SECTION 909

MARINE STRUCTURES

INDEX

909.01 SCOPE

The scope of the work includes, (a) the supply of timber and all necessary fastenings, fabrication, placing, and ballasting of timber cribwork (b) the supply and placing of ballast stone, filter fabric, granular fill, and wharf deck concrete, (c) the supply and installation of hardwood sheathing, wheel guards, chocks, ladders, ramp barrier, fendering and mooring cleats.

The Contractor is advised that the ferry terminal will normally be operational during construction and that all work shall be scheduled so as to ensure a minimum of disruption to service.

A total work schedule shall be submitted to the Owner's Representative for approval at least 1 week prior to the commencement of any work and subsequent partially revised work schedules will be submitted for the approval of the Owner's Representative on a weekly basis for the week following. The Contractor is again advised that all work schedules shall be accepted by the Owner's Representative.

The ferry boat(s) shall normally be in continuous operation during the construction period and the Contractor is to consider this when determining prices and schedules for his tender.

909.02 GENERAL

909.02.01 Dimensions

The Contractor shall construct and install timber cribs to dimensions indicated on the drawings. All dimensions at site shall be checked before commencing work and any discrepancies shall be reported to the Owner's Representative, in writing.

909.02.02 Protection

The Contractor shall protect completed work from damage resulting from work on other sections, from damage resulting from environmental conditions and shall repair or replace portions or entire crib(s) at no extra cost.

The Contractor shall be responsible for his work and for consequences resulting therefrom during construction, including floating, towing, setting, and ballasting until final acceptance.

909.03 MATERIALS

909.03.01 Timber

Timber shall be used which has been graded and stamped in accordance with applicable grading rules and standards of associations or agencies which have been accepted to grade timber by the Canadian Lumber Standards Administration Board of CSA. All lumber and timber shall be sawn.

Only Douglas Fir, Pacific Coast Hemlock, or Eastern Hemlock shall be used; grade shall be Number 1-Structural.

909.03.02 Hardwood

Hardwood shall be construction grade treated birch, maple, or other species as approved by the Owner's Representative.

909.03.03 Grading Authority

National Lumber Grades Authority (N.L.G.A.)

909.03.04 Miscellaneous Steel

All steel shall be medium structural steel conforming to CSA G40.21, "Structural Quality Steels", or the latest edition thereof.

909.03.04.01 Connections

A	NAILS AND SPIKES SHALL CONFORM TO THE CSA SPECIFICATION B111-1974, "WIRE NAILS, SPIKES, AND STAPLES".	C	DRIFT BOLTS SHALL BE MADE FROM ROUND STOCK, DIAMOND OR WEDGE POINTED, AND HAVE A BUTTON HEAD. THE LENGTH OF DRIFT BOLTS SHALL EQUAL THE SUM OF TIMBER FASTENED LESS 50MM.

B	BOLTS AND NUTS SHALL CONFORM TO THE CSA SPECIFICATION B33.1-1961, "SQUARE AND HEXAGON BOLTS AND NUTS, STUDS AND WRENCH OPENINGS".	D	LAG SCREWS SHALL CONFORM TO THE CSA STANDARD B34-1967, "MISCELLANEOUS BOLTS AND SCREWS", TABLE 18.
		E	WASHERS SHALL CONFORM TO THE FOLLOWING STANDARDS:-

All lag screw washers shall conform to the CSA B19.1 "Plain Washers", for Class 2 - Common Punched Washers with wide rims.

Round plate washers for 13mm and 16mm diameter machine bolts shall be 6.4mm thick x 76.2mm diameter and have a hole diameter of 15mm and 18mm respectively.

Round plate washers for 19mm, 22mm and 25mm diameter machine bolts shall be 7.9mm thick x 76.2mm diameter and have a hole diameter of 21mm, 24mm and 27mm respectively.

Washers shall conform to G40.21-M1978, latest edition	The use of square washers shall not be permitted.
Two (2) washers shall be used with each machine bolt.	All hardware for cribwork shall be galvanized

909.03.05 Galvanizing

Galvanizing shall conform to CSA G164 "Hot Dip Galvanizing of Irregularly Shaped Articles". Unless otherwise specified, the minimum weight of zinc coating shall be as stated in Table 1 of this Standard. The fabricator is to adhere to the recommendations of Appendix A and Appendix B of the Standard.

