

Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001

Aggregates General

PART 1 - GENERAL

1.1 Related Work .1 Refer to Section 01 33 00 for Shop Drawing/Submissions 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.

Wharf Construction

Port Bickerton East

Guysborough County, Nova Scotia

Project No. R.082082.001

Aggregates General

- .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.

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.
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Wharf Construction**Port Bickerton East****Guysborough County, Nova Scotia****Project No. R.082082.001**

Aggregates General

.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.

.9 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

END OF SECTION

Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001

Pile Driving Templates

PART 1 – GENERAL1.1 Related Work

- .1 Refer to other Specifications Sections for related information.
- .2 Refer to Section 01 33 00 for Shop Drawing/Submissions requirements.
- .3 Section 31 61 13 – Pile Foundations – General.
- .4 Section 31 62 18 – Steel H-Piles.
- .5 Section 31 62 19 – Wood Piles.

1.2 References

- .1 ASTM A252-10, Specification for Welded and Seamless Steel Pipe Piles.
- .2 ASTM A307-14, Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
- .3 ASTM A325M-14, Specification for High-Strength Bolts for Structural Steel Joints.
- .4 ASTM A490M-14A, Specification for High-Strength Steel Bolts.
- .5 CAN/CSA-G40.20-13, General Requirements for Rolled or Welded Structural Quality Steel.
- .6 CAN/CSA-G40.21-13, Structural Quality Steels.
- .7 CAN/CSA-S16-14, Limit States Design of Steel Structures.
- .8 CSA W47.1-09 (R2014), Certification of Companies for Fusion Welding of Steel.
- .9 CSA W59-13, Welded Steel Construction (Metal Arc Welding).
- .10 CGSB 1-GP-171M-98, Inorganic Zinc Coating.
- .11 CSA W47.1S1-M1989 (R1998), Supplement No. 1 to W47.1-1983 Certification of Companies for Fusion Welding of Steel Structures.

Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001

Pile Driving Templates

Page 2

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| .12 | CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding. |
| .13 | CSA W59S1-M1989 (1998), Supplement No. 1-M1989, Steel Fixed Offshore Structures, to W59-M1989, Welded Steel Construction (Metal Arc Welding). |
| <u>1.3 Shop Drawings</u> | <p>.1 Submit shop drawings in accordance with Section 01 33 00 - Submissions/Shop Drawing.</p> <p>.2 Indicate the following items:</p> <ul style="list-style-type: none"> .1 Material .2 Anchorage, field control and alignment methods .3 Design parameters .4 Tolerance for driving pile .5 Removable members .6 Alternatives |
| <u>1.4 Design Criteria</u> | <p>.1 Design templates to safely withstand following loads:</p> <ul style="list-style-type: none"> .1 All gravity loads to which template shall be subjected. .2 Lateral loads to firmly hold pile in position when driving. .3 All weather-related loads that may be applied during driving activities. |
| <u>1.5 Protection</u> | <p>.1 Protect templates from damage. Repair damage to templates, formwork or concrete arising from operations to satisfaction of <i>Departmental Representative</i> at no extra cost.</p> |
| <u>1.6 Measurement For Payment</u> | <p>.1 No measurement will be made under this section. Include costs in items of work that require templates.</p> |
| <u>PART 2 – PRODUCTS</u> | |
| <u>2.1 Materials</u> | <p>.1 Steel sections and plates: to CAN/CSA-G40.20 and CAN/CSA-G40.21, Type 350W.</p> <p>.2 Welding Materials: to CSA W59.</p> <p>.3 Bolts, nuts and washers: to ASTM A307 or ASTM A325M.</p> |
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Wharf Construction

Port Bickerton East

Guysborough County, Nova Scotia

Project No. R.082082.001

Pile Driving Templates

PART 3 – EXECUTION

3.1 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 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.
- .2 Before driving batter piles set templates to within 10 mm of elevations indicated on shop drawings.

3.3 Placing Batter Piles

- .1 Remove members in templates as necessary to place batter piles. Replace members prior to placing other batter piles or driving of batter piles. Indicate members to be removed for this operation on shop drawings. Mark them "Removable".

