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**Part 1            GENERAL**

**1.1            Related Work**

- .1      Refer to Section 01 33 00 for Submission and Shop Drawing requirements.

**1.2            Source Approval**

- .1      Source of materials to be incorporated into work or stockpiled requires acceptance.
- .2      Inform *Departmental Representative* of proposed source of aggregates and provide access for sampling at least four (4) weeks prior to commencing production.
- .3      If, in the opinion of *Departmental Representative*, materials from the proposed source do not meet, or cannot reasonably be processed to meet specified requirements, procure an alternative source to demonstrate that materials from source in question can be processed to meet specified requirements.
- .4      Should a change of material source be proposed during work, advise *Departmental Representative* four (4) weeks in advance of proposed change to allow sampling and testing.
- .5      Acceptance of material at source does not preclude future rejection if it is subsequently found to lack uniformity, or if it fails to conform to requirements specified, or if its field performance is found to be unsatisfactory.

**1.3            Production Sampling**

- .1      Aggregate will be subject to continual sampling during production.
- .2      Provide *Departmental Representative* with ready access to source and processed material for purpose of sampling and testing.

**1.4            Measurement for Payment**

- .1      This item will not be measured separately.

**Part 2           PRODUCTS**

**2.1            Materials**

- .1      Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material or other deleterious substances.
  - .2      Flat and elongated particles are those whose greatest dimension exceeds four times their least dimension.
  - .3      Fine aggregates satisfying requirements of applicable section shall be one, or a blend of following:
    - .1          Natural sand
    - .2          Manufactured sand
    - .3          Screening produced in crushing of quarried rock, boulders, gravel or slag
  - .4      Coarse aggregates satisfying requirements of applicable section shall be one of following:
    - .1          Crushed rock or slag.
    - .2          Gravel composed of naturally formed particles of stone.
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**Part 3 EXECUTION**

**3.1 Development of Aggregate Source**

- .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 directed by the *Departmental Representative*.
- .2 Clear, grub and strip an area ahead of quarrying or excavating operation sufficient to prevent contamination of aggregate by deleterious materials.
- .3 When operating in stratified deposits use excavation equipment and methods that will produce a uniform, homogeneous aggregate.
- .4 When excavation is completed, 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 a neat condition.

**3.2 Processing**

- .1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.
- .2 Blend aggregate if required to obtain gradation requirements specified. Use approved methods and equipment.
- .3 Blending to increase percentage of crushed particles or decrease percentage of flat and elongated particles is permitted.
- .4 Wash aggregates if required to meet specifications. Use only equipment accepted by *Departmental Representative*.

**3.3 Handling**

- .1 Handle and transport aggregates to avoid segregation, contamination and degradation.

**3.4 Stockpiling**

- .1 Stockpiling aggregates on stabilized, clean and well drained surfaces.
  - .2 To ensure that no material other than stockpiled aggregate is used, do not incorporate bottom 250 mm of stockpile into work, if aggregates are stockpiled on ground.
  - .3 Stockpile far enough apart to prevent intermixing.
  - .4 Reject intermixed or contaminated materials. Remove and dispose of rejected materials as directed within 48 hours of rejection.
  - .5 Stockpile materials in uniform layers of thickness as follows:
    - .1 Max 1 m for coarse aggregate and base course materials.
    - .2 Max 2 m for fine aggregate and sub-base materials.
    - .3 Max 1.5 m for other materials.
  - .6 Complete each layer over entire stockpile area before beginning next layer.
  - .7 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.
  - .8 Coning of piles or spilling of material over edges of pile will not be permitted.
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- .9 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

**END OF SECTION**

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**Part 1            GENERAL**

**1.1            Related Work**

- .1    Refer to other Specifications Sections for related information.
- .2    Refer to Section 01 33 00 for Submission and Shop Drawing requirements.
- .3    Section 31 61 13 – Pile Foundations – General.
- .4    Section 31 62 17 – Steel Sheet Piling.

**1.2            References**

- .1    ASTM A307-21, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
- .2    ASTM F3125 / F3125M-21, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.
- .3    CSA G40.20-13 / G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel.
- .4    CSA S16:19, Design of Steel Structures.
- .5    CSA W47.1:19, Certification of Companies for Fusion Welding of Steel.
- .6    CSA W59-18, Welded Steel Construction.
- .7    CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding.