909.03.06 Ballast Stone

Ballast used for filling cribs shall have a minimum dry bulk density in place of 2600 kg/m^3 (SSD). Ballast shall consist of hard, durable quarry stone or natural rock pieces, free of organic material, silt or foreign substances. Ballast shall be a maximum size not exceeding 400mm on any side and minimum size of not less than 300mm on any side.

The rock material, if subjected to the Los Angeles Abrasion Test (ASTM C131 “Standard Test Method for Resistance to Degradation of Small Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine”), shall have a loss not greater than 40%. When tested for soundness, five cycles of magnesium sulphate, ASTM C88 “Standard Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate”, the rock material shall have a loss not greater than 15%.

909.03.07 Filter Fabric

Non-woven geotextile filter fabric shall have the following minimum mechanical properties: thickness 3.0mm, mass of 270 gm/m^2, tensile strength of 550 Newtons, 100 percent elongation at rupture, Mullen Burst strength of 1700 KPa, Ball Burst strength of 1350 Newtons, tear strength of 290 Newtons. These typical properties shall be as defined by CGSB CAN2 4.2.

909.03.08 Granular Fill

Granular fill shall be in accordance with Section 902 “Select Materials Compacted – Granular”". However, the gradation shall comply with Granular "B" for selected Granular Base Course Material.

909.03.09 Wood Preservation

All timber shall be treated in conformance with Section 590.

909.03.10 Wharf Concrete

Concrete and all component materials shall conform to Section 904.

909.03.11 Reinforcing Steel

Reinforcing steel shall conform to Section 905.

909.03.12 Ramp Barrier

The posts shall be cut from 115mm outside diameter galvanized steel pipe, schedule 40, 6.0mm wall thickness and fitted with a galvanized steel cap. The barrier chain shall be 9.5mm, galvanized steel. The caution marker shall be painted aluminum, and can be purchased at the Department of Works, Services, and Transportation Depot, White Hills, St. John's. The lockset shall be top quality brass, pad-lock type, equivalent to Viro No. 303, or approved equal.

909.03.13 Mooring Cleats

The cast iron mooring cleat shall have an approximate minimum weight of 209kg and shall be as manufactured by I.M.P. Group Limited, or approved equal. The exact details for the mooring cleat and cleat block are shown on the drawings. Anchors for mooring cleats shall be 1000mm long, 25mm diameter machine bolts, complete with 6mm flat washers and nuts.

909.03.14 Rubber Fendering

909.03.14.01 Rubber Blasting Mat Type Fendering

Materials used in the fabrication of new rubber blasting mat type fendering shall be sections of used rubber tires; new 20mm diameter galvanized fibre core wire rope and 6mm thick steel bars

Williams NEB-100, E-1 galvanized eyes, 25mm Williams Super high tensile steel, solid, all thread, anchor bolts complete with hex nuts and plates shall be utilized in the fendering system. All wire rope clips, 20mm diameter shackles with screw pins, clamps and hardware shall be galvanized.

All materials shall be subject to the approval of the Owner's Representative and conform to that shown on the contract drawings.

909.03.14.02 Rubber Tire Type Fendering

The 14:00 x 24 or larger rubber tires, if indicated on contract drawings, used for fendering shall be of reasonable quality and shall be accepted by the Owner's Representative.

New 20mm diameter, galvanized, fibrecore wire rope of the appropriate length as determined by the Owner's Representative shall be utilized to hang the fender in place. All hardware shall be galvanized and as shown on the contract drawings.

909.04 CONSTRUCTION AND FABRICATION

909.04.01 Preparation for Timber Cribwork Construction

The Contractor shall take closely spaced accurate soundings, 1500mm centre to centre or less, precisely located by a template to determine actual slope of sea bed over the base area of crib and construct crib bottom to match sea bed slope.

The Contractor shall have on hand, prior to sinking of a crib, sufficient ballast stone to completely fill the crib. The Contractor shall also provide suitable plant and equipment to keep the crib in proper position and alignment during the sinking operation.

