

SPECIFICATIONS FOR
SUPPLYING AND DRIVING STEEL PIPE PILES

1.0 DESCRIPTION

The Work shall consist of:

- .1 Supplying, handling, hauling, storing, aligning and driving steel pipe piles for foundation and slope stability works;
- .2 Cutting off piles at the required elevations;
- .3 Pre-boring of piles, if applicable;
- .4 Supplying and placing concrete infill, if applicable;
- .5 Splicing piles, if shown on the Drawings or deemed necessary by the Engineer; and
- .6 Supplying and installing pile tips, if shown on the Drawings or deemed necessary by the Engineer.

2.0 REFERENCES AND RELATED SPECIFICATIONS

All reference standards and related specifications shall be current issue or latest revision at the date of tender advertisement.

2.1 References

- CAN/CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel
- CSA W59, Welded Steel Construction (Metal Arc Welding)
- AASHTO/AWS D1.5M/D1.5 Bridge Welding Code

2.2 Related Specifications

- Specifications for Supply, Fabrication and Erection of Miscellaneous Metal
- Specifications for Reinforced Cast-in-Place Concrete

3.0 SUBMITTALS

The Contractor shall submit the following to the Engineer:

- .1 Copies of Mill Certificates and mill test reports showing chemical analysis and physical tests for all piling material shall be submitted to the Engineer for review prior to commencement of pile driving. Piling material without this certification will be rejected.

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

is in conformance with the specified requirements. The stamp shall include the appropriate material specification number, testing date, and the signature of an authorized officer of the Canadian laboratory.

- .2 Manufacturer's specifications and catalogue for all mechanical hammers to be used.
- .3 Certificate of mass for gravity or drop hammers. If this certificate is not available, the gravity or drop hammers shall be weighed in the presence of the Engineer. Hammers so weighed shall have the exact mass marked on them. Gravity hammers shall weigh at least 1.5 ton but in no case shall the mass of the hammer be less than the combined mass of the pile and pile cap.
- .4 Pile driving procedures to be used for the installation of the driven steel pipe piles.
- .5 Proposed welding procedures conforming to AWS D1.5 or CAN/CSA W59 and CAN/CSA W47.1 to be used for splicing the piles and installing pile tips, if applicable. The following shall be included in the submitted welding procedures:
 - i. The welding process, position of weld, filler metal, flux, shielding gas if required, joint configurations, number and size of passes, preheat and inter-pass temperatures if required, sequence of passes, current, rate of pass, electrode size, electrical stick-out and polarity;
 - ii. Methods proposed for edge preparation;
 - iii. Measures proposed to control distortion, shrinkage and residual stresses;
 - iv. Proposed methods and sequence of assembly; and
 - v. Welding equipment to be used.
- .6 Proof of certification for the welders conducting the Work (if applicable). All welders shall satisfy one of the following requirements:
 - i. Welders qualified in accordance with the requirements of AASHTO/AWS D1.5M/D1.5,
 - ii. Valid Canadian Welding Bureau (CWB) Welding ticket, or
 - iii. Valid "Welder's Licence" as issued by the Mechanical and Engineering Division, Department of Labour and Manpower, Province of Manitoba, with a minimum of 5 years of experience welding on steel structures.
- .7 Submittals for the concrete infill in accordance with the Specifications for Reinforced Cast-in-Place Concrete.

4.0 MATERIALS

4.1 Steel Pipe Piles

As a minimum, steel pipe piles shall conform to the requirements of CAN/CSA G40.21M, Grade 300W. Where piling is designated in metric dimensions, imperial equivalent piling will be acceptable. Mill certificates shall be provided to the Engineer prior to pile installation.

All piles crushed excessively or bent through negligence or carelessness in driving operations shall be replaced by the Contractor at his own expense unless, at the discretion of the Engineer, the damage is so slight that the pile can be repaired properly by the Contractor at his own expense.

4.2 Pile Tips

Pile tips shall conform to the requirements of CAN/CSA G40.12M, Grade 300W.