3.4 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

Wharf Construction**Port Bickerton East****Guysborough County, Nova Scotia****Project No. R.082082.001**

Sitework, Demolition, and Removals

PART 1 – GENERAL

- 1.1 Related Work
- .1 Refer to other specification sections for related information.
- .2 Refer to Section 01 33 00 for Shop Drawing/Submission 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.
- 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.

**Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001**

Sitework, Demolition, and Removals

.3 Provide temporary power and lighting as shown on the plan or 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 his 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.

.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 Reinstate 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

Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001

Excavating and Backfilling

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 D698-12e2, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- .2 AASHTO T99-15, 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.
- 1.3 Related Work .1 Refer to other Specification Sections for related information.
- .2 Refer to Section 01 33 00 for Shop Drawing/Submissions 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 m³.
- .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.

Wharf Construction**Port Bickerton East****Guysborough County, Nova Scotia****Project No. R.082082.001**

Excavating and Backfilling

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 Sub-Base material in accordance with Section 32 11 19.
- .2 Granular Base material in accordance with Section 32 11 23.
- .3 Nominal Clear Stone material in accordance with Section 32 11 25.
- .4 Corestone material in accordance with Section 31 37 10.

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 indicated or as directed by *Departmental Representative*.

Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001

Excavating and Backfilling

- .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 Trench Bottom Preparation

- .1 Where required due to removal of unsuitable material or unauthorized over-excavation bring bottom of excavation to design grade with approved material.
- .2 Compact trench bottom to density at least equal to density of adjacent surrounding soil.

3.6 Pre-Installation Inspection

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

3.7 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.
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Wharf Construction

Port Bickerton East

Guysborough County, Nova Scotia

Project No. R.082082.001

Excavating and Backfilling

- .6 Compact common backfill materials:
 - .1 In non-pavement areas, to a density at least equal to density of adjacent, undisturbed soil.
 - .2 In pavement areas, compact to a minimum of 90% for cohesive soils and 95% for cohesionless soils of corrected maximum dry density, maximum density ASTM D698, AASHTO T99, Method C.
 - .7 Compact granular backfill material to a minimum 95% of corrected maximum dry density, maximum density AASHTO T99, Method C.
 - .8 Compact using approved mechanical tamping devices, or by hand tamping to achieve specified compaction.
- 3.8 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

Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001

Geotextiles

PART 1 - GENERAL

- 1.1 Related Work
- .1 Refer to other Specification Sections for related information.
 - .2 Refer to Section 01 33 00 for Shop Drawing/Submissions requirements.
- 1.2 References
- .1 ASTM D4595-11, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
 - .2 CAN/CGSB-4.2 No. 42-M, Textile Test Methods.
 - .3 CAN/CGSB-148.1 No 14-M, Methods of Testing Geotextiles and Geomembranes.
 - .4 ASTM D4751-16, Standard Test Methods for Determining Apparent Opening Size of a Geotextile.
- 1.2 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 D4595, CAN/CGSB-4.2 No. 42, CAN/CGSB-148.1 No 14 and ASTM D4751;
 - .1 Tensile Strength 900 N
 - .2 Tear Strength 360 N

Wharf Construction

Port Bickerton East

Guysborough County, Nova Scotia

Project No. R.082082.001

Geotextiles

- .3 Elongation at break 50%
- .4 Filtration Opening Size = 100 - 80um.
- .5 Permeability = 2 x 10⁻¹ cm sec.

PART 3 - EXECUTION

3.1 Preparation of Base

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

3.2 Placing
Filter Fabric

- .1 Place filter fabric on prepared surface loosely from top of the slope to the bottom allowing fabric to conform easily to contours of the slope.
- .2 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.
- .3 Longitudinal seems will have a minimum of 450 mm overlap and will be pinned every 600 mm with 100 mm nails.
- .4 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.
- .5 Place granular base material over filter fabric to a depth of 200 mm. No equipment will be permitted on fabric.

