

## 1 GENERAL

### 1.01 RELATED REQUIREMENTS

- .1 Section 35 31 23.13 - Rubble Mound Breakwater.

### 1.02 REFERENCES

- .1 ASTM International
  - .1 ASTM D 4791-10, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.
- .2 U.S. Environmental Protection Agency (EPA)/Office of Water
  - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

### 1.03 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples:
  - .1 Allow continual sampling by Departmental Representative during production.
  - .3 Provide Departmental Representative with access to source and processed material for sampling.
  - .4 Install sampling facilities at discharge end of production conveyor, to allow Departmental Representative to obtain representative samples of items being produced. Stop conveyor belt when requested by Departmental Representative to permit full cross section sampling.
  - .5 Provide front end loader or other suitable equipment including trained operator for stockpile sampling as necessary. Move samples to storage place as directed by Departmental Representative.
  - .6 Supply new or clean sample bags or containers according appropriate to aggregate materials.
  - .7 Pay cost of sampling and testing of aggregates which fail to meet specified requirements.
- .4 Sustainable Design Submittals:
  - .1 Erosion and Sedimentation Control: submit copy of erosion and sedimentation control plan in accordance with authorities having jurisdiction.

### 1.04 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Transportation and Handling: handle and transport aggregates to avoid segregation, contamination and degradation.
- .3 Storage: store washed materials or materials excavated from underwater 24 hours

minimum to allow free water to drain and for materials to attain uniform water content.

## 2 PRODUCTS

### 2.01 MATERIALS

- .1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, free from adherent coatings and injurious amounts of disintegrated pieces or other deleterious substances.
- .2 Flat and elongated particles of coarse aggregate: to ASTM D 4791.
  - .1 Greatest dimension to exceed 5 times least dimension.
- .3 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
  - .1 Screenings produced in crushing of quarried rock, boulders, gravel or slag.
  - .2 Reclaimed asphalt pavement.
  - .3 Reclaimed concrete material.
- .4 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
  - .1 Crushed rock.
  - .2 Gravel and crushed gravel composed of naturally formed particles of stone.
  - .3 Light weight aggregate, including slag and expanded shale.

### 2.02 SOURCE QUALITY CONTROL

- .1 Inform Departmental Representative of proposed source of aggregates and provide access for sampling 4 weeks minimum before starting production.
- .2 If materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate alternative source.
- .3 Advise Departmental Representative 4 weeks minimum in advance of proposed change of material source.
- .4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

## 3 EXECUTION

### 3.01 EXAMINATION

- .1 Verification of Conditions: verify that conditions are acceptable for topsoil stripping.
  - .1 Visually inspect substrate in presence of Departmental Representative.

- .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

### 3.02 PREPARATION

- .1 Aggregate source preparation:
  - .1 Prior to excavating materials for aggregate production, clear and grub area to be worked, and strip unsuitable surface materials. Dispose of cleared, grubbed and unsuitable materials as approved by authority having jurisdiction.
  - .2 Where clearing is required, leave screen of trees between cleared area and roadways as directed.
  - .3 Clear, grub and strip area ahead of quarrying or excavating operation sufficient to prevent contamination of aggregate by deleterious materials.
  - .4 When excavation is completed dress sides of excavation to nominal 1.5:1 slope, and provide drains or ditches as required to prevent surface standing water.
  - .5 Trim off and dress slopes of waste material piles and leave site in neat condition.
  - .6 Provide silt fence or other means to prevent contamination of existing watercourse or natural wetland features.
- .3 Processing:
  - .1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.
  - .2 Blend aggregates, as required, including reclaimed materials that meet physical requirements of specification is permitted in order to satisfy gradation requirements for material and, percentage of crushed particles, or particle shapes specified.
    - .1 Use methods and equipment approved in writing by Departmental Representative.
- .4 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate gradation.
- .5 Where necessary, screen, crush, wash, classify and process aggregates with suitable equipment to meet requirements.
  - .1 Use only equipment approved in writing by Departmental Representative.
- .6 Stockpiling:
  - .1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Departmental Representative. Do not stockpile on completed pavement surfaces.
  - .2 Stockpile aggregates in sufficient quantities to meet project schedules.
  - .3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.
  - .4 Except where stockpiled on acceptably stabilized areas, provide compacted sand base not less than 300 mm in depth to prevent contamination of aggregate. Stockpile aggregates on ground but do not incorporate bottom 300 mm of pile into Work.