**1.3            Shop Drawings**

- .1    Submit shop drawings in accordance with Section 01 33 00 – Submissions and Shop Drawings.
- .2    Indicate the following items:
  - .1    Material
  - .2    Anchorage, field control and alignment methods
  - .3    Design parameters
  - .4    Tolerance for driving pile
  - .5    Removable members
  - .6    Alternatives

**1.4            Design Criteria**

- .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            Protection**

- .1    Protect templates from damage. Repair damage to templates, formwork, or concrete arising from operations to satisfaction of *Departmental Representative* at no extra cost.
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**1.6 Measurement For Payment**

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

**Part 2 PRODUCTS**

**2.1 Materials**

- .1 Steel sections and plates: to CSA G40.20 and CSA G40.21, Type 350W.
- .2 Welding materials: to CSA W59.
- .3 Bolts, nuts, and washers: to ASTM A307 or ASTM F3125.

**Part 3 EXECUTION**

**3.1 Fabrication**

- .1 Fabricate structural steel for templates in accordance with CSA S16 and reviewed shop drawings.
- .2 Welding in accordance with CSA W59.
- .3 Welding companies shall be qualified under provisions of CSA W47.1.

**3.2 Positioning**

- .1 Position and hold template in location to receive piles with an accuracy which will ensure piles are within tolerances specified.

**3.3 Removal of Templates**

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

**END OF SECTION**

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**Part 1 GENERAL**

**1.1 Related Work**

- .1 Refer to other specification sections for related information.
- .2 Refer to Section 01 33 00 for Submission and Shop Drawing requirements.

**1.2 Submissions**

- .1 Methodology:
  - .1 When requested provide methodology for carrying out the work.
- .2 Provide submission in accordance with Section 01 33 00 – Submissions and Shop Drawings.

**1.3 Protection**

- .1 Prevent movement, settlement or damage of adjacent structures. Provided bracing and shoring as required. In event of damage, immediately replace such items or make repairs to approval of *Departmental Representative* and at no additional cost to *Departmental Representative*.
- .2 Prevent debris from going adrift and becoming a menace to navigation.
- .3 All damage to existing structures, roadways, pipelines, electrical systems not specified for removal to be repaired at the Contractor's cost to the satisfaction of the *Departmental Representative*.

**1.4 Measurement For Payment**

- .1 Sitework, demolition and removals will be measured in accordance with Section 01 29 00.

**Part 2 PRODUCTS**

NOT APPLICABLE

**Part 3 EXECUTION**

**3.1 Preparation**

- .1 Inspect site and verify with *Departmental Representative* items designated for removal and items to be preserved.
- .2 Locate and protect utility lines. Preserve in operating condition active utilities traversing site.
- .3 Provide temporary power and lighting as required by the *Departmental Representative*.
- .4 Existing fill and vent pipes, oil waste tanks and underground storage tanks to be protected from any damages. All repairs to damages as a result of Contractor's operations to be at their cost and to the satisfaction of the *Departmental Representative*.

**3.2 Removal**

- .1 Remove items indicated.
  - .2 Do not disturb adjacent structures designated to remain in place.
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- .3 At end of each day's work, leave work in safe condition so no part is in danger of toppling or falling.

### **3.3 Disposal of Material**

- .1 Disposal of materials not designated for salvage or re-use in work, will be the contractor's responsibility, and must be disposed of off-site.
- .2 The material to be disposed is to be transported and disposed of in an environmentally acceptable manner to the satisfaction of the *Departmental Representative*, and in accordance with any local, Municipal, Provincial and Federal restrictions and regulations.

### **3.4 Restoration**

- .1 Upon completion of work, remove debris, trim surfaces and leave work site clean.
- .2 Reinstall guard rails, utility poles and electrical service.
- .3 Reinstall areas and existing works outside areas of demolition to conditions that existed prior to commencement of work. Match condition of adjacent, undisturbed areas.

**END OF SECTION**

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**Part 1            GENERAL**

**1.1            Description**

- .1      This section specifies requirements for excavating and backfilling for storm sewer, water and sewage mains, and sewage overflow.

**1.2            Reference Standards**

- .1      ASTM D698-12(2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
- .2      ASTM D1557-12(2021), Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)).
- .3      AASHTO T99-21, Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 kg (5.5 lb) Rammer and 305 mm (12 in) Drop.
- .4      ASTM C127-15, Standard Test Method for Relative Density (Specific Gravity), and Absorption of Coarse Aggregate.
- .5      AASHTO T85-21, Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate.
- .6      ASTM C136/C136M-19, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
- .7      ASTM C117-17, Standard Test Method for Materials Finer than 75 µm (No. 200) Sieve in Mineral Aggregates by Washing.