END OF SECTION

**Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001**

Corestone and Rip Rap

PART 1 - GENERAL

- 1.1 Related Work
- .1 Refer to other Specification Sections for related information.
 - .2 Refer to Section 01 33 00 for Shop Drawing/Submission requirements.
- 1.2 Reference Standards
- .1 ASTM C127-15, Standard Test Method for Relative Density (Specific Gravity) and Absorption of Coarse Aggregate.
 - .2 AASHTO T85-14, Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate.
- 1.3 Submissions
- .1 Product Data/Samples:
 - .1 Provide samples of materials proposed for the work.
 - .2 Methodology:
 - .1 Provide methodology for carrying out the work.
 - .3 Provide submissions in accordance with Section 01 33 00.
- 1.4 Measurement For Payment
- .1 Corestone will be measured in accordance with Section 01 29 00.
 - .2 Rip Rap will be measured in accordance with Section 01 29 00.
 - .3 Prices will include the entire cost of supplying and placing the material in the work, rough grading as necessary, taking soundings, diving inspections, all as shown on the drawings, and as specified.

PART 2 - PRODUCTS

- 2.1 Rip Rap
- .1 Hard durable crushed quarried rock, free from silt, clay, organic matter and other foreign substances and free from splits, seams or defects likely to impair its soundness during handling or under action of water.
 - .2 Specific gravity of not less than 2.65 when tested to ASTM C127 or AASHTO T85.
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Wharf Construction**Port Bickerton East****Guysborough County, Nova Scotia****Project No. R.082082.001**

Corestone and Rip Rap

- .3 Rip Rap will be sized as shown on drawings and will be free of seams that would affect its durability.

2.2 Corestone

- .1 To be pit run or quarried material rough and angular in shape requiring approval by the *Departmental Representative* prior to being used in the work.
- .2 Material not to contain organic matter, frozen lumps, sod, roots, logs, stumps or any other objectionable matter.
- .3 Corestone gradation shall be within the following limits:

IMPERIAL SIZE	METRIC SIZE	% PASSING BY MASS
18"	450 mm	100
8"	200 mm	44 – 75
4"	100 mm	25 – 50
2"	50 mm	7 – 14

- .4 Material to be screened, if required, to ensure no fines or stones less than 0.2 kilograms are placed in the work.
- .5 Material to be blended so that homogenous mix of smaller and larger sizes within the approved range is attained.

PART 3 - EXECUTION3.1 Tolerances

- .1 Surface of bearing layer to be within 50 mm of elevation indicated and variation in elevation over whole area of bearing layer not to exceed 75 mm.
- .2 Other layers to be within 100 mm of lines shown.

3.4 Protection

- .1 Take into account anticipated weather conditions and degree of exposure of site in setting requirements for protection.
- .2 Schedule and carry out construction so that each phase of work is not left exposed longer than necessary.
- .3 The Contractor should note that the work site is subject to water level variations due to tidal action.

Wharf Construction

Port Bickerton East

Guysborough County, Nova Scotia

Project No. R.082082.001

Corestone and Rip Rap

- .4 The Contractor will be responsible to replace any material lost due to storms, tidal erosion or by his own activities.

END OF SECTION

**Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001**

Pile Foundations – General

PART 1 - GENERAL

- 1.1 Related Work
- .1 Refer to other Specification Section for related information.
 - .2 Refer to Section 01 33 00 for Shop Drawings/Submissions requirements.
 - .3 Section 31 09 18 – Pile Driving Templates.
 - .4 Section 31 62 18 – Steel H-Piles.
 - .5 Section 31 62 19 – Wood Piles.
- 1.2 Submissions
- .1 Methodology:
 - .1 Provide methodology including type of pile driving equipment to carry out the work.
 - .2 The Contractor is required to submit the bearing pile (H-Pile) refusal criteria as determined by a Geotechnical engineer registered in the Province of Nova Scotia.
 - .3 Provide submissions in accordance with Section 01 33 00.
- 1.3 Existing Sub-Surface Conditions
- .1 Sub-surface investigation reports may be available for viewing at the *Departmental Representative's* office and at the offices of Public Works and Government Services Canada, 1713 Bedford Row, Halifax, N.S.
 - .2 Notify the *Departmental Representative* immediately if subsurface conditions at site differ from these indicated.
 - .3 **The site is known to contain cobbles and boulders. Contractor shall be prepared to advance through cobbles and boulders as required.**
- 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.

Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001

Pile Foundations – General

Page 2

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 timber piles as indicated in accordance with Section 31 62 19 – Wood Piles.
- .2 Supply full length steel H-Piles as indicated in accordance with Section 31 62 18 – Steel H Piles.
- .3 Provide equipment of sufficient capacity to handle full length piles without cutting and splicing.
- .4 Pile lengths indicated are based on lengths estimated to remain in completed structure plus a 1.0 metre cut-off allowance.
- .5 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 Nova Scotia, Canada.
- .6 Welding materials: to CSA W48.1

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 Hammer:
 - .1 Supply a hammer as determined by a Wave Equation Analysis Program. When required penetration is not

Wharf Construction**Port Bickerton East****Guysborough County, Nova Scotia****Project No. R.082082.001**

Pile Foundations – General

achieved by the use of hammers complying with minimum requirements, either provide larger hammer or take other measures acceptable to the *Departmental Representative*. Drop hammers are permitted. Replace all piles damaged due to overdriving at no additional expense to the Contract. Pile driving shall be carried out using a pile driving hammer with a rated energy per blow of between 350 J/cm² and 450 J/cm² of pile area. Acceptance of hammer chosen will be based on confirmation of pile capacities as determined by the pile driving analyzer.

.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:
 - .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.

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 Contractor shall use a Pile Driving Analyzer and Wave Equation Analysis to determine and confirm driving criteria such as hammer size and variation in impact, suitability of driving cap and cushions, and penetration resistance relative to set on at least three (3) piles at start-up of pile placement. Confirm criteria during pile installation by using Pile Driving Analyzer and Wave Equation

- Analysis on additional piles when requested by *Departmental Representative*. *Departmental Representative* will select piles. Work to be performed by geotechnical engineer registered or licensed in the Province of Nova Scotia.
- .2 Testing by Contractor will use Pile Driving Analyzer and Wave Equation Analysis to confirm driving criteria such as, hammer size and variation in impact, suitability of driving cap and cushions, and penetration resistance relative to set for initial driving and restriking. *Departmental Representative* will select piles to be tested.
 - .3 Dynamic monitoring of the pile driving using the pile driving analyzer will form the basis of determining pile capacities and determining final penetration resistance in initial driving and in restriking.
 - .4 The dynamic monitoring consists of attaching strain transducers and accelerometers to the pile, usually close to the pile head, and connecting these to a monitoring station nearby by means of a cable. Contractor must take care to ensure that no damage is done to the transducers, cables, or equipment.
 - .5 The preparation of the pile head will be done by the Contractor.
 - .6 Prepare piles to be instrumented by drilling and tapping holes for installation of strain transducers and accelerometers.
 - .7 Make allowance for probable interruption in driving for: changing or modifying hammer, cap, cushions, or other equipment; replacing or adjusting of transducers and accelerometers; and assessing of monitored results.
 - .8 Replace or adjust hammer and modify cap, cushions and other equipment, as directed by *Departmental Representative*.
 - .9 Confirm that final set has been achieved, when instructed, by restriking instrumented piles seven (7) days or more after determination of penetration resistance for initial set.
 - .10 The pile driving analyzer shall be on site prior to start of pile driving operations. The first three piles driven shall be monitored during
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initial driving and restrike, and two (2) CAPWAP (or approved equivalent) analyses performed.

- .11 After driving and monitoring the first three (3) piles driven, the pile driving analyzer shall be brought to the site on a minimum of three (3) additional occasions, at the discretion of the *Departmental Representative*. A total of three (3) piles shall be monitored on each occasion, during initial driving and restrike and two (2) CAPWAP (or approved equivalent) analysis performed. In addition, the pile driving analyzer shall be brought to the site:
 - .1 Prior to use of a hammer that has not been previously been monitored with the pile driving analyzer.
 - .2 When, in the opinion of the *Departmental Representative*, hammers are not performing properly.
 - .12 The cost for the dynamic monitoring will be considered incidental to the piling work and will not be separately measured.
 - .13 Contractor shall notify *Departmental Representative* at least two (2) days in advance of the pile driving analyzer arriving on site.
 - .14 Determine the static ultimate bearing capacity for piles that are tested. Determine developed capacities after restriking to investigate possible set-up or relaxation phenomenon. Determine the final penetration resistance to which the piles should be driven to ensure that the required pile bearing capacities are attained.
 - .15 Measure the actual driving stresses developed in piles and indicate whether the magnitudes are sufficient to cause damage to piles. Check on tensile stresses developed in driving through any loose soils and if such stresses are excessive, recommend how they should be reduced to safe levels.
 - .16 Measure the actual energies transferred to piles and determine the energy ratios (transferred energy as a percentage of manufacturer's rated energy), at final penetration resistance. Determine whether the pile hammer is operating in a sufficiently consistent manner to enable final penetration resistance values to be used as a control on pile driving. The *Departmental Representative* reserves the right to require the Contractor to overhaul or replace pile hammers operating in an erratic or excessively inefficient manner.
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Wharf Construction**Port Bickerton East****Guysborough County, Nova Scotia****Project No. R.082082.001**

