SECTION 903

CONSTRUCTION SPECIFICATION FOR PILING

INDEX

903.01 SCOPE

The scope of this specification is to cover the supply and driving of piles, sheet piles, and associated work, in steel or timber. Piles shall be supplied by the Contractor unless noted in the contract documents that piles shall be supplied by the Department.

903.02 MATERIALS

All materials shall be new and previously unused. The Contractor shall provide Mill Certificates and a Letter of Compliance for all piling and piling related materials used in the project.

903.02.01 Timber - Round Piles

Timber piles shall be clean peeled and shall comply with CSA-056 “Round Wood Piles.” Piles shall be pressure treated with a preservation treatment in accordance with CSA-080 “Wood Preservation.”

903.02.02 Steel Sheet Piles And H-Piles

Steel sheet piles and steel H-piles shall comply with the requirements of 300W specified in CSA G40.20/G40.21 “General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel” or ASTM A328/A328M “Standard Specification for Steel Sheet Piling.” The straightness tolerance shall be 25mm in 20 metres.

Two copies of the mill certificates, indicating that the steel meets the requirements of the appropriate standards for Sheet and H piles shall be submitted to the Owner’s Representative prior to shipment to the job site.

Where mill test certificates originate from a mill outside of Canada or the United States of America the Contractor shall have the information on the mill certificates verified by testing at a Canadian laboratory. The laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply to comply with the requirements of ISO/IEC 17025 “General Requirements for the Competence of Testing and Calibration Laboratories” for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian testing laboratory and appropriate wording stating that the material conforms to the specified material requirements. The stamp shall include the appropriate material specification number, the date (i.e., yyyy-mm-dd), and the signature of an authorized officer of the Canadian testing laboratory.

903.02.03 Steel Tube Piles

Steel tube piles shall be welded or seamless tube piles and shall comply with the requirements of ASTM A252/A252M “Standard Specification for Welded and Seamless Steel Pipe Piles” Grade 2 or Grade 3. If welded, they shall be welded by the Electric Arc method in accordance with CSA W59 “Welded Steel Construction.”

The straightness tolerance shall be 25mm in 20 metres.

2 copies of the mill certificates, indicating that the steel meets the requirements specified shall be submitted to the Owner’s Representative prior to shipment to the job site.

Where mill test certificates originate from a mill outside of Canada or the United States of America the Contractor shall have the information on the mill certificates verified by testing by a Canadian laboratory. The laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply to comply with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be

stamped with the name of the Canadian testing laboratory and appropriate wording stating that the material conforms to the specified material requirements. The stamp shall include the appropriate material specification number, the date (i.e., yyyy-mm-dd), and the signature of an authorized officer of the Canadian testing laboratory.

903.02.04 Pile Tips

As per the contract documents.

903.02.05 Concrete and Reinforcement for Steel Tube Piles

Concrete and steel reinforcement shall be in accordance with Section 904 and Section 905 respectively.

903.02.06 Storage and Handling

All piles shall be stored and handled in such a manner that damage is prevented and that design strengths will not be affected by deterioration or deformation.

903.02.07 Pile Cap Plates and Anchorages

As per the contract documents.

903.03 PILE DRIVING

903.03.01 General Requirements and Restrictions

Piles shall not be driven until other excavation is completed to below cut-off level. Any material forced up between the piles shall be removed to the correct elevation. Any fill material shall be placed to the underside of footing elevation before driving piles.

Piles shall not be driven within 15 metres of concrete placed during the preceding 7 days.

The Contractor shall not drive piles in such a manner that the piles are subjected to excessive or undue abuse. Forcing piles into their proper position by the use of excessive manipulation is prohibited.

The Contractor's driving operations shall not cause vibration sufficient to harm the construction or adjacent property.

The Owner’s Representative will reject any pile that is found to be defective or damaged. No additional compensation will be made for the removal and replacement or other work made necessary through rejection of a defective or damaged pile.

Piles will be driven from the center of the pile groups and will proceed outward.

903.03.02 Tolerances

Piles shall be driven as nearly as possible in the exact position specified on the drawings. After driving, piles at the cut-off elevation shall not be more than 75 millimetres from the location shown on the drawings.

Deviation from the vertical or required batter shall not be more than 20 millimetres per linear metre of pile. Any pile so out of line or plumb as to impair its usefulness shall be pulled and re-driven or an additional pile shall be driven as required by the Owner's Representative. The piles shall not be jacked or pulled laterally to bring their tops into correct location.

