consist of broken stone, having a maximum size of 19 mm, conforming to the requirements of Article M.03.01.

(c) Fine Aggregate, water, air-entraining admixture and retarder admixture shall conform to the requirements of Article M.03.01.

(d) Portland Cement for the units shall conform to the requirements of Article M.03.01, except that Type III or Type IIIA portland cement may be used at no additional cost to the State.

(e) Water Reducing Admixture: The Contractor may submit, for approval of the Engineer, a water-reducing admixture for the purpose of increasing the workability and reducing the water requirement for the concrete.

(f) Calcium Chloride: The addition to the mix of calcium chloride, or admixtures containing calcium chloride, will not be permitted.

(g) Steel Reinforcement: Steel Reinforcement shall conform to the requirements of Article M.06.01.

5--Cast-in-Place Concrete Piles: Cast-in-place concrete piles shall be in strict accordance with the details shown on the plans or in the special provisions. Unless otherwise indicated, the concrete shall conform to Class "C" as shown in Article M.03.01, and no air-entraining shall be provided. The steel reinforcement shall conform to the requirements of Article M.06.01

Shells shall be manufactured specifically for use as piles. The use of other type metal products such as piping, tubing or circular forms shall not be permitted without prior written approval of the Engineer. Any such approval will be contingent upon the actual driving performance of the shell in place.

6--Prestressed Concrete Piles (Pretensioned): Materials for pretensioned piles shall conform to the requirements of Article M.14.01, except as follows:

Concrete: The concrete for the piles shall be air-entrained concrete composed of portland cement, fine and coarse aggregates, admixtures and water. The air-entraining feature may be obtained by the use of either air-entraining portland cement or, if permitted by the Engineer, an approved air-entraining admixture. The entrained air content shall be not less than 4 percent or more than 6 percent.

The Contractor shall design and submit for the approval of the Engineer a concrete mix which shall attain a minimum strength of 35 MPa. The mix shall have a minimum cement content of 8.0 bags per cubic meter. The compressive cylinder strength at the time of transfer of prestressing load shall be a minimum of 25 MPa. No piles shall be removed from the casting plant, nor be transported to the work site, nor be driven until the compressive strength is 35 MPa minimum.

The Contractor shall further provide a certified statement that the mix submitted shall meet the requirements. Its ultimate strength at 28 days shall have a minimum value of 35 MPa.

Fine Aggregate: The fine aggregate shall conform to the requirements of Article M.03.01-2 except as amended by the addition of the following:

Fine aggregate for use in prestressed piles shall not contain any materials that are deleteriously reactive with the alkalis in the cement in an amount sufficient to cause excessive expansion of mortar, grout or concrete; except that if such materials are present in injurious amounts, the portland cement shall be modified in accordance with the provisions listed under the requirements for portland cement.

Portland Cement: Portland cement for the piles shall conform to the requirements of Article M.03.01, except as supplemented and amended hereinafter.

Type III or Type IIIA portland cement may be used at the Contractor's option. The tricalcium aluminate ($3Ca Al_2O_3$) content of the portland cement shall be limited to a maximum of 8%. Where high sulfate resistance is required, as specified on the plans or as directed, the tricalcium aluminate content shall be limited to a maximum of 5 percent. This criteria is attained when the water-soluble sulfate (as SO_4) in soil exceeds 0.20 percent or the sulfate (as SO_4) in ground or surface water exceeds 1,000 parts per million.

Where the fine aggregate contains materials that are deleteriously reactive with the alkalis in the cement, as noted in the requirements of fine aggregate, the portland cement shall contain less than 0.6 percent alkalis calculated as sodium oxide or shall have a material added that has been shown to prevent harmful expansion due to the alkali-aggregate reaction.

Splicing cement shall conform to the requirements of the special provisions.

Pile Tip: Steel for the pile tip shall conform to the requirements of Article M.06.02. Anchorages for the pile tip shall conform to the requirements of Article M.06.01 or M.06.02, whichever shall apply.

Jet Pipe: The jet pipe and fittings shall be a 50 mm galvanized steel pipe provided with a top connection and bottom jetting outlets as shown on the plans or as directed. With the approval of the Engineer, other material may be substituted for the galvanized pipe, connections, fittings and outlets.

Pile Extension: Materials for pile extensions shall conform to the requirements listed above or as noted on the plans.