Pile Foundations – General

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- .17 Indicate, from Analyzer records, the location and extent of suspected damage to any pile being monitored. When requested by the *Departmental Representative*, monitor any additional piles where damage is suspected.
 - .18 Employ auxiliary analyses and tests for determination of complex hammer or pile cushion stiffnesses, stress wave speed, or CAPWAP (or approved equivalent) analyses to determine damping and quake parameters, where deemed necessary by the *Departmental Representative* for proper monitoring of piles.
 - .19 Reference all depth measurements to Chart Datum. All elevations shall be measured from an established bench mark approved by the *Departmental Representative*.
 - .20 The dynamic monitoring shall be under the full-time site supervision of a geotechnical Engineer, registered in the Province of Nova Scotia, who is experienced in using and interpreting the Pile Driving Analyzer.
 - .21 Provide copies of Pile Driving Analyzer data to the *Departmental Representative* as it is collected in the field.
 - .22 On completion of the Analyzer monitoring of a pile, submit one copy of the test data to the *Departmental Representative*. Provide an interpretation of the findings in each case with recommendations, as applicable.
 - .23 Within seven (7) days after completion of initial pile driving analyzer testing, provide a written interim report describing results of the monitoring, CAPWAP (or approved equivalent) analysis, recommendations made and changes to pile driving operations that may have resulted.
 - .24 After completion of the total Analyzer Testing program, provide a final report in six (6) copies to the *Departmental Representative*, containing the following information:
 - .1 Project Data - Structure, location, name of Contractor, Client, vertical control datum, designation and locations of piles tested, etc.
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Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001

Pile Foundations – General

Page 7

- .2 Pile Installation Equipment and Methods - hammer details, hammer and pile cushion details, pile driving sequences, pile splicing arrangements, etc.
 - .3 Dynamic Testing - pile number, type, length, pile toe elevation and data driven, pile properties, penetration resistance, measured force and impact velocity, transferred energy, set values, wave equation analysis results, auxiliary testing and analysis, damping and quake values, bearing capacity, driving stresses, assumed soil properties based on bore hole information, hammer performance, pile integrity, interpretation, conclusions and recommendations, actions taken at site to adjust piling operations, etc.
 - .4 Other relevant information.
- .25 Make available immediately on request and maintain for at least five (5) years, all field data and test results including electronic test data. Do not erase records without written authorization from the *Departmental Representative*.
- 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 water jet, driving cap, cushion.
 - .3 Pile size, length and location.
 - .4 Sequence of driving piles.
 - .5 Number of blows per 500mm for entire length of pile and number of blows per 25 mm for last 100 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.
 - .9 All measurements, observations and calculations associated with pile driving analyzer and wave equation analysis.
 - .2 Provide *Departmental Representative* with three copies of records.
- 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.

Wharf Construction**Port Bickerton East****Guysborough County, Nova Scotia****Project No. R.082082.001**

Pile Foundations – General

- .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 Reinforce pile heads if necessary.
- .6 Do not drive piles within a radius of 8 m of concrete which has been in place less than 3 days.
- .7 Redrive piles lifted during driving of adjacent piles.
- .8 Use of water jet:
 - .1 Use water jets only with written permission of *Departmental Representative*.
 - .2 When water jets are permitted number of jets and volume and pressure of water must be sufficient to freely erode material immediately adjacent to pile. Plant must be capable of delivering water pressure of at least 690kPa as measured at two 20 mm nozzles.
 - .3 Restriction: stop jetting at a minimum of 1 m above tip elevation of piles previously driven within 2 m of jet, except where piles are to be carried to rock surface. Drive piles down beyond depth of jetting until required resistance is obtained. If there is evidence that jetting has disturbed load-bearing capacities of previously installed piles, restore bearing capacity of those piles by re-driving. Re-drive where necessary after jetting operations in area have been completed.
- .9 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.
- .10 Remove cut-off lengths from site on completion of work.
- .11 Installation of each pile will be subject to acceptance by *Departmental Representative*. *Departmental Representative* will be sole judge of acceptability of each pile with respect to final

Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001

Pile Foundations – General

driving resistance and depth of penetration. *Departmental Representative* to accept final driving of all piles prior to removal of pile driving rig from site.

- .12 Shape bottom of timber pile so that shoe will have full bearing on pile prior to driving. Install pile shoes using spikes.
- .13 Wood fender piles have to be driven to competent soil to develop the required lateral resistance. The required driving resistance is 4 blows for the last 25mm of pile penetration.
- .14 Contractor shall install temporary lateral bracing during construction to maintain position of the piles until casting of the deck.

3.6 Driving Tolerances

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

3.7 Obstructions

- .1 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.

3.8 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.

3.9 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*.

Wharf Construction

Port Bickerton East

Guysborough County, Nova Scotia

Project No. R.082082.001

END OF SECTION

Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001

Steel H-Piles

PART 1 - GENERAL1.1 Related Sections

- .1 Refer to other Specifications Sections for related information.
- .2 Refer to Section 01 33 00 for Shop Drawing/Submissions requirements.
- .3 Section 31 09 18 – Pile Driving Templates
- .4 Section 31 61 13 – Pile Foundations, General Requirements.

1.2 Measurement Procedures

- .1 Supply and installation of H-piles will measured in accordance with Section 01 29 00.
- .2 Consider pile shows as incidental to installation of piles.
- .3 Mobilization of equipment will be considered incidental to installation of piles.
- .4 Actual number and lengths of piles installed will be established by *Departmental Representative* from piling records.
- .5 Adjustments in contract price due to changes in number and lengths of piles will be based on unit prices established in Contract.

1.3 References

- .1 CSA W47.1-09 (R2014) Certification of Companies for Fusion Welding of Steel.
- .2 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
- .3 CSA W59-13, Welded Steel Construction (Metal Arc Welding).
- .4 CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.
- .5 CSA W59S1-M1989 (R1998) Supplement No. 1-M1989, Steel Fixed Offshore Structures, to W59-1989, Welded Steel Construction (Metal Arc Welding)

Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001

Steel H-Piles

Page 2

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- 1.4 Shop Drawings .1 Submit shop drawings in accordance with Section 01 33 00 - Submissions/shop drawings.
- .2 Indicate: pile shoes.
- .3 Each drawing submitted shall bear the signature and stamp of qualified Professional Engineer registered or licensed in the Province of Nova Scotia, Canada.
- 1.5 Test Reports .1 Furnish mill test reports indicating yield and chemical analysis of steel piles if requested by *Departmental Representative*.
- 1.6 Existing Sub-Surface Conditions .1 Sub-surface investigation reports are available for viewing at the *Departmental Representative's* office and at the offices of Public Works and Government Services Canada, 1713 Bedford Row, Halifax, N.S. Relevant borehole logs are included on the drawings.
- .2 Notify the *Departmental Representative* immediately if subsurface conditions at site differ from these indicated.
- .3 **The site is known to contain cobbles and boulders. Contractor shall be prepared to advance through cobbles and boulders as required.**
- 1.7 Measurement For Payment .1 Consider shoes and cap plates incidental to installation of piles.
- .2 Supply of steel H-Piles will be measured in accordance with Section 01 29 00.
- .3 Installation of steel H-Piles will be measured in accordance with Section 01 29 00.
- .4 Mobilization of equipment will be considered incidental to installation of piles.
- .5 Base tender on number and lengths of piles indicated on the plan.
- .6 *Departmental Representative* will establish actual number and lengths of piles installed from driving records.
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Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001

Steel H-Piles

.7 Adjustments in contract price due to changes in number and lengths of piles will be based on unit prices established in Contract.

1.8 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.

PART 2 - PRODUCTS

2.1 Materials

.1 Steel H piles: to CSA-G40.20/G40.21, Grade 350W. Size and weight as indicated on drawings.