- .5 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.
- .6 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Departmental Representative within 48 hours of rejection.
- .7 Stockpile materials in uniform layers of thickness as follows:
  - .1 Maximum 1.5 m for coarse aggregate and base course materials.
  - .2 Maximum 1.5 m for fine aggregate and sub-base materials.
  - .3 Maximum 1.5 m for other materials.
- .8 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.
- .9 Do not cone piles or spill material over edges of piles.
- .10 Do not use conveying stackers.
- .11 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

### 3.03 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water.
- .4 Waste Management: separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- .5 For temporary or permanent abandonment of aggregate source, restore source to condition meeting requirements of authority having jurisdiction.
- .6 Restrict public access to temporary or permanently abandoned stockpiles by means acceptable to Departmental Representative.

**END OF SECTION**

## 1 GENERAL

### 1.01 RELATED REQUIREMENTS

- .1 Section 31 63 19 - Bored and Socketed Piles

### 1.02 MEASUREMENT PROCEDURES

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

### 1.03 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A 252-98(2002), Standard Specification for Welded and Seamless Steel Pipe Piles.
  - .2 ASTM A 307-04, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile.
  - .3 ASTM A 325M-05, Standard Specification for Structural Steel Bolts, Steel, Heat Treated 830 Mpa Minimum Tensile Strength Metric.
  - .4 ASTM A 490M-04a, Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3 for Structural Steel Joints Metric.
- .2 Canadian Standards Association (CSA International)
  - .1 CAN/CSA-G40.20/G40.21-2004, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.
  - .2 CAN/CSA-S16-01, Consolidated (Consists of the CAN/CSA-S16-01, along with S16S1-05 and Updates # 1 and # 2 to CAN/CSA-S16-01).
    - .1 CAN/CSA-S16-01, Limit States Design of Steel Structures.
  - .3 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel Structures.
  - .4 CSA W48-01(R2006), Filler Metals and Allied Materials for Metal Arc Welding.
  - .5 CSA W59-03, Welded Steel Construction (Metal Arc Welding) (metric version).
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-1.171-98, Inorganic Zinc Coating.
  - .2 CAN/CGSB-1.184-98, Coal Tar-Epoxy Coating.
- .4 The Master Painters Institute (MPI)/Architectural Painting Specification Manual, ASM-February 2004.
  - .1 MPI #19, Inorganic Zinc Rich Primer.
- .5 The Society for Protective Coatings (SSPC)
  - .1 SSPC-SP 5/NACE No.1-2000, White Metal Blast Cleaning Joint Surface Preparation Standard.

### 1.04 SYSTEM DESCRIPTION

- .1 Design Requirements: design templates to safely withstand following loads:
  - .1 Gravity loads to which template are subjected.

### 1.05 ACTION AND INFORMATIONAL 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.
  - .1 Include product characteristics, performance criteria, and limitations.
- .3 Submit shop drawings and indicate following items:
  - .1 Material.
  - .2 Anchorage, field control and alignment methods.
  - .3 Design parameters.
  - .4 Tolerance for driving pile.
  - .5 Removable members.

### 1.06 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## 2 PRODUCTS

### 2.01 MATERIALS

- .1 Steel sections and plates: to CAN/CSA-G40.20/G40.21, Type 300W.
- .2 Pile sleeves: to ASTM A 252, Grade 300W .
- .3 Welding materials: to CSA W48/CSA W59.
- .4 Bolts, nuts and washers: to ASTM A 307.
- .5 Protective coating: to MPI #19.

### 2.02 FABRICATION

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

## 3 EXECUTION

### 3.01 PREPARATION

- .1 Lining:
  - .1 Line inside surfaces of sleeves and pile guides with timber strips 25 mm thick or nylon roping 25 mm thick to provide protection to pile coating during driving operation.