**1.3            Related Work**

- .1      Refer to other Specification Sections for related information.
- .2      Refer to Section 01 33 00 for Shop Drawing and Submission requirements.

**1.4            Definitions**

- .1      Rock excavation: excavation of material from solid masses of igneous, sedimentary or metamorphic rock which, prior to its removal, was integral with its parent mass, and boulders or rock fragments having individual volume in excess of 1.5 m<sup>3</sup>.
- .2      Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation including dense tills, hardpan, frozen materials and partially cemented materials such as asphalt which can be ripped and excavated with heavy construction equipment.

**1.5            Protection of Existing Features**

- .1      Existing buried utilities and structures:
    - .1      Prior to commencing any excavation work, notify applicable owner or authorities, establish location and state of use of buried utilities and structures. Clearly mark such locations to prevent disturbance during work.
  - .2      Existing buildings and surface features:
    - .1      Protect existing buildings and surface features which may be affected by work from damage while work is in progress and repair damage resulting from work.
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**1.6 Shoring and Bracing**

- .1 Comply with applicable local regulations to protect existing features.

**1.7 Samples**

- .1 At least 2 weeks prior to commencing work, inform *Departmental Representative* of proposed source of fill materials and provide access for sampling.

**1.8 Measurement For Payment**

- .1 Work performed under this Section will be incidental to work involved in other sections of this specification.

**Part 2 PRODUCTS**

**2.1 Materials**

- .1 Granular Backfill: to consist of hard, durable, quarry or pit run material of an approved quality. The material will be free from frost, snow stumps, weeds, sod, roots, logs, silt, organic material, garbage, or any other waste materials and must be capable of being compacted to degree as specified herein and meeting approval of the *Departmental Representative*. Slate, sandstone or shale rock shall not be accepted. Specific gravity not less than 2.65 when tested to ASTM C127 (AASHTO T85).
- .1 75 mm minus crushed rock (subbase): crushed and screened, hard, durable stone free from clay and organic matter and graded as follows:

| ASTM SIEVE SIZE | % PASSING BY MASS |
|-----------------|-------------------|
| 75 mm           | 100               |
| 50 mm           | 70 – 100          |
| 25 mm           | 50 – 100          |
| 4.75 mm         | 22 – 100          |
| 2.36 mm         | 0 – 20            |
| 0.075 mm        | 0 – 10            |

- .2 150 mm minus crushed rock: crushed and screened, hard, durable stone free from clay and organic matter and graded as follows:

| ASTM SIEVE SIZE | % PASSING BY MASS |
|-----------------|-------------------|
| 200 mm          | 100               |
| 150 mm          | 90 – 100          |
| 112 mm          | 20 – 35           |
| 80 mm           | 0 – 20            |
| 20 mm           | 0 – 10            |

- .2 Granular Base: rock, clear, hard durable, angular, crushed quarried rock aggregate free from silt, clay lumps, organic matter, foreign substances and free from splits, seams or defects. Specific gravity not less than 2.6 when tested to ASTM C127 (AASHTO T85).
- .1 Gradation to be within the following limits when tested to ASTM C136 and ASTM C117 and giving a smooth curve without sharp breaks when plotted on a semi-log grading chart.
  - .1 Gradation – PE TIE Class A Gravel (base):

| ASTM SIEVE<br>SIZE | % PASSING BY MASS |
|--------------------|-------------------|
| 31.5 mm            | 100               |
| 25.0 mm            | 95 – 100          |
| 12.5 mm            | 50 – 83           |
| 4.75 mm            | 30 – 60           |
| 1.18 mm            | 15 – 40           |
| 600 µm             | 10 – 32           |
| 300 µm             | 5 – 22            |
| 75 µm              | 3 – 9             |

### Part 3 EXECUTION

#### 3.1 Site Preparation

- .1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

#### 3.2 Stockpiling

- .1 Stockpile fill materials in areas approved by *Departmental Representative*. Stockpile granular materials in manner to prevent segregation.

#### 3.3 Dewatering

- .1 Keep excavations free of water while work is in progress.
- .2 Protect open excavations against flooding and damage due to surface run-off.
- .3 Dispose of water in a manner not detrimental to public and private property, or any portion of work completed or under construction.