.2 Welding materials: to CSA W48.

.3 Pile driving shoes: Pruyne Points – HP-75600 or approved equal.

PART 3 - EXECUTION

3.1 Installation

.1 Install piling in accordance with Section 31 61 13 - Pile Foundations – General.

.2 Hold piles securely and accurately in position during installation.

.3 Prior to commencement of pile installation operation, submit to *Departmental Representative* for approval, details of equipment and method to be used for the installation of piles.

.4 Cut off piles squarely at required elevation.

3.2 Welding

.1 Weld to CSA W59 and CSA W59S1.

.2 Welding certification of companies: to CSA W47.1 and CSA W47.1S1.

3.3 Records

.1 Keep complete and accurate record of each pile driven.

.2 Indicate:

.1 Pile location.

.2 Deviations from design location.

.3 Cross section shape and dimensions.

Wharf Construction

Port Bickerton East

Guysborough County, Nova Scotia

Project No. R.082082.001

Steel H-Piles

- .4 Original length.
- .5 Ground elevation.
- .6 Tip elevation.
- .7 Cutoff elevation.

3.4 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

Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001

Wood Piles

PART 1 - GENERAL1.1 Related Work

- .1 Refer to other Specification Sections for related information.
- .2 Refer to Section 01 33 00 for Shop Drawing/Submission requirements.
- .3 Section 31 09 18 – Pile Driving Templates.
- .4 Section 31 61 13 – Pile Foundations – General.

1.2 Reference Standards

- .1 CSA O80 Series-15, Wood Preservation.
- .2 NLGA standard grading rules for Canadian Lumber 1980 edition or most recent edition at time of tendering.
- .3 ASTM A123/A123M-15, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .4 ASTM A307-14, Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength.
- .5 CSA O56-10 (R2015), Round Wood Piles.
- .6 CSA G40.21-13, Structural Quality Steel.
- .7 CSA W59-13, Welded Steel Construction (Metal Arc Welding).

1.3 Submissions

- .1 At least two (2) weeks prior to finalizing timber order, submit a schedule of pile lengths for review.
- .2 Submit methodology for field treatment.
- .3 Provide submissions in accordance with Section 01 33 00.

1.4 Protection

- .1 Avoid dropping, bruising or breaking of wood fibres.
- .2 Avoid breaking surfaces of treated piles.
- .3 Do not damage surfaces of treated piles below cut-off elevation by boring holes or driving nails or spikes into them to support temporary material or staging. Support staging in rope slings

Wharf Construction
Port Bickerton East
Guysborough County, Nova Scotia
Project No. R.082082.001

Wood Piles

carried over tops of piles or by attaching to pile clamps of approved design.

- .4 Treat cuts, breaks or abrasions on surfaces of treated piles, bolt holes and field cuts in accordance with CSA O80 using field applied preservative.

1.5 Inspection

- .1 All timber piles to be inspected and accepted by *Departmental Representative* prior to being incorporated in the work.

1.6 Measurement
For Payment

- .1 Consider shoes and cap plates incidental to installation of piles.
- .2 Supply of timber fender piles will be measured in accordance with Section 01 29 00.
- .3 Installation of timber fender piles will be measured in accordance with Section 01 29 00.
- .4 Mobilization of equipment will be considered incidental to installation of piles.
- .5 Base tender on number and lengths of piles indicated on the plan.
- .6 *Departmental Representative* will establish actual number and lengths of piles installed from driving records.
- .7 Adjustments in contract price due to changes in number and lengths of piles will be based on unit prices established in Contract.

PART 2 - PRODUCTS

2.1 Materials

- .1 Round Wood Piles:
- .1 Fender Piles: Red pine, with minimum butt size of 300mm and tip diameter in accordance with Table A-1 CAN/CSA-O56. *Departmental Representative* shall be sole judge as to quality and dimension of piles or equal to CAN/CSA-O56.
- .2 Timber Treatment:
- .1 Preservative treatment to CSA O80 Series for Marine Construction Coastal Waters. Where assay retentions are not indicated, they are to be taken as 1.5 times the

Wharf Construction**Port Bickerton East****Guysborough County, Nova Scotia****Project No. R.082082.001**

Wood Piles

indicated gauge retention. Creosote preservative will not be permitted for fender piles.