If a crib is out of alignment or not in the correct location, the Contractor will be required to refloat the crib and replace the crib in its correct position.

909.04.02 Treated Timber Crib Work Construction

The timber cribs shall be constructed as shown on the contract drawings and to at least 500mm above LNT and the Owner's Representative's approval obtained prior to sinking in final position in the work. In general, the following procedure shall be adhered to:-

a) Levelling Pieces: Place levelling pieces beneath bottom timbers in such a manner that they will conform to the shape of the ground. Place levelling pieces horizontally so that succeeding pieces will be solidly secured at intersections of bottom timbers and vertical posts and other levelling pieces by means of machine bolts of proper lengths.

b) Bottom Timbers: Place bottom timbers lengthwise and crosswise to form the bottom three courses of the cribs. Crosswise and lengthwise bottom timbers shall be of one piece and spaced as shown on the drawings. Secure three courses of bottom timbers together with machine bolts at every intersection with each other and vertical posts.

c) Ballast Floor: Place ballast floor on all pockets of the bottom or middle course of bottom timbers. Secure each ballast floor timber to bottom timbers with drift bolts so that adjacent ballast floor timbers are not secured to same bottom timber.

d) Longitudinals: All longitudinals for individual cribs shall be in one length below elevation 500mm. Above this elevation, where the cribs are married, the longitudinals shall be of sufficient length to span one bay of one crib and one half bay of the adjacent crib. Where they are joined, they shall be butt joined by mid bay in the middle of a 1200mm block, the block being secured to the timber below by a drift bolt in the centre and the longitudinal to the block by drift bolts in the ends of the longitudinal, for all longitudinals, butt joints shall form a staggered pattern and adjacent longitudinals directly above or below shall not be joined in the same bay. All longitudinals shall be secured to the crossties at every intersection by a drift bolt and to the vertical post by a machine bolt every third course of longitudinals.

e) Crossties: Crossties to be in one length across cribs. Secure crossties to intersection of longitudinals by a drift bolt and to intersection of vertical posts by a machine bolt every third course of crossties. The top course shall be machine bolted as well. All machine bolts on the exterior face from elevation 300mm below LNT to the deck elevation shall be countersunk.

f) Vertical Posts: Vertical posts are to be in one length from the bottom of the cribwork to the underside of the concrete deck. One vertical post shall be located at each corner of each crib and at the intersection of the crossties with the longitudinals. Vertical posts shall be secured to the crossties and longitudinals at every third course with machine bolts of adequate length. Where two cribs are married together, one of the adjacent vertical posts may be eliminated 500mm above LNT.

g) Fillers: Blocking shall be placed in the cribwork as indicated on the drawings, and as directed by the Owner's Representative. It shall be the exact length to completely fill the proper spaces and shall be placed under all crossties and longitudinals which are carrying the bearing weight of the deck. It shall be of the same size and material as the crossties or longitudinals, full length, and shall be drift-bolted with two bolts into the timber immediately below it.

h) Holing: Bore holes for drift bolts 1.5mm smaller than the bolt diameter and for full length of bolt. Bore holes for machine bolts to same diameter as bolt. The inside of all drilled holes shall be thoroughly treated with one coat of wood preservative.

i) Ballast Stone: Place ballast stone in such a manner not to damage timber cribwork. The Owner's Representative will be the sole judge as to the acceptability of the placing method. Place ballast so that differential height of fill between adjacent cells will be less than 1000mm.

j) Hand place final items of ballast stone to fill voids and depressions so as to hold gravel in place.

k) After the final items of ballast stone are in place and before any granular fill is put in place, a layer of filter fabric shall be loosely spread over the ballast stone. All joins in the filter fabric shall be lapped 200mm. The filter fabric shall be securely held in place until the granular fill is placed on top of the fabric. Vehicular traffic will not be permitted to operate directly on the fabric.

l) A 150mm thick layer of granular fill shall be placed over the top of the ballast and filter fabric in the crib to form a base for the wharf concrete deck. Install gravel to the grade required and compact to 100% of the maximum Standard Proctor Dry Density (ASTM D698-78) in preparation for concrete slab work.

