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## **1.0      GENREAL**

### **1.1      DEFINITIONS**

- .1    “Refusal” is attained when the resistance to pile penetration for the last 150 mm of driving is not less than [    blows/mm] with a final set of [    blows] for the last 25 mm using a hammer in accordance with clause 3.1.1.
- .2    “Minimum Ultimate Pile Capacity” is [    ] times the specified pile design load.

### **1.2      REFERENCES**

- .1    Provide steel H–piling in accordance with the following standards (latest revision) except where specified otherwise.
- .2    American Society for Testing and Materials (ASTM)
  - .1    ASTM A27/A27M            Standard Specification for Steel Castings, Carbon, for General Application.
  - .2    ASTM A123                 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - .3    ASTM A148                 Standard Specification for Steel Castings, High Strength, for Structural Purposes.
  - .4    ASTM A780                 Standard Practice for Repair of Damaged Hot-Dip Galvanized Coatings.
  - .5    ASTM D1143                Standard Test Method for Piles Under Static Axial Compressive Load.
- .3    Canadian Standards Association (CSA)
  - .1    CSA-G40.21                Structural Quality Steel.
  - .2    CSA-W59M                 Welded Steel Construction (Metal Arc Welding) (Metric Version).

### **1.3      SUBMITTALS**

- .1    Provide the following submittals.
- .2    A detailed description of the pile driving equipment at least 30 days prior to mobilizing piling equipment to the Site. Include the type and make of the hammer; hammer mass; hammer energy and efficiency factor; details, mass, and dimensions of the driving cap; and the type of leads.
- .3    Mill test certificates for the piles, and for the pile tips and shoes at least 30 days prior to delivering the materials to the Site.

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- .4 Product Data and mill test certificates for the pile tips and shoes at least 30 days prior to delivering the materials to the Site.
- .5 The pile installation record within 48 hours after driving of the pile is completed.
- .6 A detailed plan for the pile load tests at least 10 days prior to conducting any test. Include the following: details of the equipment and apparatus to be used such as the load platform, hydraulic jacks, pumps, pressure gauges, reaction beams, surveyor's level, target rod, and dial gauges; details of reaction piles; and certification of the calibration of the jack and pressure gauge combination.
- .7 Results of the pile load test within 24 hours after the test has been completed.
- .8 A record plan at the completion of the pile driving operation showing the actual locations and elevations of all of the piles.

#### **1.4 QUALITY CONTROL**

- .1 Provide a qualified supervisor to oversee the pile driving [and load testing] operations.
- .2 Pile Installation Records: During pile driving operations, prepare the following installation records for each pile:
  - .1 Project and Contract names, and name and signature of the Contractor's personnel responsible for quality control including preparing records.
  - .2 Date of driving and site conditions.
  - .3 Specified pile identification, location, orientation, and cutoff elevations.
  - .4 Size and initial length of the pile.
  - .5 Penetration and number of blows.
  - .6 Elevation, time, and duration of any interruption in driving or any erratic or unusual pile behaviour.
  - .7 Other pertinent information, including any required by the Minister.
- .3 Static Load Test:
  - .1 Notify the Minister at least 48 hours prior to installing test piles and starting load testing.
  - .2 Install test piles and complete pile load tests as specified, in the presence of the Minister, and prior to proceeding with any other pile installation.
  - .3 Install test piles using the same pile materials and driving equipment that will be used for the other piles.
  - .4 Provide and install brackets and reference beams for checking the test pile driving operation.
  - .5 Perform the pile load tests using the [Standard Loading Procedure] in accordance with ASTM D1143.

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- .6 Do not incorporate reaction [or test piles] in the Permanent Work. [Test piles may be incorporated in the Work subject to the results of the load test, its condition, and the authorization of the Minister.]
- .7 Instrument the test pile using telltale rods in accordance with ASTM D1143 to permit measurement of the tip and top of the pile.
- .8 Align the jacks with the pile and properly place the deformation measuring devices and reference beams. Support the reference beams beyond the influence of the pile and loading mechanism. The reference beams are to be of metal sections and be rigid in their reaction against the dial gauges.
- .9 Load the test pile in accordance with ASTM D1143 [with the exception of an additional rebound cycle test from [ ] kN to 0 to [ ] kN during the loading stage of the test.]. [Upon completion of the Standard Loading Procedure, reload until the pile failure or until a maximum load of [ ] kN has been obtained, whichever occurs first].
- .10 Interpret the results of the pile load test in accordance with the following:
  - .1 [ ]

## 1.5 QUALITY ASSURANCES

- .1 The Minister will inspect the pile driving operation including splicing, welding, shoe installation, hammer and cap performance, pile alignment, penetration resistance, Refusal, heaving, and re-tapping.
- .2 On selected piles, the Minister will obtain elastic compression and set graphs.
- .3 The Minister will interpret the ultimate pile capacity in accordance with the following:
  - .1 [ ].
  - .2 It is anticipated that the ultimate pile capacity will be achieved by driving the pile to Refusal.