903.03.03 Driving Equipment

All piles shall be driven with a hammer developing an energy per blow of not less than 6X10^6 Joules (newton metre) times the cross sectional area of the pile (square metre) or as specified in the contract document. The energy should be capable of remote regulation to prevent damage to the piles. The piles and hammer shall be held securely in the correct alignment by rigid leads extending down to the lowest point the hammer must reach.

The use of vibratory hammers to drive or partially drive either H-piles or pipe piles must be accepted by the Owner's Representative.

Prior to pile driving, a WEAP analysis will be conducted by the testing company, selected as per section 903.06, to determine the penetration resistance for the given hammer and driving system.

Unless written authorization to stop driving has been received from the Department's Geotechnical Engineer, penetration to the depths stated in the contract documents shall be achieved even if blow counts indicate the required resistances have been achieved. Piles that have been stopped at a shallower depth for any reason shall not be cut until written approval specifically approving the cutting has been received from the Geotechnical Engineer. If blow counts have not been achieved at the penetration depth stated in the contract documents, the piles shall be driven deeper until the blow counts are achieved or approval to stop driving has been received from the Geotechnical Engineer.

903.03.04 Jetting

Jetting shall not be used unless written permission has been given by the Owner's Representative. Appropriate special conditions will be given should jetting be authorized.

903.03.05 Helmets

Pile heads shall be protected by helmets having adequate cushioning material next to the pile head. The helmet shall distribute the blow of the hammer evenly throughout the pile cross-section.

Timber piles shall be prevented from splitting by collars.

903.03.06 Records

The Contractor shall not commence driving piles in the absence of the Owner's Representative.

Blows per 300 millimetres for each 300 millimetres shall be recorded. For the final 300 millimetres the blows per 25 millimetres shall be recorded.

When driving is interrupted before final penetration is reached, the final record of penetration shall not be taken until, on resumption of driving, a further penetration of 300 millimetres has been obtained.

The Owner's Representative will maintain daily records of driving for each pile which will include the type and make of hammer, rated energy, observed stroke and observed blow rate. The pile size and length, location within the pile group, the time of start and time of finish for the driving of each pile and the sequence of pile driving within each group will be recorded. The toe elevations upon termination of driving piles will be documented as will the elevation of the toes of adjacent piles before striking of any pile. Any interruption of continuous driving, and any observed pile damage will also be recorded.

903.03.07 Re-driving

Piles pushed up by driving or loosened by jetting of adjacent piles shall be re-driven to comply with the requirements of the contract. Similarly, if a pile(s) is suspected to have hung up on a boulder, the Contractor shall re-drive the pile(s) in question as well as others in the immediate vicinity.

After all piling is complete and all piles are driven to meet project criteria, the Contractor shall return to each footing and re-drive at least 10 percent of the piles in each footing rounded to the next highest number of piles plus one. The piles selected for re-driving shall be randomly selected by the Owner's Representative. If movement exists on 1 or more piles, additional piles shall be re-driven until the Owner's Representative is satisfied that all piles have met the design criteria as established on the contract drawings or in the specifications.

The Contractor is advised that piling shall not be cut-off until all re-driving is complete.

903.03.08 Driving Of Tube and H-Piles When Boulders Are Anticipated Or Driving To Bedrock

When boulders are anticipated, pile tips shall be fitted. Driving shall be carried out until the pile tips make contact with rock. Driving energy shall be decreased to about a quarter and the pile shall be subjected to twenty blows. Energy can be increased with approval from the Owner's Representative by 25% at twenty blows for each interval until the Owner's Representative is satisfied that the requirements of the contract are complied with. Adjacent piles should then be re-driven.

When steel tube and H-piles are to be driven to and chipped or socketed into bedrock, rock injector pile tips shall be fitted to the ends of the piles. The piles shall be chipped into the bedrock using low energy. When the piles are firmly seated, the energy shall be increased in stages or intervals and eventually driven to refusal at the rated energy as stipulated in the contract documents.

903.04 SPLICES

903.04.01 Timber Piles

No splices will be permitted for timber piles.

903.04.02 Steel Piles

No splices will be permitted for steel piles except where allowed for in the contract or as authorized by the Owner's Representative unless the toe elevations for the pile should extend beyond those specified in the contract drawings.