#### 3.4 Excavation

- .1 Excavate to lines, grades, elevations and dimensions indicted or as directed by *Departmental Representative*.
- .2 Dispose of surplus and unsuitable excavated material in approved location off site.
- .3 Do not obstruct flow of surface drainage or natural watercourses.
- .4 Stockpile suitable excavated materials required for backfill in approved location.
- .5 Dispose of surplus and unsuitable excavated material off site.

### **3.5 Pre-Installation Inspection**

- .1 Excavations require inspection and approval prior to commencement of installation operations.

### **3.6 Backfilling**

- .1 Do not proceed with backfilling operations until *Departmental Representative* has inspected and approved installations.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .3 Do not use backfill material which is frozen or contains ice, snow or debris.
- .4 Backfilling around installations:
  - .1 Place bedding and surround material as specified elsewhere.
  - .2 Place material by hand under, around, and over installations until 300 mm of cover is provided. Dumping material directly on installations will not be permitted.
- .5 Place backfill material in uniform layers not exceeding 150 mm in thickness up to subgrade elevation or top of trench. Compact each layer before placing succeeding layer.

### **3.7 Compaction**

- .1 Compact common backfill materials:
  - .1 In non-pavement areas, compact to a density at least equal to density of adjacent, undisturbed soil.
  - .2 In pavement areas, compact to 100% standard proctor maximum dry density.
- .2 Compact granular backfill materials to 100% standard proctor maximum dry density.
- .3 Compact using approved mechanical tamping devices, or by hand tamping to achieve specified compaction.

### **3.8 Granular Base (Class 'A')**

- .1 Do not place granular base until sub-base surface is compacted, inspected and approved by *Departmental Representative*.
- .2 Place material only on a clean unfrozen surface, properly shaped and compacted and free from snow and ice.
- .3 Place materials to the lines, grades, and depths as indicated on the drawings or as directed by the *Departmental Representative*.
- .4 Remove and replace portion of work in which material becomes segregated during spreading.
- .5 Compact to a density not less than 100% of maximum dry density ASTM D698.
- .6 Shape and roll alternately to obtain a smooth, even, and uniformly compacted base.
- .7 Apply water as is necessary during compacting to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.
- .8 In areas not accessible to rolling equipment, compact to required density with approved mechanical tampers.

**3.9 Granular Sub-Base (75 minus)**

- .1 Do not place granular sub-base until finished sub-grade is inspected and approved by *Departmental Representative*.
- .2 Place material only on a clean unfrozen surface, properly shaped and compacted and free from snow and ice.
- .3 Begin spreading sub-base material on a crown line or high side of a one-way slope.
- .4 Place material in uniform layers not exceeding 150 mm when compacted or to such other depth as approved by *Departmental Representative*.
- .5 Shape each layer to a smooth contour and compact to specified density before a succeeding layer is placed.
- .6 Remove and replace portion of a layer in which material has become segregated during spreading.
- .7 Compact to a density not less than 95% of maximum dry density, AASHTO T99-10, Method D except last 150 mm up to subgrade elevation. Compact last 150 mm to 100% maximum density, AASHTO T99-10, Method D.
- .8 Shape and roll alternately to obtain a smooth, even, and uniformly compacted base.
- .9 Apply water as is necessary during compacting to obtain specified density. If material is excessively moist, aerate by scarifying with suitable equipment until moisture content is corrected.
- .10 In areas not accessible to rolling equipment, compact to required density with approved mechanical tampers.

**3.10 Restoration**

- .1 Upon completion of work, remove surplus materials and debris and correct defects noted by *Departmental Representative*.
- .2 Clean and reinstate areas affected by work as directed by *Departmental Representative*.

**END OF SECTION**

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**Part 1            GENERAL**

**1.1               Related Work**

- .1      Refer to other Specification Sections for related information.
- .2      Refer to Section 01 33 00 for Submission and Shop Drawing requirements.

**1.2               References**

- .1      ASTM D4751-21a, Standard Test Methods for Determining Apparent Opening Size of a Geotextile.
- .2      ASTM D4632-15a, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
- .3      ASTM D4533/D4533M-15, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
- .4      ASTM D4491/D4491M-21, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
- .5      ASTM A123/A123M-17, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .6      CSA G40.20-13 / G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel

**1.3               Mill Certificates**

- .1      At least two weeks prior to start of work, furnish *Departmental Representative* with copies of mill test data and certificate that filter fabric delivered to job site meets requirements of this section.

