

PART 1 - GENERAL

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| <u>1.1 Related Sections</u> | .1 | Section 03 30 00: Structural Concrete |
| | .2 | Section 31 23 10: Excavating, trenching and backfilling |
| <u>1.2 Measurement for Payment</u> | .1 | No measurement will be made under this section. Include costs in items of concrete work for which formwork is required. |
| <u>1.3 References</u> | .1 | Do concrete formwork to CSA A23.1, except where specified otherwise. |
| | .2 | Do concrete falsework to CSA S269.1, except where specified otherwise. |
| <u>1.4 Submittals</u> | .1 | Submittals in accordance with section 01 33 00 Submittal Procedures. |
| | .2 | Each shop drawings for formwork and falsework submitted shall bear the stamp of a qualified professional Engineer registered or license in the Province of New Brunswick. |
| | .3 | Clearly indicate method and schedule of construction, materials, arrangement of joints, ties, shores, liners and locations of temporary embedded parts. Comply with Clause 3 of CSA S269.1 for falsework drawings. |

PART 2 - PRODUCT

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| <u>2.1 Materials</u> | .1 | Formwork materials: |
| | .1 | Formwork materials to CAN/A23.1/A23.2 |
| | .2 | Wood product formwork materials to be to CSA-0121, CSA-086 and CSA-0153. |
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| 2.1 Materials
(Cont'd) | .2 | Form ties:
.1 Use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes no larger than 25 mm dia. in concrete surface.

.3 Form release agent: colourless mineral oil, non-toxic, biodegradable.

.4 Falsework materials: to CSA-S269.1. |
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PART 3 - EXECUTION

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| 3.1 Fabrication and
Erection | .1 | Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings. |
| | .2 | Fabricate and erect formwork in accordance with CSA-S269.1 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1. |
| | .3 | Line forms with material only as approved by Departmental representative. |
| | .4 | Align form joints and make watertight. Keep form joints to minimum. |
| | .5 | Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete. |

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| 3.2 Formwork
Removal | .1 | Leave the formwork in place for the following time after placing concrete provided the air temperature surrounding the concrete is above 10 degree Celsius.
.1 3 days for vertical surfaces.
.2 7 days for beams and slabs or 70% of design strength.
.3 7 days for concrete anchor blocks. |
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| <u>1.1 Related Sections</u> | .1 | Section 03 30 00 - Structural Concrete. |
| <u>1.2 Measurement Procedures</u> | .1 | No measurement will be made under this section. Include costs in items of concrete work for which reinforcement is required. |
| <u>1.3 References</u> | .1 | Canadian Standards Association (CSA)
.1 CAN/CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction.
.2 CAN/CSA A23.3-14, Design of concrete structure.
.3 CAN/CSA-G30.18-09, Billet-Steel Bars for Concrete Reinforcement.
.4 CSA W186-M1990 (R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.
.5 ASTM A82-07, Standard specification for Steel Wire, Plain, for Concrete Reinforcement. |

PART 2 - PRODUCTS

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| <u>2.1 Materials</u> | .1 | Substitute different size bars only if permitted in writing by Departmental Representative. |
| | .2 | Reinforcing steel: billet steel, having a yield stress of 400 MPa, deformed bars to CAN/CSA-G30.18-09, unless indicated otherwise. |
| | .3 | Cold-drawn annealed steel wire ties: to ASTM A82. |
| | .4 | Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1. |
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- 2.2 Fabrication
- .1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
 - .2 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.
 - .3 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

- 2.3 Source Quality Control
- .1 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis.

PART 3 - EXECUTION

- 3.1 Field Bending
- .1 Do not field bend or field or tack weld reinforcement. Heating shall not be used as an aid in bending steel.

- 3.2 Placing Reinforcement
- .1 Place reinforcing steel as indicated on reviewed shop drawings and in accordance with CAN/CSA-A23.1.
 - .2 Prior to placing concrete, obtain Departmental Representative's review of reinforcing material and placement.
 - .3 Ensure cover to reinforcement is maintained during concrete pour.
 - .4 Reinforcing steel shall be free of oil, dirt, mill scale, loose or excessive rust or other coating that would reduce bond to concrete.
 - .5 Bar support shall be made of plastic or stainless steel.
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3.2 Placing
Reinforcement
(Cont'd)

- .6 Reinforcement shall be accurately position, secured and supported, using bar supports and side form spacers to ensure proper concrete cover and spacing.
- .7 Bars shall be fastened together at all intersections except where the spacing is less than 300mm in each direction in which case fastening at alternate intersections of each bar with other bar shall be permitted.

3.3 Splicing

- .1 Where splicing of rebar is allow, the minimum splice length will be 40 times the rebar size diameter.
- .2 Welding or splicing shorter bars as a substitute for supplying bars of the specified lengths shall not be permitted.

3.4 Support of
Reinforcement

- .1 Bar support shall be made of plastic or stainless steel.
- .2 Commercially available precast concrete bar supports may be used that are in contact with soil only.
 - .1 Precast bar supports shall be made of concrete with a quality at least equal to that specified for the member into which the bar supports are integrated.
 - .2 Bar supports in contact with the soil shall have a base area of less than 16 cm².

