

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 31 61 13 - Pile Foundations.

### **1.2 MEASUREMENT PROCEDURES**

- .1 No measurement will be made under this section. Include costs in items of work that require templates.

### **1.3 REFERENCES**

- .1 ASTM A 252-90, Specification for Welded and Seamless Steel Pipe Piles.
- .2 ASTM A 307-92a, Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
- .3 CAN/CSA-G40.20-M92, General Requirements for Rolled or Welded Structural Quality Steel.
- .4 CAN/CSA-G40.21-M92, Structural Quality Steels (metric version).
- .5 CAN/CSA-S16.1-M89, Limit States Design of Steel Structures.
- .6 CSA W47.1-92, Certification of Companies for Fusion Welding of Steel Structures.
- .7 CSA W47.1S1-M1989, Supplement No. 1-M1989 to W47.1-1983, Certification of Companies for Fusion Welding of Steel Structures.
- .8 CSA W48.1-M1991, Carbon Steel Covered Electrodes for Shielded Metal Arc Welding.
- .9 CSA W59-M1989, Welded Steel Construction (Metal Arc Welding) (metric version).
- .10 CSA W59S1-M1989, Supplement No. 1-M1989, Steel Fixed Offshore Structures, to W59-M1989, Welded Steel Construction (Metal Arc Welding).

### **1.4 DESIGN REQUIREMENTS**

- .1 Design templates to safely withstand following loads:
  - .1 All gravity loads to which template shall be subjected.
  - .2 Lateral loads to firmly hold pile in position when driving.

### **1.5 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Shop Drawings, Product Data, Samples and Mock-ups.
- .2 Indicate following items:
  - .1 Material.

- .2 Anchorage, field control and alignment methods.
- .3 Design parameters.
- .4 Tolerance for driving pile.
- .5 Removable members.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Steel sections and plates: to CAN/CSA-G40.20 and CAN/CSA-G40.21, Type 300 W.
- .2 Welding materials: to CSA W59.
- .3 Bolts, nuts and washers: to ASTM A 307.

### **2.2 FABRICATION**

- .1 Fabricate structural steel for templates in accordance with CAN/CSA-S16.1 and reviewed shop drawings.
- .2 Welding in accordance with CSA W59.
- .3 Use welding companies qualified under CSA W47.1.

## **PART 3 - EXECUTION**

### **3.1 POSITIONING**

- .1 Position and hold template in location to receive piles. Ensure pile positions are within tolerances specified.
- .2 Before driving batter piles set templates to within 10 mm of elevations indicated on shop drawings.
- .3 Secure templates to vertical piles in accordance with shop drawings before batter piles are placed.

### **3.2 REMOVAL OF TEMPLATES**

- .1 Avoid any damage to piling when removing templates.
- .2 When instructed by Departmental Representative, remove templates from project site.

## **PART 1 - GENERAL**

### **1.1 Related Sections**

- .1 Section 03 37 26 - Underwater Placed Concrete.
- .2 Section 31 62 16.19 - Steel Pipe Piles.

### **1.2 MEASUREMENT PROCEDURES**

- .1 Work under this Section will not be measured, but is to be included in the unit prices.

### **1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Protect piles from damage due to excessive bending stresses, impact, abrasion or other causes during delivery, storage and handling.
- .2 Replace damaged piles to satisfaction of Departmental Representative.

### **1.4 EXISTING CONDITIONS**

- .1 Sub-surface investigation reports are available for viewing at the Departmental Representative's Office, Prince William Street, Saint John, N.B.
- .2 Notify Departmental Representative immediately in writing if subsurface conditions at site differ from those indicated.

### **1.5 SCHEDULING**

- .1 Submit schedule of planned sequence of driving to Departmental Representative for review, not less than 2 weeks prior to commencement of pile driving.

### **1.6 SUBMISSIONS**

- .1 Methodology:
  - .1 Provide methodology including type of pile driving equipment to carry out the work.
- .2 Provide submissions in accordance with Section 01 33 00.

## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Material requirements for piles are specified in Sections 31 62 26.19 - Steel Pipe Piles and Sections.
- .2 Supply or fabricate full length piles as required and provide equipment to handle

full length piles without cutting and splicing.

- .3 Piles that require splices: Provide details for Departmental Representative review. Design details of splice to bear dated signature stamp of professional engineer registered or licensed in province of New Brunswick, Canada.
- .4 Welding materials: to CSA W48.1.
- .5 Pile shoes to be ring type with same internal diameter as pipe piles. Provide details for Departmental Representative's approval.
- .6 Pile shoes for timber piles to be fabricated from steel plate minimum 6mm thickness.