**1.4               Approval**

- .1      Obtain written approval of *Departmental Representative* for filter fabric before installation of material in work.

**1.5               Measurement for Payment**

- .1      Filter fabric will be considered incidental to the work.

**Part 2           PRODUCTS**

**2.1               Materials**

- .1      Synthetic fiber: rot proof, unaffected by action of oil or salt water and not subject to attack by insects or rodents.
  - .2      Fabric: nonwoven polyester and/or polypropylene fabric.
  - .3      Seams: sewn in accordance with manufacturer's recommendations.
  - .4      Physical properties: to ASTM D4632, ASTM D4533, and ASTM D4751.
    - .1      Tensile Strength 900 N.
    - .2      Tear Strength 360 N.
    - .3      Elongation at break 50%.
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- .4 Filtration Opening Size = 60 – 100  $\mu\text{m}$ .
- .5 Securing pins and washers: to CSA G40.21, Grade 300W, hot-dipped galvanized with minimum zinc coating of 600 g/m<sup>2</sup> to ASTM A123.

## **2.2 Preparation of Base**

- .1 Fine grade area to be covered with filter fabric to a uniform surface area. Fill depressions with suitable material.

## **2.3 Placing Filter Fabric**

- .1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated and retain in position with pins and weights.
- .2 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.
- .3 Allow one (1) metre of fabric for overlapping and anchoring purposes, 700 mm at the top and 300 mm at the bottom of the slope.
- .4 Longitudinal seams will have a minimum of 450 mm overlap and will be pinned every 600 mm with 100 mm nails.
- .5 Anchor top of fabric at 1 metre intervals with 15mm diameter steel rods 600 mm in length. Anchor bottom of fabric by folding fabric and placing fill on top.
- .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 hr of placement.
- .8 Replace damaged or deteriorated geotextile to the approval of the *Departmental Representative*.
- .9 Place and compact soil layers in accordance with Section 31 23 10 - Excavating and Backfilling.

**END OF SECTION**

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**Part 1 GENERAL**

**1.1 Related Work**

- .1 Refer to other Specification Section for related information.
- .2 Refer to Section 01 33 00 for Submission and Shop Drawing requirements.
- .3 Section 31 09 18 – Pile Driving Templates.
- .4 Section 31 62 17 – Steel Sheet Piling.

**1.2 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 – Submissions and Shop Drawings.

**1.3 Existing Sub-Surface Conditions**

- .1 Notify the *Departmental Representative* immediately if subsurface conditions at site differ from these indicated.

**1.4 Protection**

- .1 Protect public and construction personnel, adjacent structures and work of other sections from hazards attributed to pile driving operations or any other operations.

**1.5 Scheduling of Work**

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

**1.6 Delivery, Storage and Handling**

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

**Part 2 PRODUCTS**

**2.1 Materials**

- .1 Supply full length steel sheet piles as indicated in accordance with Section 31 62 17 – Steel Sheet Piling.
  - .2 Provide equipment of sufficient capacity to handle full length piles without cutting and splicing. Supply or fabricate full length piles.
  - .3 Do not splice piles without written permission of *Departmental Representative*. When permitted, provide details for *Departmental Representative* review. Design details of splice to bear dated signature stamp of professional engineer registered or licensed in the Province of Prince Edward Island, Canada.
  - .4 Welding materials: to CSA W48.1.
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## **Part 3 EXECUTION**

### **3.1 Equipment Requirements**

- .1 Equipment information: prior to commencement of pile installation operation, submit to *Departmental Representative* for review, details of equipment for installation of piles. For impact hammers give manufacturer's name, type, rated energy per blow at normal working rate, mass of striking parts of hammer and mass of driving cap.
- .2 Pile driving System:
  - .1 Supply a pile driving system capable of advancing pile tips to practical refusal on bedrock. The pile driving system selected will be of sufficient energy so as not to damage the piles. The actual energy required to finalize the piles could vary depending on the performance of the pile driving system. The driving criteria for finalizing piles will be established in the field at the onset of the pile driving Work, as determined by the piling inspector in conjunction with the *Departmental Representative*.
  - .2 When required penetration is not obtained by use of a pile driving system complying with minimum requirements, either provide a more powerful pile driving system or take other measures, acceptable to the *Departmental Representative*. Drop hammers are permitted. Replace all piles damaged due to over driving at no additional cost to the Contract.
- .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.
  - .2 Length: except for piles driven through water, provide length of leads so that use of a follower is unnecessary.
  - .3 Swing leads: firmly guy top and bottom to hold pile in position during driving operation. Have method reviewed by the *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.