- .1 Show full details of linings and attachment on shop drawings.
- .2 Painting:
  - .1 Prepare vertical sleeves of templates and other steel used for connection to piling for painting by blast cleaning to SSPC-SP 5/NACE No.1 and apply one coat of inorganic zinc and two coats of coal tar epoxy.
- .3 Repairs:
  - .1 Repair damaged coatings with compatible material to approval of Departmental Representative.

### 3.02 POSITIONING

- .1 Position and hold template in location to receive piles.
  - .1 Ensure pile positions are within tolerances specified.
- .2 Secure templates to vertical piles in accordance with shop drawings before batter piles are placed.

### 3.03 REMOVAL OF TEMPLATES

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

### 3.04 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

### 3.05 PROTECTION

- .1 Protect templates from damage.
- .2 Repair damage to templates, formwork or concrete arising from operations at no extra cost.

**END OF SECTION**

## 1 GENERAL

### 1.01 RELATED REQUIREMENTS

- .1 Section 31 32 21 - Geotextiles
- .2 Section 31 53 16 - Structural Timber

### 1.02 MEASUREMENT For Payment

- .1 Measurement for payment of Cribwork Ballast will be in Tonnes of material acceptably placed.
- .2 Measurement for payment of Cribwork Rockfill will be in Tonnes of material acceptably placed.

### 1.03 SOURCE OF MATERIAL

- .1 Inform Departmental Representative of proposed source of new materials and provide access for inspection at least 4 weeks prior to commencing.

## 2 PRODUCTS

### 2.01 MATERIALS

- .1 General
  - .1 Materials to be hard durable stone free from cracks, seams and other defects which may impair durability.
  - .2 Relative Density (Specific Gravity): Minimum 2.65.
  - .3 Maximum Water Absorption: 2% (ASTM C131)
  - .4 Slate and shale materials not acceptable.
- .2 Cribwork Ballast Fill, (20kg to 60kg)
  - .1 Stone sizes to be in weight range of 20kg to 60kg.
  - .2 Greatest dimension of each stone not to exceed two times least dimension.
  - .3 At least 50% of stones shall be greater than 40kg.
- .3 Cribwork Rock Fill, (50 to 150mm)
  - .1 Material to be well graded rock fill in size range of 50 to 150mm.

### **3 EXECUTION**

#### **3.01 CRIBWORK BALLAST FILL**

- .1 After the existing asphalt topping and laminated timber decking have been Removed carefully place the cribwork ballast fill material in the empty crib cells.
- .2 Do not fill the empty crib cells by end dumping or using equipment that will drop the materials for the full height of the cells.
- .3 Use suitable equipment for placing the cribwork ballast fill inside of the empty cells in order to avoid damaging the existing timber elements.
- .4 Place the cribwork ballast fill to the elevations indicated.
- .5 Adjust surface stones such that large voids and or gaps in the ballast stone material are eliminated and the rock fill above will be retained.

#### **3.02 CRIBWORK ROCK FILL**

- .1 After repairs of existing timbers and vertical planks have been secured on the inside faces of the perimeter crib cells, place the rock fill materials over the ballast stones to the elevations indicated.
- .2 Level the rock fill and remove any larger stones that stick up above the plane of the surface.

**END OF SECTION**

## 1 - GENERAL

### 1.01 SECTION INCLUDES

- .1 Materials and installation of polymeric geotextiles used in breakwaters, retaining wall structures, filtration, drainage structures and roadbeds, purpose of which is to:
  - .1 Separate and prevent mixing of granular materials of different grading.
  - .2 Act as hydraulic filters permitting passage of water while retaining soil strength of granular structure.

### 1.02 RELATED WORK

- .1 Section 01 33 00 - Shop Drawings and Other Submittal Procedures.
- .2 Section 01 74 19 - Construction/Demolition Waste Management And Disposal.
- .3 Section 31 23 10 - Excavating, Trenching and Backfilling.
- .4 Section 31 23 25 - Rock and Gravel Fill.