## **PART 3 - EXECUTION**

### **STEEL PILES**

#### **3.1 EQUIPMENT**

- .1 Prior to commencement of pile installation, submit to Departmental Representative, details of equipment for installation of piles.
  - .1 Impact hammers: give 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 such as augering, jacking, vibratory hammers or other means: give full details of characteristics necessary to evaluate performance.
- .2 Hammer: Supply a hammer of suitable size to advance the piles to achieve necessary end resistance. The hammer selected will be of sufficient energy so as not to damage the piles. Hammer(s) to be a variable energy type capable of delivering between 40 and 100 kJ of energy per blow on a sustained basis. All steel pipe piles to be driven to bedrock or as approved by Departmental Representative.
- .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 reviewed by Departmental Representative, to ensure support to pile while being driven. Inclined leads to be used for battered piles.
  - .2 Length: except for piles driven through water, provide length of leads so that use of a follower is unnecessary.
  - .3 Swing leads:
    - .1 Firmly guy top and bottom to hold pile in position during driving operation. Method to be reviewed by Departmental Representative.
- .4 Followers:
  - .1 When permitted, provide followers of such size, shape, length and mass to permit driving pile in desired location to required depth and resistance. Provide followers with socket or hood carefully fitted to top of pile to minimize loss of energy and prevent damage to pile.
  - .2 Drive applicable load test piles using similar follower.
- .5 Other Equipment:
  - .1 Any other equipment necessary to advance the piles.

### 3.2 PREPARATION

- .1 Ensure that conditions and equipment at pile locations are adequate to support pile driving operation and load testing 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 meter for entire length of pile and set for last blows number of blows per 25 mm for last 300 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 before, during and after driving of each pile.
- .2 All measurements, observations and calculations associated with pile driving analyzer and wave equation analysis.
- .3 Provide Departmental Representative with three copies of records.

### 3.4 DRIVING

- .1 Use driving caps and cushions to protect piles. Reinforce pile heads if necessary. 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 Ensure pile is not overstressed.
- .5 Piles that are to be socketed are to be driven into bedrock surface with only sufficient drive energy to obtain an adequate seal to allow cleanout and installation of sockets. Take special precaution to ensure no damage occurs to pile that would impair cleanout and socket installation.
- .6 Ensure no contact between pile and structure takes place when driving batter piles adjacent to existing structures.
- .7 Restrike already driven piles lifted during driving of adjacent piles to assure set.
- .8 Remove loose and displaced material from around piles after completion of driving, and leave clean, solid surfaces to receive foundation concrete.

- .9 Use of water jet:
  - .1 If permitted, provide details for Departmental Representative's review approval.
  - .2 Restriction: if, during operation, conditions are found to be unacceptable, as determined by Departmental Representative, stop using water jet.
- .10 Cut off piles neatly and squarely at elevations as indicated. Provide sufficient length above cut-off elevation so that part damaged during driving is cut off. Do not cut tendons or other reinforcement which will be used to tie pile caps to pile.
- .11 Remove cut-off lengths from site on completion of work.

### **3.5 DRIVING TOLERANCES**

- .1 Pile heads to be within 75 mm of locations as indicated.

### **3.6 OBSTRUCTIONS**

- .1 Piles to be driven to bedrock. Piles driven to boulders not acceptable. Bedrock elevations to be determined from borehole data.

### **3.7 REPAIR/RESTORATION**

- .1 Pull out rejected piles and replace with new piles.
- .2 No extra compensation will be made for removing and replacing or other work made necessary through rejection of defective piles.

### **3.8 PROTECTION**

- .1 Protect adjacent structures, services and work of other sections from hazards due to pile driving operations.
- .2 Arrange sequencing of pile driving operations and methods such that no damage occurs to adjacent existing structures. If damaged, remedy damaged items to restore to original or better condition at own expense.

## **PART 1 - GENERAL**

### **1.1 RELATED SECTIONS**

- .1 35 51 24 - Float Installation.
- .2 03 05 10 - Concrete General
- .3 03 37 26 - Underwater Placed Concrete

### **1.2 MEASUREMENT FOR PAYMENT**

- .1 Supply, Preparation, and driving of steel pipe piles acceptably incorporated into work will be paid by the unit. Including in this work will be the pile splices and supply and installation of pile shoes and Guide Piles.
  - .1 Included in this bid item will be the Underwater placed Concrete specified under section 03 27 26.
- .2 Actual number and lengths of piles installed: established by Departmental Representative from piling records.
- .3 Supply and Installation of Cathodic Protection will be included in the lump sum bid price under this contract. Cathodic Protection shall be installed at the locations shown on the plans, or as directed by the Departmental Representative.