When permitted, Contractor shall provide detailed drawings and calculations for the Owner's Representative to review. Design details of splice shall bear dated signature and stamp by a Professional Engineer registered or licensed in the Province of Newfoundland and Labrador, Canada.

Welding design shall be according to CSA W59 and shall be done by a qualified welder employed by a firm certified according to CSA W47.1 "Fusion Welding of Steel Company Certification", Division 1 or Division 2.1. Welding procedures shall be according to CSA W47.1 and CSA W59, and the latest edition of CSA S6 "Canadian Highway Bridge Design Code."

If accepted by the Owner's Representative, splice piles in place during installation by welding. To prevent distortion, tack opposite points first and then weld opposite sections for pipe walls thinner than 10 millimetres weld against a backup ring. Hold members in alignment during splicing operation. Make splice by complete joint penetration groove welds as indicated on shop drawings.

If splices are within 5.0 metres of the pile cut off elevation specified then they shall be made with complete penetration welds as per the details on the contract plans and all welds shall receive 100% ultrasonic or radiographic inspection.

Pile splices specified as part of the design specifications which are below 5.0 metres from the pile cut off elevation shall be made with complete penetration welds as per the details on the contract plans. All piles shall receive visual Inspection with 20% of the piles rounded to the next highest number receiving 100% ultrasonic or radiographic inspection. Piles chosen for testing shall be determined by the Owner's Representative.

The Contractor shall employ an independent testing company with no corporate affiliation to carry out the visual inspection and non-destructive testing of welds. The independent testing company shall be certified by the Canadian Welding Bureau to the requirements of CSA W178.1 “Welding Inspection Organizations Company Certification” for bridge structures by radiographic or ultrasonic test methods. The welding inspector shall have documented evidence of training, professional knowledge, skill and experience in visual inspection of structural steel welds and material, and have a valid certificate showing qualification to a Level II or III according to CSA W178.2 “Certification of Welding Inspectors.”

903.05 CONCRETE FILL IN TUBULAR STEEL PILES

After acceptance by the Owner’s Representative, the pile shells including rejected shells left in the ground shall be cut off at the required elevation and shall be filled with concrete.

Prior to filling each pile, the inside shall be inspected with an electric lamp attached to a drop cord of sufficient length to reach the bottom of the pile. Any debris and water shall be removed before placing the concrete.

Reinforcing steel shall be installed in the concrete fill at the top of all the piles as shown on the drawings.

No concrete shall be placed until all driving within a radius of 15 metres has been completed. If this cannot be done, driving within these limits shall be stopped until the concrete in the last pile has set for at least 7 days.

Concrete shall be placed continuously until the shell is filled.

The concrete shall be worked thoroughly down into place and compacted with a vibrator to the lowest extent of the reinforcement.

After placing, the concrete shall be protected from frost for at least 3 days.

903.06 PILE TESTING REQUIREMENTS FOR DRIVEN PILES

Dynamic monitoring of the pile driving will be conducted on the greater of: 10% of all piles in each abutment or at least 4 piles in each abutment; to confirm pile resistances, energy transfer to piles and performance of the pile-driving hammer. Pile tests will be done in accordance with ASTM D4945 “High Strain Dynamic Testing of Piles”, using a Pile Driving Analyzer. Testing will be conducted by a qualified testing company selected by the Contractor from the approved list in the Contract Documents. The use of an alternate dynamic testing company other than those indicated will require the prior approval of the Department.

50% of the piles to be tested at each abutment will be driven to full penetration according to the pile driving criteria outlined above. The remaining 50% of piles to be

tested will be driven and stopped prematurely, approximately 1 to 2 metres higher. Test piles will not be driven adjacent to each other because a temporary change in pore pressures may affect the measured resistances. After waiting at least 3 days to allow soil set-up or relaxation to develop, the shallower piles will be driven to full depth while taking dynamic measurements to determine pile resistance at end of initial driving. The deeper piles will then be re-struck and monitored to determine the pile resistance at re-striking. No extra compensation will be paid for the above described waiting period.

Pile capacities as determined in the field by dynamic testing will be confirmed by the dynamic testing company by completion of a Case Pile Wave Analysis Program (CAPWAP) analysis on a minimum of one of the tested piles from each abutment.