### 1.03 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM D 4491-99a, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
  - .2 ASTM D 4595-86-94, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
  - .3 ASTM D 4716-00, Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
  - .4 ASTM D 4751-99a, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-4.2-M88, Textile Test Methods.
  - .2 CAN/CGSB-148.1, Methods of Testing Geotextiles and Geomembranes.
    - .1 No.2-M85, Mass per Unit Area.
    - .2 No.3-M85, Thickness of Geotextiles.
    - .3 No.7.3-92, Grab Tensile Test for Geotextiles.
    - .4 No.6.1-93, Bursting Strength of Geotextiles Under No Compressive Load.
- .3 Canadian Standards Association (CSA)
  - .1 CAN/CSA-G40.20-04/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel.
  - .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

#### 1.04 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 - Shop Drawing and other Submittal Procedures.
- .2 Submit to Departmental Representative the following samples at least 2 weeks prior to commencing work.
  - .1 Minimum length of 1 m of roll width of geotextile.

#### 1.05 MILL CERTIFICATES

- .1 Submit to Departmental Representative a copy of mill test data and certificate at least 2 weeks prior to start of work.

#### 1.06 DELIVERY AND STORAGE

- .1 During delivery and storage, protect geotextiles from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.

#### 1.07 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management And Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, and packaging material, in appropriate on-site bins, for recycling in accordance with Waste Management Plan.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

#### 1.08 MEASUREMENT FOR PAYMENT

- .1 The supply and installation of Geotextile will be measured for payment by square meters of material acceptable incorporated into the work. Overlapping will not be measured for payment.

## 2 - PRODUCTS

### 2.01 MATERIAL

- .1 Geotextile: woven or non-woven synthetic fibre fabric, supplied in rolls.
  - .1 Width: 3.5 m minimum.
  - .2 Length: 50 m minimum.
  - .3 Composed of: minimum 85% by mass of polyester with inhibitors added to base plastic to resist deterioration by ultra-violet and heat exposure.
- .2 Physical properties:
  - .1 Thickness: to CAN/CGSB-148.1, No.3, minimum 2.5 mm.
  - .2 Mass per unit area: to CAN/CGSB-148.1, No.2, minimum 400 g/m<sup>2</sup>.
  - .3 Tensile strength and elongation (in any principal direction): to ASTM D 4595.
    - .1 Tensile strength: minimum 1200 N, wet condition.
    - .2 Elongation at break: 50 to 100 percent.
    - .3 Seam strength: equal to or greater than tensile strength of fabric.
  - .4 Mullen burst strength: to CAN/CGSB-4.2, method 11.1, minimum 3100 kPa.
- .3 Hydraulic properties:
  - .1 Apparent opening size (AOS): to ASTM D 4751, 50 to 150 micrometres.
  - .2 Permittivity: to ASTM D 4491, 0.25 cm per second.
- .4 Securing pins and washers: to CAN/CSA-G40.21, Grade 300W, hot-dipped galvanized with minimum zinc coating of 600 g/m<sup>2</sup> to CAN/CSA G164.

## 3 - EXECUTION

### 3.01 INSTALLATION

- .1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated and retain in position with securing pins and washers.
- .2 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.
- .3 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.
- .4 Overlap each successive strip of geotextile 600 mm over previously laid strip.
- .5 Pin successive strips of geotextile with securing pins at 600 mm interval at midpoint of lap.
- .6 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.
- .7 After installation, cover with overlying layer within 4 hours of placement.

- .8 Replace damaged or deteriorated geotextile to approval of Departmental Representative.
- .9 Place and compact soil layers in accordance with Section 31 23 10 - Excavating Trenching and Backfilling.

### 3.02 CLEANING

- .1 Remove construction debris from Project site and dispose of debris in an environmentally responsible and legal manner.

### 3.03 PROTECTION

- .1 Vehicular traffic not permitted directly on geotextile.