## 1.6 DELIVERY STORAGE, AND HANDLING

- .1 Inspect each shipment of material and timely replace any damaged materials.
- .2 Unload, handle, and store piles according to the manufacturer's recommendations to prevent damage to the [galvanizing and the] pile.

## 2.0 PRODUCTS

### 2.1 MATERIALS

- .1 Provide materials in accordance with the following.
- .2 The pile design load is [ ].

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- .3 Piles: Rolled structural steel H-Sections in accordance with CSA-G40.21, Grade 300W. Provide H-Sections as specified in the Contract Documents.
- .4 Pile Tips and Shoes: Cast steel in accordance with [ASTM A148, Grade [60-90]] [ASTM A27 [Grade 35-65]].
- .5 Galvanizing: In accordance with ASTM A123. Provide a minimum zinc coating of 610 g/m<sup>2</sup>.

## **2.2 FABRICATION**

- .1 Provide piles that are straight and true with adjoining surfaces square to the pile axes.
- .2 Perform welding in accordance with CSA-W59M.
- .3 Only 1 splice per pile is allowed unless otherwise authorized by the Minister. For splices, use full penetration butt welds over the whole cross section of the pile.
- .4 Weld pile tips or shoes in accordance with the manufacturer's written instructions.

## **3.0 EXECUTION**

### **3.1 PILE DRIVING EQUIPMENT**

- .1 Provide a hammer having a ram weight of not less than [                      kg] and delivering not less than [        J] of energy per blow.
- .2 For single, double, or differential acting hammers, power by compressors or boilers of sufficient size so that the pressure at the hammer meets the manufacturer's requirements, and the speed of the hammer is as specified by the manufacturer for the specified energy level.
- .3 For diesel operated or other types of pile hammers, provide accurate means, acceptable to the Minister, for measuring the energy per blow delivered to the pile.
- .4 Provide leads that are firmly supported, extending down to the lowest reach of the hammer and that allow free movement of the hammer.

### **3.2 INSTALLATION**

- .1 Drive the piles at the locations, and to the orientation [and tip elevations] specified in the Contract Documents.
- .2 Continuously drive the pile, without any pauses, until Refusal or the specified minimum tip elevation [and Minimum Ultimate Pile Capacity] has been attained.
- .3 Do not drive the top of the piles below the ground surface.
- .4 Prevent the piles from becoming twisted, bent, or otherwise damaged during the pile handling and driving operation and, if applicable, during any adjacent excavation.

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- .5 Where pile driving is interrupted for any length of time prior to Refusal or to attaining the specified minimum tip elevation [and Minimum Ultimate Pile Capacity], an additional minimum length of [300] mm of penetration will be required when driving resumes before the specified criteria are applied.
- .6 Record the elevation of the top of each pile and after all adjacent piles are driven to Refusal or the specified minimum tip elevation [and Minimum Ultimate Pile Capacity].
- .7 Re-tap any piles that have heaved more than [3 mm] until Refusal or the specified minimum tip elevation [and Minimum Ultimate Pile Capacity] is re-established. Do not re-tap any pile earlier than 24 hours after the initial driving without authorization of the Minister.

### **3.3 INSTALLATION TOLERANCES**

- .1 Location: Maximum deviation of [+/-75] mm at the cutoff level from the specified location.
- .2 Elevation: Maximum deviation of [+/-25] mm at the specified cutoff or driving elevation.
- .3 Orientation: Maximum deviation of [1%] of the pile length from plumb or the specified batter.

### **3.4 REPAIR OF DAMAGED OR IMPROPERLY INSTALLED PILES**

- .1 Repair, extract and re-drive, or provide replacement piles as directed by the Minister, to correct piles that are damaged or have been driven out of alignment.
- .2 Repair damaged galvanized surfaces by metallizing in accordance with ASTM A780, Method A3. Provide a minimum thickness of 180 microns.

**END OF SECTION**