PART 1 - GENERAL

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| <u>1.1 Related Sections</u> | .1 | Section 03 10 00 - Concrete Forming and Accessories. |
| | .2 | Section 03 20 00 - Concrete Reinforcing. |
| | .3 | Section 03 37 26 - Underwater Placed Concrete. |
| | .4 | Section 05 50 00 - Metal Fabrications. |
| | .5 | Section 33 05 13 - Precast Reinforced Concrete Pipe. |
| <u>1.2 Measurement Procedures</u> | .1 | Concrete Deck (ramp): cast-in-place reinforced concrete deck (200mm thick) for the boat ramp as shown will be measured in square metres (m ²) calculated from neat dimensions indicated or authorized in writing by the Departmental Representative. Area measurements to be made on the surface area of the deck to the outside face of the wheelguard. Additional reinforcing and concrete for the wheelguard and footings as shown will be considered incidental to the work. The traction zone design as shown will also be considered incidental to this item. |
| | .2 | Concrete Cap Beam; cast in place reinforced concrete beam along the top of H-piles to be measured in cubic metres (m ³) calculated from neat dimensions indicated or authorized in writing by Departmental Representative. Construction/control joints and galvanized protection angle as shown will be considered incidental to this item. |
| | .3 | Concrete Wall Panels; supply and installation of reinforced precast wall panels as shown will be measured in square meters (m ²) calculated from neat dimensions indicated or authorized by the Departmental Representative. |
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1.2 Measurement
Procedures
(Cont'd)

- .4 Concrete Ladder Panels; supply and installation of reinforced precast ladder panels as shown will be measured in units. A ladder unit will be considered full height (top and bottom panel) as shown on drawings. Supply and installation of the prefabricated galvanized steel ladder unit and holdfast(s) as shown will be included in the price.
.1 The supply and installation of all the steel components and inserts as shown to complete the ladder units, and modification to reinforcing bars and formwork of concrete panels to accommodate ladder unit will be considered incidental to this section.
- .5 Concrete Anchor Blocks (wharf); supply and installation of precast reinforced concrete anchor blocks as shown will be measured in units.
- .6 Floating Docks Concrete Anchor Blocks; supply and installation of precast reinforced concrete anchor blocks for the floating docks as shown will be measured in units. Supply and installation of chains, shackles, chain links, zinc sacrificial anodes and stainless steel bent bars as shown will be considered incidental to the work.
- .7 Floating Dock Concrete Landing Blocks; supply and installation of cast-in-place reinforced concrete landing blocks Type 1 and 2 as shown will be measured in cubic metres (m³) calculated from neat dimensions indicated or authorized in writing by Departmental Representative. Light pole base L3 as shown with Type 1 landing block will be paid under this item. Stainless steel anchor bolts, non-shrink grout and galvanized hinge brackets as shown will be incidental to the work.
- .8 Light pole concrete base L1 & L2: cast-in-place reinforced concrete for the light pole bases L1 and L2 as shown will be measured by the unit. Stainless steel anchor bolts and non-shrink grout will be incidental to the work.

1.2 Measurement
Procedures
(Cont'd)

- .9 Concrete slab: cast-in-place reinforced concrete for the Harbour Authority building as shown will be measured in square metres (m2) calculated from neat dimensions indicated or authorized in writing by the Departmental Representative.
- .10 Concrete Retaining Wall: cast-in-place reinforced concrete for retaining wall as shown will be measured in cubic meters (M3) calculated from neat dimensions indicated or authorized in writing by the Departmental Representative.
- .11 Hoist Foundation: supply and installation of cast-in-place reinforced concrete for the Hoist foundation including anchor bolts as shown shown will be measured in units.
- .12 The supply and placement of "Lifting Anchors" will be considered incidental to the work.
- .13 Formwork and falsework will not be measured but considered incidental to the work.
- .14 No deductions will be made for volume of concrete displaced by reinforcing steel.
- .15 Heating of water and aggregates and providing cold weather protection will not be measured but considered incidental to work.
- .16 Cooling of concrete and providing hot weather protection will not be measured but considered incidental to work.
- .17 Concrete used in the casting of concrete cylinders for testing and other miscellaneous concrete fill-in of voids and corner H-piles as shown will not be measured for payment but will be considered incidental to the work.
- .18 Reinforced Concrete used for the electrical duct banks as shown on electrical drawings will be considered incidental to electrical work. Formwork is required to create vertical faces for the electrical duct banks.
- .19 Supply and installation of concrete additives

1.2 Measurement
Procedures
(Cont'd)

as recommended by the supplier will not be measured but considered incidental to work.

- .20 Reinforcing steel will not be measured but considered incidental to the work.

1.3 References

- .1 Canadian Standards Association (CSA)
- .1 CSA-A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A283-00 (R2011), Qualification Code for Concrete Testing Laboratories.
 - .3 CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .2 American Society for Testing and Materials (ASTM)
- .1 ASTM C260/C260M 10a, Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C494/C494M 11, Standard Specification for Chemical Admixtures for Concrete.