**END OF SECTION**

## 1 GENERAL

### 1.01 RELATED REQUIREMENTS

- .1 Section 31 62 16.19 - Unfilled Tubular Steel Piles
- .2 Section 31 63 19 - Bored and Socketed Piles

### 1.02 ACTION AND INFORMATIONAL 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 Sub-surface investigation report: when site conditions differ from those indicated, submit written notification to Departmental Representative and await further instructions.
- .4 Submit schedule of planned sequence of driving to Departmental Representative for review, as specified.
- .5 Spliced piles: when authorized, submit design details of splice complete with signature and stamp of qualified professional engineer registered or licensed in Province of New Brunswick, Canada.
- .6 Equipment:
  - .1 Submit prior to pile installation for review by Departmental Representative, list and details of equipment for use in installation of piles.
  - .2 Impact hammers: submit manufacturer's written data as specified.
  - .3 Non-impact methods; submit characteristics to evaluate performance.
- .7 Submit drivability analysis as specified, to Departmental Representative for hammer approval.
- .8 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.

### 1.03 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .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 Departmental Representative.

#### 1.04 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Divert unused, or cut off concrete materials from landfill to local facility as approved by Departmental Representative.

#### 1.05 EXISTING CONDITIONS

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

#### 1.06 SCHEDULING

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

### 2 PRODUCTS

#### 2.01 MATERIALS

- .1 Material requirements for piles are specified in Section[s].
- .2 Supply or fabricate full length piles as indicated and provide equipment to handle full length piles without cutting and splicing.
- .3 Splice piles only with written approval of Departmental Representative.
  - .1 When permitted, provide details for Departmental Representative review.
  - .2 Design details of splice to bear dated signature stamp of professional engineer registered or licensed in Province of New Brunswick, Canada.

#### 2.02 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 such as augering, jacking, vibratory hammers or other means: provide full details of characteristics necessary to evaluate performance.
- .3 Hammer:
  - .1 Hammers to be selected on basis of drivability analysis using wave equation theory, performed to show that piles can be driven to levels indicated.
  - .2 Drivability analysis to include, but not be limited to, following: hammer, cushion, and cap block details; static soil parameters; quake and damping factors, total soil resistance, blow count, pile stresses and energy throughput at representative penetrations.

- .3 When required criteria cannot be achieved with the proposed hammer, use larger hammer and take other measures as required.

### 3 EXECUTION

#### 3.01 PREPARATION

- .1 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 to avoid damages to adjacent existing structures.
  - .3 When damages occur, remedy damaged items to restore to original or better condition at own expense.
- .2 Ensure that ground conditions at pile locations are adequate to support pile driving operation and load testing operation.
  - .1 Make provision for access and support of piling equipment during performance of Work.

#### 3.02 INSTALLATION

- .1 Leads: construct pile driver leads to provide free movement of hammer.
  - .1 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.
  - .2 Inclined leads to be used for battered piles.
  - .3 Swing leads:
    - .1 Obtain approval from Departmental Representative prior to using swing leads.
    - .3 Firmly guy top and bottom to hold pile in position during driving operation.
    - .4 Method to be reviewed by Departmental Representative.
- .2 Followers:
  - .1 Obtain approval from Departmental Representative prior to using followers.
  - .2 Provide followers of such size, shape, length and mass to permit driving pile in desired location to required depth and resistance.
  - .3 Provide followers with socket or hood carefully fitted to top of pile to minimize loss of energy and prevent damage to pile.
  - .4 Drive applicable load test piles using similar follower.
- .3 Installation of each pile will be subject to review of Departmental Representative.
  - .1 Departmental Representative will be sole judge of acceptability of each pile.
  - .2 Departmental Representative to review final driving of all piles prior to removal of pile driving rig from site.
- .4 Drive each pile to practical refusal in bedrock.
  - .1 Do not overdrive to cause damage to piles in bedrock.
  - .2 Departmental Representative will determine refusal criteria for piles

driven to rock based on type of pile and driving equipment.

- .5 Drive each pile to pile tip elevation as indicated on drawings.