Pile tips shall be fabricated to the dimensions shown on the Drawings and shall be subject to approval by the Engineer.

4.3 Splice Backer Rings

Splice backer rings shall conform to the requirements of CAN/CSA G40.21M, Grade 300W.

4.4 Welding Materials

The Contractor is responsible for supplying all welding materials. All welding materials shall conform to the requirements of the Specifications for Supply, Fabrication and Erection of Miscellaneous Metal.

4.5 Concrete Infill

Concrete infill shall conform to the requirements for cast-in-place concrete piles as identified in the Specifications for Reinforced Cast-in-Place Concrete.

5.0 CONSTRUCTION METHODS

5.1 Handling and Storage

Piling shall be handled, hauled and stored in a manner that avoids damage to the piling materials. Loading and unloading shall be by crane, loader or other appropriate hoisting equipment.

The Contractor, in the handling and lifting of the piles, will not be permitted to drag them along the ground. Piles shall be stockpiled off the ground on timber blocking and handled in a manner to avoid any damage.

If piles are damaged due to the Contractor's handling operations, the Contractor shall, at his own expense, replace all damaged piles with piles meeting the requirements of this Specification and as shown on the Drawings.

5.2 Location and Alignment

The piles shall be driven in the positions shown on the Drawings or as directed by the Engineer. Piles shall be driven vertically unless shown otherwise on the Drawings, and shall not deviate more than 2 percent out-of-plumb. Batter piles shall be driven to the batter specified, and shall not deviate more than 2 percent from the batter specified. Piles shall not be more than 75 mm off centre measured at cut-off elevation from the locations as specified on the Drawings.

The Contractor shall take adequate precautions to ensure that the piles are in proper alignment, including the use of installation frames, fixed leads or other means as are necessary. The method of maintaining alignment shall be accepted by the Engineer.

Piles shall not be jacked or pulled into their final positions.

5.3 Driving Steel Pipe Piles

Piles (for both foundation and slope stability work) shall be driven to the depths and in accordance with the pile set criteria on the Drawings or as directed by the Engineer. Pile set criteria will be based upon the actual driving energy of the hammer not the rated or theoretical energy. All pile driving equipment, driving methods and procedures shall be reviewed by the Engineer before any driving is started. Acceptable driving equipment includes hammers, vibratory hammers, driving frames or other equipment as may be required by the Engineer.

The Contractor shall remove any surface and/or shallow depth obstructions to obtain the required penetration of the piles.

Pile driving equipment to be used by the Contractor shall be of such capacity that the required bearing and penetration shall be obtained without damage being done to the piles. Driving of all piles shall be continuous and without interruption until the pile has been driven to cut-off elevation or the set criteria has been met. The driving of the piles with driving extensions should be avoided if practicable, and shall be done only under written permission of the Engineer. When driving extensions are used, one pile from each group of 10 shall be a long pile driven without extensions, and shall be used as a test pile to determine the average bearing capacity of the group.

If the Contractor can demonstrate conclusively that special methods, other than providing a higher capacity hammer, are necessary to advance the pile to the required penetration, such supplementary methods will be subject to the Engineer's approval and will be paid for as a Extra Work in accordance with the General Conditions. For the special types of piling, driving heads, mandrels, or other devices in accordance with the Manufacturer's recommendations shall be provided so that the pile may be driven without damage and without unnecessary drilling.

Pile driver leads shall be used to support the piles while they are being driven and shall be braced to the supporting crane so as to hold the piles securely and accurately in the required position during driving. Leads shall be of sufficient length to be supported firmly on the ground. The use of hanging or swinging leads will not be allowed unless they can be held in a fixed position during the driving operations. Batter piles shall be driven with inclined leads.

The heads of steel pipe piles shall be squared and protected by a cap of a design approved by the Engineer. The cap shall be designed to hold the axis of the pile in line with the axis of the hammer. The top of the cap shall have a timber shock block.