### **1.3 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A 106/A 106M-04b, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
  - .2 ASTM A 252-98(2002), Standard Specification for Welded and Seamless Steel Pipe Piles.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.171-98, Inorganic Zinc Coating.
- .3 Canadian Standards Association (CSA International)
  - .1 CSA-G40.20/G40.21-2004, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .2 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel Structures.
  - .3 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding.
  - .4 CSA W59-03, Welded Steel Construction Metal Arc Welding, metric version.
  - .5 CSA-Z245.1-02, Steel Pipe.

#### 1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheet.
- .3 Submit shop drawings and indicate: pile shoes, pile cap, tip reinforcement.
- .4 Quality Assurance: test reports:
  - .1 Prior to fabrication, and, if requested, provide Departmental Representative with two copies of steel producer's certificates in accordance with ASTM A 252.
  - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Deliver new, undamaged materials to site, accompanied by certified test reports, with manufacturer's logo and mill identification mark provided on pipe piling.
- .4 Storage and Protection:
  - .1 Store and handle pipe piling in accordance with manufacturer's written instructions to prevent permanent deflection, distortion or damage to interlocks.
  - .2 Support pipe piling on level blocks or racks spaced not more than 3m apart and not more than 0.60m from ends.
- .5 Waste Management and Disposal:
  - .1 Separate waste materials for in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
  - .3 Divert unused concrete materials from landfill to local facility as approved by Departmental Representative.



## **PART 2 - PRODUCTS**

### **2.1 MATERIALS**

- .1 Steel pipe: seamless, of sizes and wall thicknesses indicated, bevelled cut ends to API SPEC 5L, grade 3.
- .2 Pipe material have following minimum properties:
  - .1 Yield strength: 310MPa.
  - .2 Tensile strength: 450MPa.
  - .3 Elongation at rupture: 20%in 50mm.
  - .4 Weldable steel: to ASTM A 106/ASTM A106M carbon equivalent less than 0.55%.
- .3 Pipe chemical composition: to ASTM A 252.
- .4 Pipe allowable tolerances:
  - .1 Deviation from straight line, specified diameter, wall thickness and Out-of-roundness on body of pipe and at pipe ends to conform to API SPEC 5L.
  - .2 Pipe to be checked for deviations before leaving mill.
  - .3 Pile length: plus or minus 18m.
- .5 Pile tip reinforcement: to CSA-G40.20/G40.21, Grade 300W.
- .6 Pile driving shoes: to CSA-G40.20/G40.21, Grade 300W.
- .7 Steel pile caps: to CSA-G40.20/G40.21, Grade 300W.
- .8 Welding electrodes: to CSA W48 series.
- .9 Concrete: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .10 Anodes: Sacrificial Anodes to be Renode II Anode No. Rm 37 FM as manufactured by Reynolds Metal Co.

## **PART 3 - EXECUTION**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

### **3.2 FABRICATION**

- .1 Pipe pile splicing will be required.
- .2 Allowable tolerance on axial alignment to be 0.25% as measured by 3m straight edge.

- .3 Allowable deviation from straight line over total length of fabricated pile to be 50mm.
- .4 Remove piles which are not within required tolerances and replace at no additional cost to the contract.
- .5 Install pile tip reinforcement, driving shoes as indicated.
- .6 Repair defective welds as approved by Departmental Representative.
  - .1 Repairs: to CSA W59.
  - .2 Unauthorized weld repairs may be rejected.
- .7 Repair damaged exterior protective coating of piles.
- .8 The Contractor shall be responsible to remove all Foreign materials and water from within the entire length of the pile, at no cost to the Contract.

### 3.3 INSTALLATION

- .1 Install piling in accordance with Section 31 61 13 - Pile Foundations, General Requirements.
- .2 If approved by Departmental Representative, splice piles in place during installation by welding.
  - .1 To prevent distortion, tack opposite points first and then weld opposite sections.
  - .2 Make splice by complete joint penetration groove welds as indicated on shop drawings.
- .3 Perform internal visual inspection of steel pipe, joints and base prior to placing of concrete.
  - .1 Ensure pipe inside is free from foreign matter.
- .4 Install concrete in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .5 Fill steel pipe pile with concrete using methods to limit free fall and to prevent segregation. Ensure adequate vibration to completely fill cross section of pipe.
  - .1 Ensure adequate vibration to completely fill cross section of pipe.
- .6 Set dowels in concrete in accordance with details as indicated.
  - .1 Secure until concrete is set.
- .7 Install pile caps as indicated.
- .8 Install driving shoes during as part of field work.

### 3.4 WELDING

- .1 Weld to CSA W59.

- .2 Welding certification of companies: to CSA W47.1.
- .3 Welding certification of companies welding steel reinforcing bars placed in reinforced concrete: in accordance with CSA W186.