### 3.03 APPLICATION / DRIVING

- .1 Use driving caps and cushions to protect piles.
  - .1 Reinforce pile heads as required.
  - .2 Piles with damaged heads as determined by [Departmental Representative will be rejected.
- .3 Hold piles securely and accurately in position while driving.
- .4 Deliver hammer blows along axis of pile.
- .5 Do not drive piles within 3 m of masonry or concrete which has been in place less than 7 days.
- .6 Restrike already driven piles lifted during driving of adjacent piles to assure set.
- .7 Remove loose and displaced material from around piles after completion of driving, and leave clean, solid surfaces to receive foundation concrete.
- .8 Cut off piles neatly and squarely at elevations as indicated [to tolerance of plus or minus 50 mm.
  - .1 Provide sufficient length above cut-off elevation so that part damaged during driving is cut off.
  - .2 Do not cut tendons or other reinforcement, which will be used to tie pile caps to pile.
- .9 Remove cut-off lengths from site on completion of work.

### 3.04 DRIVING TOLERANCES

- .1 Pile heads to be within 50 mm of locations as indicated.
- .2 Piles not to be more than 0.5% of length out of vertical alignment.

### 3.05 OBSTRUCTIONS

- .1 Where obstruction is encountered that causes sudden unexpected change in penetration resistance or deviation from specified tolerances, remove obstruction.

### 3.06 REPAIR AND RESTORATION

- .1 Pull out rejected piles and replace with new piles.
- .2 Remove rejected pile and replace with new, and if necessary, longer pile.
- .3 Remove rejected pile and fill hole as directed by Departmental Representative.
- .4 No extra compensation will be made for removing and replacing or other work made

necessary through rejection of defective piles.

### 3.07 FIELD QUALITY CONTROL

- .1 Replace/adjust hammer and modify cap, cushions, and other equipment, as directed by Departmental Representative.
- .9 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, 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 set for last 25mm.
    - .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.

### 3.08 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**

## 1 GENERAL

### 1.01 RELATED REQUIREMENTS

- .1 Section 03 30 20 - Reinforcing Steel
- .2 Section 03 30 00 - Cast-in-Place Concrete
- .3 Section 31 63 19.13 - Rock Sockets for Piles

### 1.02 MEASUREMENT PROCEDURES

- .1 Measurement for payment of Rock Socketed Pipe Piles acceptably incorporated into this contract will be by the unit from base elevation to cut-off including rock-socket. Included also will be:
  - .1 Pile Shoes.
  - .2 Reinforcing Steel.
  - .3 Pipe Pile
  - .4 Grout and Cast-in-Place Concrete
  - .5 Any required welding.
  - .6 Removal of material from interior of pipe piles.
  - .7 Drilling and socketing of sockets for piles.
- .2 No payment will be made for defective piles.
- .3 Supply and Installation of Cathodic Protection will not be measured for payment but will be incidental. Cathodic Protection shall be installed at the locations shown on the plans, or as directed by the Departmental Representative.

### 1.03 REFERENCES

- .1 ASTM International
  - .1 ASTM A 53/A 53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
  - .2 ASTM A 252-10, Standard Specification for Welded and Seamless Steel Pipe Piles.
  - .3 ASTM A 1008/A 1008M-11, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

- .2 CSA International
  - .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  - .2 CSA G30.18-09, Carbon and Steel Bars for Concrete Reinforcement.
  - .3 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .4 CSA S16-09, Design of Steel Structures.
  - .5 CAN/CSA-S6-06, Canadian Highway Bridge Design Code.
  - .6 CSA W59-03(R2008), Welded Steel Construction (Metal Arc Welding).

#### 1.04 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for piles and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of New Brunswick, Canada.
- .4 Field Quality Control Submittals:
  - .1 Maintain field driving records for each shell, including elevation of bedrock, driven depth of pile and rock socket depth, cut-off elevation of shell and protruding core.
  - .2 Provide Departmental Representative with three copies of field records.
  - .3 Submit detailed method statement and procedures for controlling and monitoring verticality and alignment of piles before starting pile installation.
  - .4 Submit mill report and results of concrete tests.