The Contractor shall drive all piling in the sequence as shown on the Drawings or specified by the Engineer to minimize pile upheaval. If upheaval does occur, the Contractor shall re-drive the lifted piles to the specified elevations. The Contractor shall excavate material that has boiled up during pile driving operations. The elevation of all piles previously driven or redriven shall be confirmed to detect uplift. If uplift of 5 mm or more occurs in any pile, that pile shall be redriven to its original elevation and thereafter to the required final driving resistance. If cavities remain around the piles after driving, the cavities shall be filled with sand or other approved material to the satisfaction of the Engineer.

For pile installation monitoring purposes, the Contractor shall paint markings on each pile at 0.25 meter intervals, with a label at each 1.0 meter interval, starting from the toe of the pile.

The Contractor shall ensure the safety of all personnel during pile driving operations. In particular, overhead protection shall be provided for all personnel located adjacent to the pile driving lead and under the pile driving hammer. The overhead protection shall be designed and constructed so as to safely withstand forces from falling debris or other matter.

Pre-boring will not be allowed unless it is specified in the Special Provisions, on the Drawings or approved in writing by the Engineer.

Where refusal is required, final set shall be determined by three consecutive readings meeting the set criteria indicated on the Drawings or as directed by the Engineer. Final set will be measured and recorded in blows per 25mm by the Engineer.

5.4 Pile Cut-Offs

The piles shall be cut off level at the required elevations as specified on the Drawings or as directed by the Engineer.

5.5 Splicing Piles and Installing Pile Tips

The Contractor shall splice pipe piles in accordance with this Specification, the Drawings, welding procedures, and the following:

- .1 The butting ends of the driven pile and its extension shall be cut square to give reasonable bearing between the mating surfaces.
- .2 The butting surface of the extension shall be bevelled to facilitate a full penetration groove weld. Splice backer rings shall be installed inside the driven pile and shall be tack welded to the pile. The backer rings shall be placed symmetrically about the joint.
- .3 Before welding over previously deposited metal, the slag shall be removed. This requirement shall apply to successive layers, to successive beads, and to the cratered area when welding is resumed after any interruption.
- .4 Material to be welded shall be preheated in accordance with CSA W59.
- .5 The piles shall not have more than one splice per pile unless otherwise approved by the Engineer. The location of the splice(s) shall be approved by the Engineer.

5.6 Defective Piles

The pile driving procedures shall not subject the piles to excessive and undue abuse producing deformation of the steel. Manipulation of piles to force them into proper position will not be permitted. Piles damaged by improper driving, or driven out of proper location, or driven below the cut-off elevation, shall be corrected by one of the following methods accepted by the Engineer:

- .1 The piles shall be withdrawn and replaced by new, if necessary, longer piles, or
- .2 Replacement piles shall be driven adjacent to defective or low piles, or
- .3 The piles shall be spliced or built up, as otherwise provided herein, or a sufficient portion of the footing extended to properly embed the piles. All piles, pushed up by the driving of adjacent piles or by any other cause, shall be driven down again.

5.7 Concrete Infill

Mixing and placing concrete infill shall be done in accordance with the Specifications for Reinforced Cast-in-Place Concrete.

Concrete shall not have a free fall of more than 2.0 metres and shall be placed so that the aggregates do not separate or segregate.

Concrete shall be placed to the elevations as shown on the Drawings. Laitance on the top of the pile shall be removed before placing the pile cap. The concrete shall be vibrated throughout the entire length of the pile.

The shaft shall be free of water prior to placing of concrete. Concrete shall not be placed in or through water unless authorized by the Engineer.

In the event that tremie concrete is allowed by the Engineer, the concrete shall be placed as specified herein. The shaft of the pile shall be pumped clear of water so that the bottom can be inspected and cleaned, if required. Pumping shall then be stopped and water shall be allowed to come into the shaft until a state of equilibrium is reached. Concrete shall then be placed by means of a tremie pipe. The tremie pipe shall have a suitable gate in the bottom to prevent water from entering the pipe. The bottom of the pipe shall be maintained below the surface of the freshly placed concrete at all times during placement. The pipe shall be capable of being raised or lowered quickly in order to control the flow of concrete.

