

# Specification For Supply And Installation Of Piling - 6400

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## 1 GENERAL

### 1.1 Description

1.1.1 The Work shall consist of the driving and/or construction of piles in accordance with the plans and this specification, or as directed by the Ministry.

## 2 MATERIALS

2.1 Wood steel and precast concrete piling shall be supplied by the Contractor to the bridge site unless stated otherwise in the plans or special provisions. Reinforcing steel and concrete for cast-in-place concrete piles and for concrete filled steel pipe piles shall be supplied by the Contractor to the bridge site. The Contractor shall be responsible for unloading and properly storing all material.

2.2 Mill test certificates showing chemical analysis and physical tests of all steel shall be submitted to the ministry two weeks prior to delivery.

2.2.1 In addition to CSA Specification G40.21, the boron content shall be limited to 0.0008%.

2.3 Where mill test certificates originate from a mill outside Canada or the United States of America, the Contractor shall have the information on the mill test certificate verified by independent testing by a Canadian laboratory. This laboratory shall be certified by an organization accredited by the Standards Council of Canada

to comply with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian laboratory and appropriate wording stating that the material specification number, testing date, and the signature of an authorized officer of the Canadian laboratory.

- 2.4 Materials shall not be driven or cast until the Ministry has reviewed all test results verifying that the material meets the requirements on the plans.

### **3 CONSTRUCTION**

#### **3.1 General**

- 3.1.1 All piling shall be driven or constructed the full length as indicated on the Plans. Exception for driven piles may apply as follows:

- 3.1.1.1 If refusal is reached prior to reaching an embedment length of 7.5 meters, continue driving in order to achieve an embedment length of 7.5 meters;
- 3.1.1.2 If refusal is reached after an embedment length of 7.5 meters is reached and prior to reaching the full length indicated on the Plans, no further driving is required;
- 3.1.1.3 If, after driving to the full length of the Plans, it is determined, by the Engineer, that the pile has not achieved capacity, additional pile length will be required;
- 3.1.1.4 Refusal will be defined as a penetration of 30 blows per decimeter at a driving energy of 47,000 joules per blow.

- 3.1.2 Pre-drilling to facilitate driving of piles shall not be permitted unless shown in the plans or the special provisions, or as otherwise approved by the Ministry.

- 3.1.2.1 For concrete filled steel pipe piles, predrilling to a maximum of 1.5 meters below the ground line to facilitate accuracy of pile placement will be permitted.

#### **3.2 Driving Equipment**

- 3.2.1 Piles shall be driven using a hammer having sufficient mass or energy capacity to obtain the specified pile penetration without unacceptable damage to the piles.

3.2.2 A sufficient driving energy shall be between 30,000 joules, and 47,000 joules. The hammer and pile shall be adequately cushioned to avoid damage to the top of the pile caused by the impact of driving forces. The cap and pile top shall be squared to distribute the hammer blow uniformly to the top surface of the pile.

3.2.2.1 If the top of the pile becomes damaged during the pile driving operation, driving shall be stopped, the damaged portion of the pile shall be removed and the top of the pile shall be squared.

3.2.2.2 If damage to the top of the pile continues to occur, the tops of piles shall be stiffened at no additional expense to the Ministry. The method used to stiffen the pile will be subject to approval by the Engineer.

### **3.3 Soil Conditions**

3.3.1 When a variation in soil conditions dictates, the Contractor may be required to provide a hammer with a greater energy capacity, or employ supplemental methods such as jetting or predrilling in order to obtain the specified pile penetration.

### **3.4 Caps**

3.4.1 The tops of all precast concrete, wood, and steel piles shall be held in position and protected by caps of approved design. Caps shall incorporate suitable shock blocks. The top surface of the piles shall be square to the longitudinal pile axis, and for wood piles, the butt end shall be shaped or chamfered to prevent splitting at its periphery.\

### **3.5 Leads**

3.5.1 Piles shall be supported in alignment and position with leads while being driven. Leads shall be so designed and constructed to afford freedom of movement of the hammer and to permit proper placing of batter piles. Leads shall preferably be of sufficient length to be firmly supported on the ground surface. Hanging or swinging leads may be permitted provided they are so constructed that they can be held in a fixed position during the driving operations.

### **3.6 Followers**

- 3.6.1 The driving of piling with followers shall be done only under written permission from the Ministry. When followers are used, and if deemed necessary by the Ministry, one pile from each group of ten shall be a long pile driven without a follower, and shall be used as a test pile to determine the average load capacity of the group.