909.04.03 Treated Dimension Timber

Treated dimension timber wheel guard and wheel guard blocking shall be installed on the exterior faces of the wharf, as shown on the drawings.

The treated timber wheel guard and coping shall be in lengths of at least 6000mm, unless otherwise specified.

Butt joints shall be made over blocks 600mm long. Similar blocks shall be used as supports under the wheel guard spaced at 1500mm on centres. The wheel guard shall be secured through the blocking to the material below by means of galvanized hardware as shown on the drawings.

The wheel guard and wheel guard blocks shall be given two coats of best quality marine alkyd base paint, colour red. The first coat shall be applied when the wood is dry, and the second coat shall be applied when the first coat is dry; all painting being done when weather conditions are suitable for painting. A treated timber coping shall be installed around the perimeter of the wharf structure, as shown on the drawings.

The coping shall be fastened to the underlying timber using 16mm diameter drift bolts spaced at 1500mm centres and secured to the concrete deck with 16mm diameter galvanized machine bolts on 1500mm centres, complete with nuts and washers.

909.04.04 Treated Hardwood Sheathing, Fenders, Chocks, and Ladders

Treated hardwood sheathing, fenders, chocks, and ladders shall be placed on the exterior faces of the wharf, as shown on the drawings.

The fenders shall be installed at 600mm centres and the lengths shall be as shown on the drawings. Each fender shall be fastened with 3 13mm diameter galvanized lag screws, complete with washers and shall be counter sunk. Fenders shall be bevelled 40^{o}, top and bottom. Chocks of the same material as the fenders shall be fitted and fastened in 3 rows between the fenders. Each chock shall be fastened with 2 13mm diameter galvanized lag screws complete with washers and countersunk.

The treated hardwood sheathing shall be installed to the lengths shown on the drawings. The sheathing shall have a minimum width of 150mm and a maximum width of 250mm. Each member shall be fitted tight to the adjacent sheathing and fastened with 3 13mm diameter galvanized lag screws. Sheathing more than 150mm in width shall be fastened with 5 galvanized lag screws, staggered. The top and bottom of each member shall be bevelled 45°.

The ladders shall be located as shown on the drawings or as directed by the Owner's Representative. The ladder rungs shall be 25mm diameter galvanized steel rods, 1000mm long at 300mm centres. A handhold consisting of a 25mm diameter galvanized steel rod 1500mm long, bent as shown and embedded 150mm into the wheel guard, shall be provided for each ladder. The ladder uprights shall consist of 4 pieces of 150mm by 150mm treated hardwood and shall be secured to the cribwork by 4 equally spaced 13mm diameter galvanized lag screws, complete with washers and countersunk. The top and bottom of each ladder upright shall be bevelled 45 degrees.

909.04.05 Rubber Fendering

909.04.05.01 Rubber Blasting Mat Type Fendering

Fenders shall be specially fabricated for use in a marine environment to absorb energy when impacted by marine traffic. Single purpose blasting mats are not acceptable.

New quality blasting mat type fendering shall be from 250mm to 300mm thick. The horizontal and vertical dimensions shall be as stated on the contract drawings.

The mat shall be fabricated from rubber tire sections and secured together with 20mm diameter galvanized wire rope spaced at 400mm on centre running in one direction and 6mm thick steel bars spaced at 400mm on centre running in the perpendicular direction. Additional steel bars shall be added along one side and parallel to the cables so that when hung in place they run along the top of the mats but still permit it to bend around the corner.

Galvanized wire rope shall extend from the top of the mat(s) and shall be secured to Williams NEB-100, E-1 galvanized eyes. The eyes are to be fastened to 25mm Williams super high tensile steel, solid all thread anchor bolts c/w Hex nuts and plates. Other arrangements may be required if so indicated on the contract drawings.

The new blasting mat type fender shall be hung in position so that the galvanized wire ropes lie in a horizontal position with the rubber tire section hanging vertically. In this

regard, the manufacturer shall clearly mark on the mat the correct position in which it is to be hung.

All ends of wire rope shall be connected to eye bolts and ring bolts using a minimum of three wire rope clips and 20mm shackles with screw pins.

Rubber tire blasting mat type fenders shall be fabricated, suspended and secured in place as indicated on the contract drawings.