During the dynamic testing, the testing company will provide preliminary estimates of the ultimate axial compression capacity of each pile tested as well as hammer performance and driving stresses. Conformation of tested pile capacities, by completion of CAPWAP analysis will be provided within 24 hours of testing. 1 physical copy and 1 electronic copy of the testing company's final report, signed and sealed by a licensed member of the Association of Professional Engineers and Geoscientists of Newfoundland and Labrador, containing all test results and analysis will be provided within 7 days of completion of testing.

The locations of piles to be dynamically tested will be determined in the field by the Owner's Representative and will be as recommended by the Materials Engineering Division. The Contractor will advise the Owner's Representative at least 2 weeks prior to the commencement of pile driving. Information on the dynamic testing company selected as well as the Contractor's pile driving equipment and method of installation as previously supplied to the Owner's Representative shall be confirmed at that time. The Contractor will co-ordinate with the dynamic testing company to ensure that the schedule for the dynamic monitoring is adhered to by providing all related access and assistance to enable the testing company to expeditiously perform the monitoring. No delay or other type of claims will be considered by the Department with regard to Dynamic load testing.

The Contractor will assist in the testing by providing personnel to climb the leads carrying the gages and cable and attaching the gauges by bolting them to the holes. Alternatively, the gauges will be attached to the piles before the piles are lifted and inserted into the leads. In this case, the Contractor is responsible for any damage or loss caused to the cable or gauges.

After all piles have been installed and dynamic testing of the specific number of piles has been completed, the remaining piles at both abutments will be re-struck, as per Section 903.03.7 to determine if the pile penetration resistance has decreased due to the relaxation or increased development of set-up. Where relaxation occurs the pile capacity will be re-evaluated by dynamic analysis.

903.07 MEASUREMENT FOR PAYMENT

903.07.01 Sheet Piles

903.07.01.01 Supplied

The measurement for “Supplied” will be in square metres to the nearest one decimal place. For payment purposes the measurement for sheet piles supplied will be based upon the actual quantity installed provided this quantity equals or exceeds the quantity estimated in the Unit Price Table. If the actual quantity installed is less than the quantity estimated then payment will be made for supplying the quantity installed plus the total area of unused sheet piles but not exceeding the estimated quantity. Unused sheet piles will include only uncut sheet piles in lengths originally supplied to the Contractor and, if necessary, cut-off sections of sheet pile whose lengths are 3 metre or longer. For payment purposes the length of cut off sections will be calculated based upon the difference between the estimated pile toe elevation as shown on the contract drawings and the actual pile toe elevation.

903.07.01.02 Installed

The measurement for “Installed” will be in square metres to the nearest one decimal place based upon the actual quantity of pile installed and left in place after cut off as accepted by the Owner’s Representative.

903.07.02 Piles Other Than Sheet Piles

903.07.02.01 Supplied

The measurement for “Supplied” will be in linear metres to the nearest one decimal place. This measurement shall include both battered and vertical piles.

For payment purposes the measurement for “Supplied” will be based upon the actual quantity installed provided this quantity equals or exceeds the quantity estimated in the Unit Price Table. If the actual quantity installed is less than the quantity estimated then payment will be made for supplying the quantity installed plus the total length of unused piles but not exceeding the estimated quantity. Unused piles will include only uncut piles in lengths originally supplied to the Contractor and, if necessary, cut-off sections of piles whose lengths are 3 metres or longer. For payment purposes the length of cut off sections will be calculated based upon the difference between

estimated pile toe elevation as shown on the contract drawings and the actual pile toe elevation.

903.07.02.02 Installed Vertical Piles

The measurement for “Installed Vertical Piles” will be in linear metres to the nearest one decimal place based upon the actual quantity of pile installed and left in place after cut off as accepted by the Owner’s Representative.

903.07.02.03 Installed Battered Piles

The measurement for “Installed Battered Piles” will be in linear metres to the nearest one decimal place based upon the actual quantity of pile installed and left in place after cut off as accepted by the Owner’s Representative.

903.07.02.04 Pile Splices

The measurement for “Piles Splices” will be measured according to the actual number used, authorized and accepted by the Owner’s Representative and properly installed.

903.07.02.05 Pile Tips

The measurement for “Pile Tips” will be measured according to the actual number used, authorized and accepted by the Owner’s Representative and properly installed.

903.07.02.06 Pile Cap Plates and Anchorages

Pile cap plates and anchorages will not be measured and are considered incidental to the work.