### **3.2 Preparation**

- .1 Ensure that 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 Pile Driving Analyzer**

- .1 *Departmental Representative* to arrange for Pile Driving Analyzer (PDA) testing.
  - .2 Contractor shall notify *Departmental Representative* of pile driving operations at least seven (7) days in advance of the work.
  - .3 If pile is suspect of meeting refusal on a boulder within the native soils, PDA testing shall be conducted to confirm capacity.
  - .4 Contractor shall allow adequate time for *Departmental Representative* to perform PDA testing as required by the *Departmental Representative*.
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- .5 PDA shall be conducted during the initial pile installation to confirm that the pile driving equipment is not damaging the piles and that driving resistances and capacities are acceptable.

### 3.4 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 driving cap, and cushion.
  - .3 Pile size, length and 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 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 during driving of each pile.
- .2 Provide *Departmental Representative* with an electronic copy of records in PDF file format.

### 3.5 Driving

- .1 Use driving caps to protect piles. Reinforce pile heads if necessary. Piles with damaged heads as determined by *Departmental Representative* will be rejected.
- .2 Use steel drive shoes to protect pile toes during driving to the approval of the *Departmental Representative*.
- .3 Hold piles securely and accurately in position while driving.
- .4 Deliver hammer blows in direct axis of pile.
- .5 Do not drive piles within a radius of 8 m of concrete which has been in place less than 3 days.
- .6 Redrive piles lifted during driving of adjacent piles.
- .7 Use of water jet:
  - .1 Water jetting is not permitted.
- .8 Cut off piles neatly and squarely at elevations indicated. Provide sufficient length above cut-off elevation so that part damage during driving is cut off.
- .9 Remove cut-off lengths from site on completion of work.
- .10 Installation of each pile will be subject to acceptance by *Departmental Representative*.
  - .1 *Departmental Representative* will be sole judge of acceptability of each pile with respect to final driving resistance and depth of penetration or other criteria used to determine load capacity.
  - .2 *Departmental Representative* to accept final driving of all piles prior to removal of pile driving rig from site.
- .11 Drive each steel sheet sections to elevations shown on the drawings.

### 3.6 Obstructions

- .1 Remove all obstructions from the surface prior to installing piles and install piles to the specified depth and/or pile resistance.

- .2 Where obstruction is encountered that causes sudden and unexpected change in penetration resistance or deviation from specified tolerances, advise Department Representative and submit for their review the Contractor's proposed method(s) for achieving specified penetrations and tolerances. Incorporate review comments in the proposed method(s) and proceed with the work.
- .3 Consideration will be made for additional compensation for non-native material and or situations that are encountered under the surface, over and above what could be reasonably anticipated from soils information available and causes delays/additional costs in piling. Each case will be reviewed and approved by the *Departmental Representative* by means of the Request for Information (RFI) process.

### **3.7 Damaged or Defective Piles**

- .1 Remove rejected pile and replace with a new, and if necessary, a longer pile.
- .2 No extra compensation will be made for removing and replacing or other work made necessary through rejection of a defective pile.

### **3.8 Penetration**

- .1 Protect adjacent structures, services and work of other section 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 original or better condition at Contractor's expense and to the satisfaction of the *Departmental Representative*.

**END OF SECTION**

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**Part 1            GENERAL**

**1.1            Description**

- .1      This section specifies the requirements for the supply and installation of Z section hot rolled steel sheet piles. Supply and install sheet pile cutting shoes and other hardware.

**1.2            Related Work**

- .1      Section 05 12 23 – Structural Steel.
- .2      Section 31 09 18 – Pile Driving Templates.
- .3      Section 31 61 13 – Pile Foundations – General.

**1.3            References**

- .1      ASTM A449-14(2020), Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
- .2      ASTM A572/A572M-21e1, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
- .3      ASTM A615/A615M-20, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
- .4      ASTM F3125 / F3125M-21, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.
- .5      AWS D1.1/D1.1M:2020, Structural Welding Code - Steel
- .6      CSA G40.20/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .7      CSA W47.1:19, Certification of Companies for Fusion Welding of Steel.
- .8      CSA W59-18, Welded Steel Construction.