- .2 Make arrangements for timber testing by:
 - .1 Plant Inspection: Provide treatment plant identification, date of treatment, list of various pieces in the charge, charge number, plant assay testing results, concentration and type of preservative used, duration of treatment, gauge retention, species of wood; and make arrangements with the treatment plant to locate bundles, move bundles, break open bundles and carry out other measures to facilitate the inspection.
 - .2 Field Inspection: Providing same information as above and facilitating the inspection in the field.
 - .3 Filling in and submitting a preprinted form, agreed to by the *Departmental Representative*, containing the above information.
- .3 The *Departmental Representative* may test in the plant or in the field or may choose to not test some charges at either the plant or the field.
- .4 Timber will be protected during handling, shipping, offloading and field handling, by use of suitable equipment and procedures. Use rope or fabric strap slings on site for moving bundles or individual timbers, rather than metal grabs, chains or cables.
- .5 Field treatment: same as pile preservative.
- .3 Miscellaneous Hardware: Hardware must meet the following specifications:
 - .1 Machine bolts, drift bolts, nuts, round plate washers: to ASTM A307
 - .2 Spikes: to CSA B111
 - .3 Pile shoes: fabricated from steel plate minimum 6 mm thickness. Steel plate to CSA-G40.21, Grade 300W. Welding to CSA W59. No galvanizing required.
 - .4 Hot dip galvanize bolts, nuts, washers and spikes to ASTM A123 with minimum zinc coating of 600 g/m².
 - .5 All hardware galvanized unless otherwise shown on plans or specified.

2.2 Wood Preservation

- .1 Wood piles are to be treated with wood preservative treatment as specified.

PART 3 - EXECUTION3.1 Handling Timber

- .1 Timber will be protected during handling, shipping, offloading and field handling, by use of suitable equipment and procedures. Use rope or fabric strap slings on site for moving bundles or individual timbers, rather than metal grabs, chains or cables.

3.2 Handling
Treated Timber

- .1 Handle treated material to avoid damage causing alteration in original treatment.
- .2 Treat in field, spike holes, boreholes, plugged holes, cuts and any damage to treated material, using preservative, as specified herein, regardless of plant treatment type.
- .3 Treat boreholes, using a pressurized container with an extension rod, to produce a fine spray in the holes with one application. Alternately a cylindrical brush may be used.
- .4 Treat field cuts and any abrasions with minimum of two liberal applications, using either spray or brush.
- .5 In addition, field cuts and underwater damaged areas will receive a coating of plastic compound, capped with lead flashing secured with galvanized roofing nails. Plastic compound not to be water soluble and is subject to approval.
- .6 Environmental Concern: Ensure no spillage or excess application of field preservative. Provide workmen with sufficient training and protective gear to properly and safely handle the treated materials and to apply field treatment, so as to prevent undue hazard to themselves, others, or the environment.
- .7 Contain all debris and leachates (films on water surface) within the area of the work by using containment facilities such as floating booms or screens.

3.3 Preparation

- .1 Protect pile heads during driving and hold in position by using a combination cushion-driving head and pilot. Closely fit driving heads to top of pile, and extend down sides of pile for at least 75

Wharf Construction

Port Bickerton East

Guysborough County, Nova Scotia

Project No. R.082082.001

Wood Piles

mm. Where necessary protect pile heads by means of heavy steel straps of wrought iron rings.

.2 Equip piles with metal shoes.

3.4 Installation

.1 Install piles in accordance with Section 31 61 13 – Pile Foundations – General.

.2 During driving restrain lateral movement of piling at intervals not exceeding 6 m over length between ground surface and driving head.

.3 Cut off fender piles giving a bevel of 4H:1V.

.4 Treat tops of cut off bearing and batter piles with two liberal coats of copper naphthenate and a minimum 13 mm of tar roofing felt, folded over sides of pile and securely fastened. Saturate felt with copper naphthenate preservative and cover with 20 gauge or thicker galvanized metal or aluminum sheet, completely covering felt. Apply this procedure regardless of type of preservative used for initial treatment of pile. This procedure is not required for tops encased in concrete.

END OF SECTION