#### 1.05 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labeled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect piles from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

## 2 PRODUCTS

### 2.01 MATERIALS

- .1 Straight seamless and welded steel pipe: to ASTM A 53, formed from flat plate to diameters and wall thickness as indicated.
- .2 High carbon steel pile shoe: to ASTM A 53, welded to bottom of first pipe shell.
- .3 Wide welded plate sleeves: to ASTM A 1008/A 1008M, and as indicated, external 300 mm forming connections between lengths of steel pipe shell formed from flat plate.
- .4 Welding materials: to CSA W59.
- .5 Concrete mixtures and materials: to CSA A23.1/A23.2 and Section 03 30 00 - Cast-in-Place Concrete.
- .6 Grout: to Section 03 30 00 - Cast-in-Place Concrete.
- .7 Reinforcing steel: to CSA G30.18 and Section 03 20 00 - Concrete Reinforcing.
- .8 Steel core sections: to CSA G40.20/G40.21, type 300 W, as indicated on the drawings.
- .9 Anodes: Sacrificial Anodes to be Renode II Anode No. Rm 37 FM as manufactured by Reynolds Metal Co.

### 2.02 SOURCE QUALITY CONTROL

- .1 Mill report: to CAN/CSA-S6.
- .2 Concrete tests: to CSA A23.1/A23.2.

## 3 EXECUTION

### 3.01 INSTALLATION

- .1 Drive Piles to bedrock in accordance with Section 31 61 13 - Pile Foundations, General Requirements.
- .2 Drive pile with steel head having ring inside pile with 40 mm clearance and wood cushion blocks.
- .3 Splice piles, if required, by welding piles together by shielded electric welding.
  - .1 To prevent distortion, tack opposite points first and then opposite sections.
  - .2 Pipe walls thinner than 12.7 mm to be welded against a back up ring.
  - .3 Ensure top member is held in vertical alignment during splicing operation.

- .4 Remove material from inside of pile by method approved by Departmental Representative.
- .5 When pile reaches bedrock, churn drill into bedrock remove churn drill and drive pile into bedrock to form seal.
- .6 Remove drilled material from rock socket in accordance with Section 31 63 19.13 - Rock Sockets for Piles.
- .7 Perform internal visual or camera inspection of pile, joints and rock socket before placing concrete as directed by Departmental Representative.
  - .1 Ensure loose material is removed, pile is free from foreign matter and there are no faults in bedrock or bearing strata directly below pile.

### 3.02 REINFORCING STEEL

- .1 Make reinforcement into cages sufficiently rigid enough to resist damage or displacement during handling.
  - .1 When reinforcement is made up from more than one segment, include sufficient bar length required to lap splice.
  - .2 Weld lap splicing.
- .2 Weld stirrups, lateral ties or spiral ties to main bars.
- .3 Welders to be certified by Canadian Welding Bureau (CWB) who hold welding certification required for Work.
- .4 Use spacers or rollers specifically designed to achieve accurate placement of reinforcement as approved by Departmental Representative.
  - .1 Proceed with reinforcement placement only after receipt of written approval from Departmental Representative.

### 3.03 CONCRETE PLACEMENT

- .1 Concrete and placement methods: to CSA A23.1/A23.2 and Section 03 30 00 - Cast-in-Place Concrete.
- .2 Place concrete or grout into bottom of rock socket without voids, honeycombing or other defects. Secure anchor core in position by method approved by Departmental Representative. Allow concrete or grout to set.
- .3 Complete placing of concrete to required elevation within shell as approved in writing by Departmental Representative.
- .4 Place additional concrete or grout into shell and fill remainder of shell with concrete using methods approved by Departmental Representative.
- .5 As concrete work proceeds install additional lengths of anchor core welding steel sections together or tying reinforcement bars together with approved lap lengths.
  - .1 Rigidly hold new top section in vertical alignment during splicing operation.

- .6 Clean off concrete laitance accrued at top of shell.
- .7 Cut off top of shell and projecting core neatly and squarely at elevations as indicated.
- .8 Protect steel reinforcement core projecting above concrete in caisson.
- .9 When tremie concrete is used, with approval of Departmental Representative, proceed as follows:
  - .1 Clean out rock socket.
  - .2 Equalize water level inside and outside of caisson.
  - .3 Place reinforcement.
  - .4 Lower sealed tremie pipe to bottom of socket.
  - .5 Fill tremie pipe and hopper with low slump, cement rich concrete and tremie as specified in Section 03 37 26 - Underwater Placed Concrete to form an effective plug.
  - .6 Withdraw tremie pipe, allow concrete to set, pump water out, clean up all laitance and complete concreting in the dry.
  - .7 In case of losing concrete charge during tremie operations, withdraw pipe and reinforcement, remove concrete and start again.