**1.4            Submittals**

- .1      Submit shop drawings in accordance with Section 01 33 00 – Submissions and Shop Drawings.
- .2      Submit a shop drawing showing the welding and details of cutting shoes.
- .3      Submit shop drawings for the following items:
  - .1          Splice details and additional connector plates as per the Project Drawings.
  - .2          Wale systems, including all connectors and hardware.

**1.5            Existing Sub- Surface Conditions**

- .1      Notify the *Departmental Representative* immediately if subsurface conditions at site differ from those indicated.
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## **1.6 Quality Assurance**

- .1 Inspection and testing of steel sheet piling material will be carried out by testing laboratory designated by *Departmental Representative* at any time during course of Work.
- .2 Materials inspected or tested by *Departmental Representative* which fail to meet contract requirements will be rejected.
- .3 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, Contractor to pay costs for additional tests or inspections. *Departmental Representative* to approve corrected work.
- .4 Conduct all shop welding in accordance with CSA W59, AWS D1.1 or other equivalent international standard. Use welders certified to CSA W47.1 or other equivalent international standard.

## **1.7 Protection**

- .1 Protect public and construction personnel, adjacent structures and work of other sections from hazards due to pile driving operations or any other operations.

## **1.8 Delivery, Storage and Handling**

- .1 Use slings for lifting piling make sure mass is evenly distributed and piling is not subjected to excessive bending stresses.
- .2 Store sheet piling on level ground or provide supports so that sheet piling is level when stored.
  - .1 Provide blocking at spacing not exceeding 5 m so that there is no excessive sagging in piling.
  - .2 Overhang at ends not to exceed 0.5 m.
  - .3 Block between lifts directly above blocking in lower lift.
- .3 If material is stock-piled on structure, ensure structure is not overloaded.

## **1.9 Waste Management and Disposal**

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

## **Part 2 PRODUCTS**

### **2.1 Materials**

- .1 Steel sheet piles: to ASTM A572, Grade 60 (415 MPa) and as specified below.
- .2 Continuous interlocking Z section consisting of the following minimum section properties:
  - .1 Minimum section modulus: 4605 cm<sup>3</sup> per metre of wall.
  - .2 Minimum flange thickness: 20.0 mm.
  - .3 Minimum web thickness: 16.0 mm.
  - .4 System width of 1400 mm per steel sheet pile pair.
  - .5 Deliver Z Sections to site assembled in pairs.
- .3 Mark each piece of sheet piling legibly by stenciling or die-and-stamping with the following information:

- .1 Heat number.
- .2 Manufacturer's name.
- .3 Length and section number.
- .4 Do not precut lifting or slinging holes in sheet piles.
- .5 Special corners: provide fabricated special corners as specified by pile manufacturer for specific pile being installed.

## **2.2 Cutting Shoes**

- .1 Sheet Piling Cutting Shoe: supply sheet pile cutting shoes for field installation:
  - .1 Associated Pile and Fitting LLC Company.
  - .2 Approved equivalent.

## **2.3 Tie Rods, Wales and Connection Hardware**

- .1 Structural steel for wales, bearing plates, wales splices, capping channels, support angles and miscellaneous steel: to CSA G40.20/G40.21, Grade 350W or ASTM A992, Grade 50W.
- .2 Tie rods, sleeve nuts and turnbuckles:
  - .1 Tie rods: to CSA G30.18 or ASTM A615, Grade 75, unless noted otherwise.
  - .2 Tie rods: to be continuously threaded bar, 76 mm nominal diameter, unless noted otherwise.
  - .3 Sleeve nuts, connector sleeves, articulating connectors and all other hardware: to have load capacity in excess of capacity of tie rod.
  - .4 Preassemble, mark and test tie rod assemblies in shop. Align threaded connection to following tolerances at sleeve nut or connector sleeve: 1/80 of normal rod diameter, deviation of centerline, 1 in 160.
- .3 Nuts and bolts: hexagon nuts, bolts, and washers: 25mm diameter A325 to ASTM F3125/F3125M unless noted otherwise.
- .4 Tie back bolts: 47.6mm (1 7/8") diameter ASTM A449 threaded rod Type 1 complete with A563DH heavy hex nuts.