909.04.05.02 Rubber Tire Type Fendering

The fendering unit shall be fabricated, suspended from the concrete deck and held in place at the bottom of the fender as indicated on the contract drawings. All wire rope utilized to hang and secure the fender shall be 20mm galvanized steel wire rope.

Rubber tire type fenders shall be held together and suspended in a vertical plane using a single wire rope, passed through a hanger or fastening device at each end, looped, and secured to itself with suitable clamps. In addition, these fendering units may be secured in the horizontal plane using rope suitably clamped around and through each fendering unit and secured at each end if so indicated on the contract drawings.

909.04.05.03 Ramp Barrier

The barrier shall consist of foundations, two posts, chain, padlock, and caution marker.

Ramp barrier, posts, chain, concrete foundations, hardware, and caution marker shall be fabricated and erected as indicated herein or as shown and detailed on the contract drawings. The contractor shall completely fill the ramp barrier posts with concrete.

The foundations for the ramp barrier posts shall be excavated to a depth as shown on the contract drawings. The posts shall be set in concrete. The concrete foundation block shall be 30 MPa in 28 days and shall measure 500mm on each side. The excavation shall be backfilled with clean, granular backfill conforming to Granular "B" gradation. The backfill shall be compacted in 250mm lifts to 95% of the maximum Standard Proctor Dry Density (ASTM D698).

909.04.05.04 Mooring Cleats

The mooring cleat shall be secured to the concrete cleat block by 6 machine bolts complete with flat washers and nuts. After installation, the bolt holes in the cleat shall be filled with an approved sealing compound.

Submit shop drawings of mooring cleat for approval by the Owner's Representative.

909.04.05.05 Wharf Concrete

Construction of the wharf concrete shall consist of 3 concrete types; (a) "Mass Concrete" required to fill specified voids within the crib, (b) "Reinforced Wharf Deck Concrete" which includes the wharf deck, fendering blocks, cleat blocks and the vehicular loading ramp and (c) "Tremie Concrete" where specified.

Construction of the wharf concrete shall be as outlined on the contract drawings and as specified herein. The construction procedure, the supply, mixing, transportation, placing, finishing and curing of the (a) "Mass Concrete", (b) "Reinforced Wharf Deck Concrete" and (c) "Tremie Concrete" shall be as outlined in Sections 904 and 905 of the Specifications Book for "Concrete Structures" and "Concrete Reinforcement" as appropriate.

909.05 UNASSIGNED

909.06 UNASSIGNED

909.07 UNASSIGNED

909.08 MEASUREMENT FOR PAYMENT

909.08.01 Treated Timber Cribwork

Treated timber cribwork shall be measured in cubic metres of completed work in place to the nearest one decimal place. Cubic measurements of the cribwork shall be determined by the product of the following dimensions, measured in place:

a) The height of each crib shall be the average of the measurements taken at each vertical from the bottom of the lowest timber to the underside of the concrete deck.

b) The width of each crib shall be the average width as measured between the outside faces of the exterior longitudinals, each width being measured on the top tier of each row of crossties.

c) The length of each crib shall be measured close to low water level along the centre line of the crib parallel to a level water surface between outside faces of exterior crossties.

Measurement for payment for ballast stone, filter fabric, and granular fill will not be made.

909.08.02 Treated Dimension Timber

The treated dimension timber wheel guard and wheel guard blocking and coping shall be measured by the cubic metres in place to the nearest two decimal places.

909.08.03 Treated Hardwood Sheathing, Fenders, Chock, and Ladders

Treated hardwood sheathing, fenders, chocks, and ladders shall be measured by the number of cubic metres accepted in place to the nearest two decimal places.

909.08.04 Rubber Fendering

909.08.04.01 Rubber Blasting Mat Type Fendering

Measurement for payment for "Supply and Installation of Rubber Blasting Mat Type Fendering" shall be per each unit.

909.08.04.02 Rubber Tire Fendering

Measurement for payment for "Supply and Installation of Rubber Tire Type Fendering" shall be per unit. Each unit shall consist of two tires mounted in a vertical position.

909.08.05 Ramp Barrier

Measurement for payment for "Supply and Installation of Ramp Barrier" shall be lump sum. Measurement for individual components shall not be made.

