

PART 1 - GENERAL

- 1.1 RELATED SECTIONS .1 Section 01 33 00 - Submittal Procedures
- 1.2 REFERENCES .1 Boring Record: See design drawings for a copy of the boring records.
- 1.3 SUBMITTALS .1 Provide submittals in accordance with Section 01 33 00.
- .2 Sub-surface investigation reports: when site conditions differ from those indicated, submit written notification to a Departmental Representative and await further instructions.
- .3 Submit schedule of planned sequence of driving to a Departmental Representative for review, as specified.
- .4 Equipment:  
.1 Submit prior to pile installation for review by a Departmental Representative, list and details of equipment for use in installation of piles.  
.2 Impact hammers: submit manufacturer's written data as specified.
- .5 Quality assurance submittals:  
.1 Test reports: submit 3 copies of certified test reports for piles from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.  
.2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- 1.4 DELIVERY, .1 Deliver, store and handle materials in

STORAGE AND  
HANDLING

accordance with manufacturer's  
instructions.

- .2 Protect piles from damage due to excessive bending stresses, impact, abrasion or other causes during delivery, storage and handling.
- .3 Replace damaged piles as directed by a Departmental Representative.

1.5 WASTE  
MANAGEMENT AND  
DISPOSAL

- .1 Separate waste materials for disposal in accordance with Section 01 74 21.

1.6 EXISTING  
CONDITIONS

- .1 Notify a Departmental Representative in writing if subsurface conditions at site differ from those indicated and await further instructions from a Departmental Representative.

1.7 SCHEDULING

- .1 Provide schedule of planned sequence of driving to a Departmental Representative for review, not less than two weeks prior to commencement of pile driving.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Material requirements for all new piles are specified in Section 31 62 18.
- .2 Supply or fabricate full length piles as indicated and provide equipment to handle full length piles without cutting and minimal splices.
- .3 Splice piles only with written approval of a Departmental Representative.
  - .1 When permitted, provide details for a Departmental Representative's review.
  - .2 Design details of splice to bear

dated signature stamp of Professional Engineer registered or licensed in Province of New Brunswick, Canada.

.3 All splices to be designed to provide full capacity of the pile.

## 2.2 EQUIPMENT

- .1 Impact hammers: provide manufacturer's name, type, rated energy per blow at normal working rate, mass of striking parts of hammer, mass of driving cap and type and elastic properties of hammer and pile cushions.
- .2 Non-impact methods of installation are not permitted.

## PART 3 - EXECUTION

### 3.1 EQUIPMENT

- .1 Prior to pile installation; submit to Departmental Representative for review, details of equipment for installation of piles.
  - .1 Impact hammers: provide manufacturer's name, type, rated energy per blow at normal working rate, mass of striking parts of hammer, mass of driving cap and type and elastic properties of hammer and pile cushions.
  - .2 Hammer:
    - .1 When required criteria cannot be achieved with the proposed hammer, use larger hammer and take other measures as required.
  - .3 Leads:
    - .1 Construct pile driver leads to provide free movement of hammer. Hold leads in position at top and bottom, with guys, stiff braces, or other means to ensure support to pile while being driven.
    - .2 Length: except for piles driven through water, provide sufficient length of leads to ensure that use of follower is unnecessary.

- .3 Swing leads:
  - .1 Obtain approval from Departmental Representative prior to using swing leads. Firmly guy top and bottom to hold pile in position during driving operation.

### 3.2 PREPARATION

- .1 Ensure that support conditions at pile locations are adequate to support pile driving operation. Make provision for access and support of piling equipment during performance of Work.

### 3.3 FIELD MEASUREMENT

- .1 Maintain accurate records of driving for each pile, including:
  - .1 Type and make of hammer, stroke or related energy.
  - .2 Other driving equipment including water jet, driving cap, cushion.
  - .3 Pile size and length, location of pile in pile group, location or designation of pile group.
  - .4 Sequence of driving piles in group.
  - .5 Number of blows per metre for entire length of pile and number of blows per 250 mm for last 1,000 mm.
  - .6 Final tip and cut off elevations.
  - .7 Other pertinent information such as interruption of continuous driving, pile damage.
  - .8 Record elevation taken on adjacent piles during before and after driving of each pile.
- .2 Provide Departmental Representative with three copies of records.

### 3.4 DRIVING

- .1 Use driving caps and cushions to protect piles. Reinforce pile heads as required by Departmental Representative. Piles with damaged heads as determined by Departmental Representative will be rejected.
- .2 Hold piles securely and accurately in position while driving.
- .3 Deliver hammer blows along axis of pile.
- .4 Cut off piles neatly and squarely at

elevations as indicated.

3.5 DESIGN TIP  
ELEVATION

- .1 A 914.4. mm OD pipe pile is to be driven to a toe elevation of -20.0 meters.
- .2 A 609.6 mm OD pipe piles is to be driven to an approximate elevation of -33.5 meters or until bedrock is encountered. If the tip reaches elevation -33.5 meters, dynamic testing must be completed to confirm the axial capacity of the pile. Additional driving beyond the approximate toe elevation may be required to get sufficient axial capacity. See specification section 31 62 18 for testing criteria.
- .3 Secure piles in position with falsework as required facilitating concrete installation.
- .4 Installation of each pile will be subject to approval of Departmental Representative.
  - .1 Departmental Representative will be sole judge of acceptability of each pile with respect to final driving resistance, depth of penetration or other criteria used to determine load capacity.
  - .2 Departmental Representative to approve and cut off final driving of all piles prior to removal of pile driving rig from site.

3.6 OBSTRUCTIONS

- .1 Where obstruction is encountered that causes sudden unexpected change in penetration resistance or deviation from specified tolerances, proceed as directed by Departmental Representative.