## **2.4 Fabrication Steel Sheet Piles**

- .1 Fabricate full length piles to eliminate splicing Sheet Piles during installation.
- .2 Full length piles may be fabricated from piling material by splicing lengths together where approved by the *Departmental Representative*. Use complete joint penetration groove welds. Conform to requirements of piling system manufacturer.
- .3 Submit details of planned use of pile material stock to the *Departmental Representative* for approval prior to start of fabrication. Re-use cut-off lengths as directed by the *Departmental Representative*.
- .4 Allowable tolerance on axial alignment to be as required by the piling system manufacturer.
- .5 Allowable deviation from straight line over total length of fabricated pile to be 30 mm.
- .6 Repair defective welds as approved by the *Departmental Representative*. Repairs to CSA W59. Unauthorized weld repairs may be rejected.

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**Part 3 EXECUTION**

**3.1 Installation**

- .1 Do pile installation Work in accordance with Section 31 61 13 - Pile Foundations – General, except where otherwise specified.
- .2 Do welding in accordance with CSA W59.
- .3 Submit full details of method and sequence of installation of piling to *Departmental Representative* for approval prior to start of pile installation work. Details must include templates, bracing, setting and driving sequence and number of piles in panels for driving.
- .4 Drive sheet piles to the depths and dimensions shown on the Drawings using vibratory or impact hammers. The quality of the sandstone/mudstone bedrock is considered to be highly variable with depth and across the site. It is also to be noted that the bedrock elevations shown on the drawings are only inferred values using a range of boreholes and the actual bedrock elevations could be different from those shown. The refusal criterion for sheet piles is to be taken as 10 blows per 25 mm of penetration resistance for at least 100 mm of pile penetration using a pile driving hammer with minimum rated energy of 70,000 Joules. It is estimated that the SSP's driven to refusal would have bedrock penetrations of 1 to 2 m.
- .5 When installation is complete, face of wall at top of sheet piles to be within 50 mm of location as indicated and deviation from vertical not to exceed 1 in 100.
- .6 Cut drain holes and install steel drain as indicated. Include filter material in area of drain holes as indicated.
- .7 Compact backfill material within 2 m of SSP wall or anchor walls with hand operated compactor. Do not operate rollers in vibration mode within one (1) drum width of SSP or anchor wall.
- .8 Do not operate rollers over tie rods until buried with at least 300mm of backfill material.

**3.2 Obstructions**

- .1 If obstruction encountered during driving, advise the *Departmental Representative* immediately and submit proposed remedial measures for his review. Incorporate the *Departmental Representative's* review comments in the proposed work method and proceed with the Work.
- .2 Consideration will be made for additional compensation for non-native material and or situations that are encountered under the surface, over and above what could be reasonably anticipated from soils information available and causes delays in piling. Each case will be reviewed and approved by the *Departmental Representative* by means of the RFI process.

**3.3 Holes**

- .1 Patch holes in sheet pile wall, except where permanent holes are indicated.
- .2 Use material equal to that of piling to patch holes and overlap not less than hole diameter.
- .3 Weld to develop full strength of plate.
- .4 Drill any required holes in piling. Do not use flame cutting without permission of *Departmental Representative*.

**3.4 Welding**

- .1 Weld in accordance with CSA W59.
  - .2 Welding certification of companies must be in accordance with CSA W47.1.
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### **3.5 Cutting**

- .1 When flame cutting tops of piles, and flame cutting holes in piles approved by *Departmental Representative*, use following procedure:
  - .1 When air temperature is above 0 degrees C, no pre-heat is necessary.
  - .2 When air temperature is below 0 degrees C, pre-heat until steel 25 mm on each side of line of cut has reached a temperature very warm to hand (approximately 35 degrees C). Tempilstik, temperature indicating crayon marks, may be used to measure temperature.
  - .3 Use torch guiding device to ensure smooth round holes or straight edges.
  - .4 Make cut smooth and free from notches throughout thickness. If grinding is employed to remove notch or crack, finished radius to be minimum 5 mm.

### **3.6 Tie Rod Anchorage System**

- .1 Do not place backfill behind anchored bulkhead or remove material from behind bulkhead until piles have been completely driven, adjusted and secured in final position by anchorage system.
- .2 Support tie rods with new gravels to ensure continuous bearing under tie rods.
- .3 Fit and adjust tie rod systems so that connections at waling and anchor ends of tie rods are tight before backfilling.
- .4 Protect tie rods and anchor systems from damage during backfill operations.

**END OF SECTION**