903.07.03 Rejection

Any piles, tips, plates and anchorages which are rejected for reasons of improper driving, positioning or damage shall not be included in the above measurements.

903.08 BASIS OF PAYMENT

903.08.01 Sheet Piles

903.08.01.01 Supplied

Payment at the contract price for “Supplied” in the Unit Price Table shall be full compensation for all labour, materials, supplies, and equipment required to complete the work associated with the supply of piling, loading and transportation to the jobsite, unloading, handling and storage of piling materials.

Unused sheet piles shall be loaded, transported and off-loaded by the Contractor to a designated area at the nearest maintenance depot as part of the demobilization item detailed in Section 157 of the Specifications Book. When the Contractor transports the unused piles they shall present a receipt for the piles, signed by the Depot Foreman, to the Owner's Representative.

The quantity of wastage (defined as the quantity supplied to the site less the pay quantity) shall be the Contractor's responsibility and payment will not be made for such. The Owner's Representative shall determine the quantity of wastage.

903.08.01.02 Installed

Payment at the contract price per square metre for "Installed" in the Unit Price Table and shall be full compensation for all equipment, labour, cranes, crane movements, positioning, driving, cleaning, painting, protecting, and pile cut-off.

The re-driving of piles shall be considered incidental to the work and extra payment will not be made for the same. However, where the Contractor succeeds in increasing the length of piling in the works they shall be compensated for supply and installation of this material.

No payment will be made for falsework piling.

Payment for pile template(s) shall be considered incidental to the work and payment will not be made for such.

903.08.02 Piles Other Than Sheet Piles

903.08.02.01 Supplied

Payment at the contract price for "Supplied" in the Unit Price Table shall be full compensation for all labour, materials, supplies, equipment, and testing required to complete the work associated with the supply of piling including pile cap plates and anchorages, loading and transportation to the jobsite, unloading, handling and storage of piling materials.

Unused piles shall be loaded, transported and off-loaded by the Contractor to a designated area at the nearest maintenance depot as part of the demobilization item detailed in section 157 of the Specifications Book. When the Contractor transports the unused piles they shall present a receipt for the piles, signed by the Depot Foreman, to the Owner's Representative.

Wastage (defined as the quantity supplied to the site less the pay quantity) shall be the Contractor's responsibility and payment will not be made for such. The Owner's Representative shall determine the quantity of wastage.

903.08.02.02 Installed Vertical Piles and Installed Battered Piles

Payment at the contract price for "Installed Vertical Piles" and "Installed Battered Piles" in the Unit Price Table shall be full compensation for all equipment, labour, cranes, crane movements, positioning, driving, cleaning, painting, protecting, pile cut-off, pile cap plates and pile anchorages.

The re-driving of piles shall be considered incidental to the work and extra payment will not be made for the same. However, where the Contractor succeeds in increasing the length of piling in the works they shall be compensated for supply and installation of this material.

Where pile capacity is established by dynamic analysis and relaxation occurs the Contractor shall have the pile capacity re-evaluated. Piles are defined to have relaxed when more than 125 millimetre average movement occurs in those piles subject to re-driving as defined in Section 903.03.07 above. Dynamic analysis re-evaluation shall be conducted by an agency accepted by the Owner's Representative. The cost of the dynamic analysis re-evaluation shall be paid for by the Department. All other costs including but not limited to the cost of delay shall be considered incidental to the tendered price for piles driven.

No payment will be made for falsework piling.

All costs involved in filling tube piles with concrete and reinforcing shall be incidental to "Installed Vertical Piles" and "Installed Battered Piles".

Costs for pile template(s) shall be considered incidental to the work and payment will not be made for such.

903.08.02.03 Pile Splices

Payment at the contract price for "Pile Splices" in the Unit Price Table shall be full compensation for all labour, equipment, materials and services necessary to design, supply, deliver, and install pile splices and provide the specified visual and non-destructive testing.

Any approved field splicing will be considered incidental to the work.

903.08.02.04 Pile Tips

Payment at the contract price for “Pile Tips” in the Unit Price Table shall be full compensation for all labour, equipment and materials necessary to design, supply, deliver and install the pile tips.

903.08.02.05 Pile Cap Plates and Anchorages

Pile cap plates and anchorages are incidental to the work.

903.08.03 Jetting

No additional payment shall be made for jetting, if authorized.