909.08.06 Mooring Cleats

Measurement for payment for "Supply and Installation of Mooring Cleats" shall be by the number of units in place. Measurement for payment of concrete in cleat block, cleat block anchors, steel reinforcement and sealant will not be made and are considered incidental to the work.

909.08.07 Wharf Concrete

Measurement for payment for wharf concrete for the specific type described in the unit price table shall be the number of cubic metres of concrete placed as accepted by the Owner’s Representative, rounded to one decimal place.

For (a) "Mass Concrete" the measurement for payment shall be based upon outside crib dimensions or interior of finished form work as appropriate.

For (b) "Reinforced Wharf Deck Concrete" which includes the reinforced concrete in the wharf deck, fendering blocks, cleat blocks and the vehicular loading ramp, measurement for payment shall be based upon the neat lines called for in the plans.

For (c) "Tremie Concrete" the measurement for payment shall be based upon the batch quantity as described in Section 904.10.01.

Measurement for payment will not be made for form work, concrete reinforcement, mooring cleat anchors or the various other components or materials which comprise the work.

909.09 BASIS OF PAYMENT

909.09.01 Treated Timber Cribwork

Payment at the contract unit price for treated timber cribwork in place shall be compensation in full for all preparation, filter fabric, ballast stone, granular fill, treated timber, fasteners, all plant, equipment, materials, and labour necessary to perform the work as outlined herein or as shown on the contract drawings.

909.09.02 Treated Dimension Timber

Payment at the contracted unit price for treated dimension timber secured in place shall be compensation in full for all labour, equipment-use, plant, fasteners, galvanizing, and materials to perform the work as outlined herein or as shown on the contract drawings.

909.09.03 Treated Sheathing, Fenders, Chocks and Ladders

Payment at the contract unit price for treated hardwood sheathing, fenders, chocks, and ladders secured in place, shall be compensation in full for all treated hardwoods, fastenings, ladder rungs, handholds, galvanizing, labour, plant, equipment-use, and materials to perform the work as outlined herein or as indicated on the contract drawings.

909.09.04 Rubber Fendering

909.09.04.01 Rubber Blasting Mat Type Fendering

The basis of payment for "Supply and installation of Rubber Blasting Mat Type Fendering" shall be full compensation for all equipment, labour, materials and plant necessary to supply, fabricate, transport to the job site, store, handle and install the fendering including all eye bolts, anchors, steel plate if required plus all other fastenings, associated hardware and associated work as described herein or as shown on the contract drawings.

909.09.04.02 Rubber Tire Type Fendering

The basis of payment for "Supply and Installation of Rubber Tire Type Fendering" shall be full compensation for all equipment, labour, materials and plant to supply, fabricate, transport to the job site, store, handle and install the fendering including all anchors, fastenings, other associated hardware and associated work as described herein or as shown on the contract drawings.

909.09.05 Ramp Barrier

The basis of payment for "Supply and Installation of Ramp Barrier" shall be full compensation for all equipment, labour, materials, and plant to supply, fabricate, transport to the job site, store, handle and install the ramp barrier including all associated materials, fittings, hardware, excavation, backfilling and compaction, grouting into the concrete deck where so required and

the provision of concrete block foundations all as described herein or as shown on the contract drawings.

909.09.06 Mooring Cleats

The basis of payment for "Supply and Installation of Mooring Cleats" shall be full compensation for all equipment, labour, materials, and plant necessary to supply mooring cleats, anchors and sealing compound, fabricate, transport to the job site, store, handle, and install the mooring cleats together with anchors as described on the contract drawings or as described herein.

909.09.07 Wharf Concrete

The basis of payment at the contract price for: (a) "Mass Concrete", (b) "Reinforced Wharf Deck Concrete" and (c) "Tremie Concrete" shall be full compensation for all labour, equipment-use, plant, materials and services as outlined in Section 904 of the Specifications Book and for all work described herein or as shown on the contract drawings.

The supply, fabrication, transportation to the jobsite, storage and placing of reinforcing steel shall be considered incidental to the work. The Contractor is advised that mass and tremie concrete will not contain reinforcing unless specifically indicated on the contract drawings.