3.7 REPAIR/RESTORATION

- .1 No extra compensation will be made for removing and replacing or other work made necessary through rejection of defective piles.

3.8 PROTECTION

- .1 Arrange sequencing of pile driving operations and methods to avoid damages to coating system on piles.
- .2 Existing structures. When damages occur, remedy damaged items to restore to original or better condition at own expense.
- .3 Install an open cutting shoe to pile tip of all 914.4 mm OD piles prior to installation.
- .4 Install a closed shoe design for installation into sloping rock on all 609.6 mm OD pipe piles prior to installation.

PART 1 - GENERAL

1.1 Related Sections

- .1 Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
- .2 Section 31 61 13 - Pile Foundations, General Requirements.

1.2 Measurement Procedures

- .1 See Section 01 29 00-Payment Procedures for payment details.
- .2 Extra piling to replace damaged piles will be considered incidental to the work and will not be measured for payment.
- .3 Pile points/shoes are not measured for payment and considered incidental to supply of piles.
- .4 Splicing of piles will be considered incidental to the work.
- .5 Dynamic testing to confirm capacity of the 609.6 mm OD pile is considered incidental to the work.

1.3 References

- .1 All standards used shall be of latest edition.
- .2 Canadian General Standards Board (CGSB)
- .3 CAN/CGSB 1.171M, Inorganic Zinc Coating.
- .4 Canadian Standards Association (CSA)
  - .1 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.
  - .2 CSA W47.1S1, Supplement No.1 M1989 to W47.1 1983, Certification of Companies for Fusion Welding of Steel Structures.
  - .3 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.
  - .4 CSA W59, Welded Steel Construction (Metal Arc Welding) (Metric Version).
- .5 The Society for Protective Coatings
  - .1 SSPC SP [Revised 2000], Surface Preparation Specification.

PART 2 - PRODUCTS

2.1 Materials

- .1 All new round steel pipe and pipe piling shall conform to ASTM A139 Grade D, with a minimum yield stress of 315 MPa. Size and weight as indicated.
- .2 Spirally welded pipe must meet dimensional tolerances of API 5L.
- .2 Welding materials: to CSA W48.
- .3 Steel plates: to CSA G40.20/G40.21, Type and grade 350 W.
- .4 Mandatory pile tip protection:
  - .1 914.4 mm OD Piles-Open cutting pile shoe.
  - .2 609.6 mm OD Piles-Closed end shoe design for installation into sloping rock.
- .5 All HSS members to meet ASTM A500-Grade C.

PART 3 - EXECUTION

3.1 Installation

- .1 Install piling in accordance with Section 31 61 13 - Pile Foundations, General Requirements.
- .2 The steel pipe piles are to be driven vertically and plumb.
- .3 All piles are to be installed to meet the acceptance criteria outlined below in section 3.5. Where this cannot be achieved use larger hammer or other methods.
- .4 Cut off piles squarely at required elevation.

3.2 Driving Criteria

- .1 Pile Driving Criteria: Piles shall be driven using a hammer with a sufficient rated energy to achieve the acceptance criteria unless otherwise noted.

3.3 Tolerances

- .1 Breasting dolphin pipe piles shall be driven such that the existing face of the pipe pile and pile connections has a minimum clearance to the face of the existing fender panel of 100 mm. When this is not achieved, the existing fender panel must be built out with full width and height UHMW-PE panels to meet this minimum clearance.
- .2 At the mud line, all breasting dolphin pipe piles are to be within + / - 30 mm of the location indicated on the Drawings. At the

top of the pile, a tolerance up to 25 mm (perpendicular to the centerline of transfer bridge) in the direction toward the existing concrete dolphin is acceptable. At the top of the pile, there is zero tolerance (perpendicular to the centerline of transfer bridge) away from the existing concrete dolphin (i.e. toward the vessel)

- .3 At the mud line, all pipe piles (excluding the breasting dolphin piles) are to be within + / - 30 mm of the location indicated on the Drawings. At the top of the pile, all piles (excluding the breasting dolphin piles) are to be within a tolerance of + / - 25 mm of the location indicated on the Drawings.
- .4 Deviations from the vertical in any direction shall not exceed 1 horizontal in 150 vertical.

### 3.4 Welding

- .1 Weld to CSA W59 and CSA W59S1.
- .2 Welding certification of companies: to CSA W47.1 and CSA W47.1S1.

### 3.5 Acceptance Criteria

- .1 For all 914.4 mm OD pipe piles, each pile is to be driven to a pile tip elevation of - 20.0 meters.
- .2 For a 609.6 mm OD pipe pile, the pile must have a minimum factored axial resistance of 1100 kN at ULS.
  - .1 If bedrock is encountered, refusal criteria is 15 blows/25 mm for 100 mm consecutively. The hammer must have a rated energy of 375 J/cm<sup>2</sup> of steel cross sectional area.
  - .2 If bedrock is not encountered, the pile shall be driven to a tip elevation of -33.5 meters. After the pile reaches this elevation, dynamic testing in accordance with ASTM 4945, standard test method for high strain dynamic testing of deep foundations must be completed to confirm the axial capacity of the installed pile. If the pile

does not meet the required axial capacity, additional driving must be completed until sufficient axial capacity is developed.

- .3 Secure piles in position with falsework as required facilitating concrete installation.
- .4 Installation of each pile will be subject to approval of Departmental Representative.
  - .1 Departmental Representative will be sole judge of acceptability of each pile with respect to final driving resistance, depth of penetration or the results of the dynamic testing to determine the load capacity.
  - .2 Departmental Representative to approve and cut off final driving of all piles prior to removal of pile driving rig from site.