### **3.7 Water Jets**

- 3.7.1 When water jets are used, the number of jets and volume and pressure of water at the jet nozzles shall be sufficient to freely erode the material adjacent to the pile. The equipment shall have sufficient capacity to deliver at all times at least 700 kPa pressure at two 20 mm diameter jet nozzles. Before the desired penetration is reached, the jets shall be withdrawn and the piles shall be driven at least 1.5 m with the hammer to secure the final penetration.

### **3.8 Wood Piles**

- 3.8.1 Special care shall be taken during handling and driving to avoid breaking the surface of treated wood piles. Cant-hooks, pike-poles or any other sharp pointed tools shall not be used. Cuts or breaks in the surface of treated piling, the tops of driven treated piling, and bolt holes shall be given one application of approved preservative. Approved preservative shall be supplied by the Contractor at no additional cost to the Ministry.
- 3.8.2 When necessitated by the driving or pile conditions, collars, bands or other devices shall be provided by the Contractor to protect the piles against splitting and brooming.
- 3.8.3 The tip of wood piles may be pointed to a minimum square point of 100 mm by 100 mm where soil conditions make it desirable.

### **3.9 Precast Concrete Piles**

- 3.9.1 A suitable cushioning material of adequate thickness shall be provided between the cap and the pile top. The cushioning material shall be replaced when it becomes highly compressed, charred or burned.
- 3.9.2 When driving resistance of the pile is low, the energy developed during the driving shall be kept low so as not to develop tension cracking of the pile. The energy output shall be increased as the driving resistance increases.

- 3.9.3 When predrilling or jetting is permitted to facilitate placing the piles, the pile tip shall be well seated with reasonable soil resistance at the tip before full driving energy is used. Driving and jetting shall not be done simultaneously.
- 3.9.4 Precast concrete piles shall not be spliced without the approval of the Ministry.

### **3.10 Cast-in-Place Concrete Piles**

- 3.10.1 Cast- in-place concrete piles shall be constructed to the details shown on the plans. They shall consist of concrete cast in holes drilled to the required elevation. Concrete shall conform to the requirements of Specification 6300 - CONCRETE FOR BRIDGE WORK.
- 3.10.2 All holes for piles shall be drilled dry without the addition of water. The holes shall be examined for straightness, and any hole which, on visual inspection from the top, shows less than one-half of the diameter of the hole at the bottom will be rejected. Suitable casings shall be furnished and installed when required to prevent caving of the hole before concrete is placed, and to provide protection for workers and inspectors. A hole shall be immediately covered if reinforcement and concrete placement does not occur immediately after upon completion of the drilling. Holes shall be filled with concrete on the same day that they are drilled.
- 3.10.3 Surface water shall be prevented from entering the hole. Free water present in quantities sufficient to affect concrete strength shall be removed before placing concrete.
- 3.10.4 Removal of a casing shall be co-ordinated with the concrete placement. The head of concrete shall exceed the external soil and water pressure at all times. Specially designed high slump concrete may be used to prevent arching of the concrete during the casing withdrawal. The concrete shall not be vibrated internally before the casing is withdrawn, although vibrating the casing will be permitted. The casing shall be withdrawn before the concrete attains its initial set.
- 3.10.5 Concrete shall be placed through a hopper with a downpipe centred on the drilled hole to provide for free unobstructed fall which does not hit the reinforcing steel or the side of the hole. Long downpipes or other approved equipment shall be used for placing concrete in battered piles and on other occasions where the free fall is not appropriate.

3.10.6 The top two metres of concrete in the piles shall be consolidated by mechanical vibrators.

3.10.7 Where piles are to be extended above groundline as circular columns, the top 0.5 m below groundline shall be formed to maintain the proper cross-section of the pile.

3.10.8 Contaminated concrete and laitance shall be removed from the top of the piles before placing fresh concrete upon them.

### **3.11 Concrete Filled Steel Pipe Piles**

3.11.1 Concrete filled steel piles shall be constructed to the details shown on the plans. They shall consist of steel pipes, closed at the bottom, driven to depths shown on the plan or as otherwise accepted by the Ministry, and filled with concrete. Concrete shall conform to the requirements of Specification 6300 - CONCRETE FOR BRIDGE WORK.

3.11.2 When required, the Contractor shall weld the circular base plates and additional bracing to the bottom of the piles. This welding shall conform to the requirements of CSA Standard W59. Piles shall be checked immediately following driving and attempts made to seal any leaks which develop by dumping a dry mixture of sand and cement into the piles. Any water in the piles shall be removed before placing the concrete. No concrete shall be placed until all pile driving within a foundation unit has been completed.