### 3.04 DEFECTIVE CAISSONS

- .1 Where pile has encountered obstruction during driving prior to reaching specified bearing stratum consider it unsuitable. Payment on used sections as outlined in Measurement Procedures article in this section.

### 3.05 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

## 1 GENERAL

### 1.01 RELATED REQUIREMENTS

- .1 Section 31 63 19 - Bored and Socketed Piles.

### 1.02 REFERENCES

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM A 252-98(2002), Standard Specification for Welded and Seamless Steel Pipe Piles.
- .2 Canadian Standards Association (CSA International)
  - .1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel Structures.
  - .2 CSA W59-03, Welded Steel Construction (Metal Arc Welding).
  - .3 CAN/CSA-G30.18-M92(R2002), Billet-Steel Bars for Concrete Reinforcement.
  - .4 CSA-G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.

### 1.03 ACTION AND INFORMATIONAL 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 Shop Drawings:
  - .1 Indicate: reinforcing, methods of construction, operational sequence.
  - .2 Submit each drawing complete with signature and stamp of qualified professional engineer registered or licensed in Province of New Brunswick, Canada.
- .4 Quality assurance submittals:
  - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  - .2 Instructions: submit manufacturer's installation instructions.
  - .3 Submit for review by Departmental Representative three copies of pile driving records as described in PART 3 - FIELD QUALITY CONTROL.
  - .4 Equipment lists: submit to Departmental Representative, list of equipment for installation of anchor dowels before beginning work.
    - .1 Provide details sufficient to evaluate performance of equipment.
    - .2 Include details of equipment for excavating, drilling, cleaning out piles and rock sockets, installation of anchor dowels and grouting of sockets.

#### **1.04 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling 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] [DCC Representative.
- .3 Divert unused concrete materials from landfill to local quarry or facility as approved by Departmental Representative.

### **2 PRODUCTS**

#### **2.01 MATERIALS**

- .1 Grout: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Underwater concreting: in accordance with Section 03 37 26 - Underwater Placed Concrete.

### **3 EXECUTION**

#### **3.01 MANUFACTURER'S INSTRUCTIONS**

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

#### **3.02 PREPARATION/PILE CLEAN-OUT**

- .1 After pile is driven to bedrock, remove overburden inside pile down to tip of pile.
  - .1 Clean out material adhering to inside surface of pile and surfaces of shear ring by high pressure water jets.
- .2 Protect open piles from intrusion of foreign materials.

#### **3.03 INSTALLATION /SOCKETS**

- .1 Secure equipment in position during drilling.
- .2 Drill sockets into sound bedrock as indicated.
- .3 Departmental Representative to determine elevation of top of sound rock and depth of socket required.
- .4 Drill socket to minimum depth as indicated.

- .5 After drilling is completed, clean out socket.
- .6 After socket has been cleaned out and inspected, allow to stand for 24 h and inspect again for intrusion of material.
  - .1 Redrive pile, as required to seal socket and repeat drilling, cleaning out and inspection process.

### 3.04 WELDING

- .1 Weld in accordance with CSA W59.
- .2 Welding certification of companies in accordance with CSA W47.1.

### 3.05 GROUTING

- .1 Grout in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Grout anchor dowels inside pipe piles, in drilled socket and up to elevation as indicated, as soon as possible after installing anchor dowels.
- .3 Use grout mix that has been demonstrated to produce required strength at temperature prevailing in socket and pile in specified time.
  - .1 Grout mix and grouting pressure to approval of Departmental Representative.
- .4 Hold pile securely in position so that it does not move during grouting and until grout has attained specified strength.
- .5 Place grout in one continuous operation to fill socket and pile up to specified level.

### 3.06 FIELD QUALITY CONTROL

- .1 Site Tests and inspection:
  - .1 Provide method and equipment for inspection of each pile to ensure that pile and socket are properly cleaned out.
  - .2 Co-operate with and assist Departmental Representative to inspect each pile and socket.

### 3.07 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**