Heating of the concrete shall be done in accordance with the Specifications for Reinforced Cast-in-Place Concrete.

6.0 QUALITY MANAGEMENT

6.1 Quality Control

The Contractor shall provide a detailed survey of all of the pile locations and provide that to the Engineer prior to final acceptance of the piles and prior to cutting off any piles for a pile cap (foundation).

The Contractor shall replace any piles, or add additional pile(s), for piles that do not meet the specified refusal criteria or do not meet the following tolerances: +/-2% out of alignment for battered piles, +/-2% out of plumb for vertical piles, and 75 mm off centre of the specified locations. Any modifications required to the pile cap, due to piles out of tolerance or due to required additional piles to compensate for out of tolerance piles, shall be carried out as specified by the Engineer at the Contractor's own costs.

The Contractor shall be responsible for quality control testing of the concrete infill in accordance with the Specifications for Reinforced Cast-in-Place Concrete.

6.2 Quality Assurance

All welds will be inspected visually by the Engineer. The Contractor shall allow the Engineer unhindered access to the piling and shall assist the Engineer in carrying out any inspection, including suitable access.

The Engineer will undertake quality assurance testing in accordance with the Specifications for Reinforced Cast-in-Place Concrete.

6.3 Pile Driving Records

The Contractor and the Engineer will keep an independent record of each and every pile driven. The records shall give the date, time, diameter, length, location, type, total depth of penetration, rate of penetration, number of blows per 250 mm for every 1 meter in length, blows per 25mm for a minimum

of the last 75mm, steam, air or diesel pressure and the kind and size of hammer used in driving. Any unusual phenomena shall be noted and recorded, especially if they indicate possible damage to the pile.

Actual and rated energy output of driving equipment at the time of final set shall be carefully recorded by the Contractor, along with the final penetration readings, and reported immediately to the Engineer. The required set per blow will be subject to acceptance by the Engineer, showing regard for the actual and rated energies for the hammer at refusal.

7.0 METHOD OF MEASUREMENT

7.1 Steel Pipe Piles

Supplying steel pipe piles will be measured in lineal length of piling. The number of lineal metres to be paid for will be the total number of lineal metres of piling unloaded and stockpiled at the site as authorized by the Engineer.

Driving steel pipe piles will be measured in lineal length of piling. The length to be paid for will be the total number of lineal metres driven, less 50% of the total number of lineal metres of piling cut off after driving. Cut offs will be measured by the Engineer in the presence of the Contractor. Unless determined otherwise by the Engineer, cut offs shall become the property of the Contractor and shall be removed from the site.

7.2 Splicing Steel Bearing Piles

Splicing steel pipe piles will be measured on a unit basis and the number to be paid for will be the total number of splices performed by the Contractor and accepted by the Engineer.

7.3 Pre-Boring

Pre-Boring of piles will be considered incidental to supplying and driving steel pipe piles and no separate measurement will be made of this work.

7.4 Concrete Infill

Concrete infill for piles will be considered incidental to supplying and driving steel pipe piles and no separate measurement will be made of this work.

8.0 BASIS OF PAYMENT

8.1 Steel Pipe Piles

Supplying steel pipe piles will be paid for at the Contract Unit Price per metre for "Supplying Steel Pipe Piles", measured as specified herein, which price will be payment in full for performing all operations herein described and all other items incidental to the Work.

Driving steel pipe piles will be paid for at the Contract Unit Price per metre for "Driving Steel Pipe Piles", measured as specified herein, which price will be payment for performing all operations herein described and all other items incidental to the Work.

8.2 Splicing Steel Pipe Piles

Splicing of steel pipe piles will be paid for at the Contract Unit Price per pile tip for "Splicing Steel Pipe

Piles”, measured as specified herein, which price will be payment for performing all operations herein described and all other items incidental to the Work.