### **3.12 Splicing Piles**

3.12.1 Full length piles shall be used where practicable. When splicing of the piles is required, the method of splicing shall be as shown on the plans or as approved by the Ministry. The manual shielded metal-arc process shall be used for welded splices. Wood piles shall not be spliced.

### **3.13 Accuracy**

3.13.1 Piling accuracy survey must be performed jointly between the Contractor and the Engineer.

3.13.2 The Contractor shall use steel driving frames for the installation of driven piles.

3.13.3 Piles shall be driven with a variation of not more than 20 mm/m from the vertical or from the batter shown on the Plans. Manipulation of a pile to force it into proper position or alignment will not be permitted.

3.13.4 Final pile position shall fall within the following tolerances.

- Parallel to the centreline of bridge  $\pm 25$  mm
- Parallel to centreline of pile cap  $\pm 50$  mm

### 3.14 Redriving of Piles

3.14.1 After all piles in any group have been driven, any pile which has lifted due to driving of adjacent piles shall be redriven.

### 3.15 Cutting off Piles

3.15.1 The tops of all piling shall be cut to a true plane at the elevation shown on the plans or at the elevation approved by the Ministry. After driving, the length of pile remaining above the elevation of cut-off shall be sufficient to permit the complete removal of all damaged material.

3.15.2 Pile cutoffs shorter than 3.0 m shall be disposed of by the Contractor.

3.15.3 Pile cutoffs longer than or equal to 3.0 m shall become the property of the Ministry and shall be delivered to the closest Ministry yard of either Prince Albert or Moose Jaw.

### 3.16 Defective Piles

3.16.1 Any pile damaged during driving, driven out of its proper location or driven below the cut-off elevation identified on the plans or by the Ministry, shall be corrected at the Contractor's expense using a method approved by the Ministry. Remedial action may involve, but is not limited to one of the following methods:

- 3.16.1.1 The pile may be withdrawn and replaced by a new and, if necessary, a longer pile;
- 3.16.1.2 A second pile may be driven adjacent to the defective or low pile;
- 3.16.1.3 The pile may be spliced or built up as otherwise provided herein, or a sufficient portion of the footing extended to properly embed the pile.

### **3.17 Determination of Load Capacity**

3.17.1 Pile loads capacity shall be determined as per the Engineer.

#### **3.17.2 Test Piles**

3.17.2.1 When required, the Contractor shall drive test piles of a length and at the locations designated by the Ministry.

3.17.2.2 When directed by the Ministry, a representative number of piles shall be allowed to develop "set" for a period of up to 48 hours, and then redriven to determine any increase in driving resistance at no direct cost to the Ministry.

## **4 MEASUREMENT**

4.1 The number of linear metres to be paid for shall be the total number of linear metres of piling remaining in the completed structure, measured from the pile tip to the bottom of footing for cast-in-place concrete piles, or to the top of pile for driven piles.

## **5 PAYMENT**

### **5.1 Payment for Piling**

5.1.1 Payment for SUPPLY OF PILING shall be at the contract unit price. The unit price shall be full compensation for supply of steel pipe piling to the bridge site including furnishing all labour, tools, materials, supplies, equipment and other costs of handling, driving, cutting off piles and reinforcement, splicing, installation of cover plates (Plate A and Plate B) and gussets, treatment of pile tops, installing base plates and all other incidental work connected therewith.

5.1.2 Payment for INSTALLATION OF PILING shall be at the contract unit price plus pay adjustments. It shall also include the cost of all predrilling, jetting, drilling, or other work necessary to obtain the required penetration or load capacity of piles and supplying and placing concrete for concrete filled steel piles. It shall also include the cost of drilling, placing of reinforcing, and supplying and placing concrete and casing for cast-in-place piles, and the cost of installing base plates, placing of reinforcing and supplying and placing concrete for concrete filled steel piles.

5.1.2.1 Concrete for concrete filled steel piles will be paid for under the contract unit price for Concrete Type P1.

5.1.3 No payment shall be made for the furnishing or driving of falsework piles, nor will payment be made for piles driven out of place, and for piles which are damaged or defective because of the Contractor's operations .

## **5.2 Payment for Test Piles**

5.2.1 Test piles ordered by the Ministry shall be paid for as follows:

5.2.1.1 If piles are used in the structure, the test piles shall be paid for as in the case of other piles.

5.2.1.2 If piling is not used in the structure, the test piles shall be paid for as provided for extra work, due consideration being given to the cost of bringing the pile driver to the site and removing it from the work.

## **5.3 Payment for Load Tests**

5.3.1 Payment for load tests shall be made on the basis of extra work. Payment shall include the cost of all material, equipment and labour incidental to making the loading test or tests.