1.4 Certificates

- .1 Submit certificates in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prior to starting concrete work submit to Departmental Representative manufacturer's test data and certification by qualified independent inspection and testing laboratory that following materials will meet specified requirements:
- .1 Portland cement.
 - .2 Blended hydraulic cement.
 - .3 Supplementary cementing materials.
 - .4 Admixtures.
 - .5 Aggregates.
 - .6 Water.
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<u>1.4 Certificates</u> <u>(Cont'd)</u>	.3	Provide mix design and certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CAN/CSA-A23.1.
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	.4	Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1.
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<u>1.5 Waste</u> <u>Management and</u> <u>Disposal</u>	.1	Designate a cleaning area for concrete trucks off site, at a company owned site for such a purpose (meeting all federal and provincial requirements)
	.2	Use trigger operated spray nozzles for water hoses.
	.3	Designate a cleaning area for tools to limit water use and runoff.
	.4	Carefully coordinate the specified concrete work with weather conditions.
	.5	Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies or waterways. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, noncombustible material and remove for disposal.
	.6	Choose least harmful, appropriate cleaning method which will perform adequately.

PART 2 - PRODUCTS

<u>2.1 Materials</u>	.1	Blended hydraulic cement: Type GUB-F/SF to CAN/CSA-A3001.
	.2	Supplementary cementing materials: to CAN/CSA-A3001.
	.3	Water: to CAN/CSA-A23.1.

- 2.1 Materials
(Cont'd)
- .4 Aggregates: to CAN/CSA-A23.1. Coarse aggregates to be normal density.
 - .5 Air entraining admixture: to ASTM C 260.
 - .6 Chemical admixtures: to ASTM C 494/C 494M. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
 - .7 Concrete retarders: to ASTM C 494/C 494M water based,, low VOC, solvent free. Do not allow moisture of any kind to come in contact with the retarder film.
 - .8 Above materials to be used for all concrete work specified in the project except for underwater placed concrete of H-pile anchoring, see section 03 37 26.

- 2.2 Mixes
- .1 Proportion normal density concrete in accordance with CAN/CSA-A23.1, Alternative 1.
 - .1 Portland Cement: GUb-F/SF.
 - .2 Minimum compressive strength at 28 days: 35 MPa.
 - .3 Minimum cement content: 400 kg/m³ of concrete.
 - .4 Maximum water/cement ratio: 0.4
 - .5 Class of exposure: C1.
 - .6 Nominal size of coarse aggregate: 5-20 mm.
 - .7 Slump at time and point of discharge: 50 to 100 mm.
 - .8 Air content: 5 to 8 %.
 - .2 Above mix to be used for all concrete work specified in the project except for underwater placed concrete of H-pile anchoring, see section 03 37 26.
 - .3 Electrical Duct Bank concrete mix.
 - .1 Minimum compression strength at 28 days: 24 MPa.
 - .2 Nominal aggregate size: 13 mm.
 - .3 Air content: 4 to 6%.
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- 2.3 Lifting Anchors .1 'Swift Lift' anchors (recessed) as per
Manufacturer's recommendation; Dayton Superior
or equivalent.
.1 Submit shop drawings for review.

PART 3 - EXECUTION

- 3.1 Preparation .1 Obtain Departmental Representative's approval
before placing concrete. Provide 24 hours
notice prior to placing of concrete.
- .2 Pumping of concrete is permitted only after
approval of equipment and mix.
- .3 Ensure reinforcement and inserts are not
disturbed during concrete placement.
- .4 Prior to placing of concrete inform
Departmental Representative's approval of
proposed method for protection of concrete
during placing and curing in adverse weather.
- .5 Maintain accurate records of poured concrete
items to indicate date, location of pour,
quality, air temperature and test samples
taken.
- .6 Do not place load upon new concrete until
authorized by Departmental Representative.

- 3.2 Construction .1 Do cast-in-place concrete work in accordance
with CAN/CSA-A23.1.

- 3.3 Finishing .1 Finish concrete in accordance with
CAN/CSA-A23.1.
- .1 Float surfaces with wood or metal floats
or power finishing machines and bring surfaces
to true grade or dimensions.
- .2 Curing of concrete shall be done by
mean of saturated wet burlap or approved
fabric.
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| <u>3.3 Finishing</u>
<u>(Cont'd)</u> | .2 | Broom finish deck surface with coarse bristle obtaining a coarse textured finish with a non-slip finish. All brush strokes to be in the direction perpendicular to traffic. |
| | .3 | Exposed concrete panels to have smooth finish. |
| <u>3.4 Site Tolerance</u> | .1 | Concrete tolerance in accordance with CAN/CSA-A23.1. |
| <u>3.5 Field Quality Control</u> | .1 | Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory designated by Departmental Representative in accordance with CAN/CSA-A23.1/A23.2 and Section 01 45 00. |
| | .2 | Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent. |
| | .3 | Non-destructive Methods for Testing Concrete shall be in accordance with CAN/CSA-A23.2. |
| <u>3.6 Handling</u> | .1 | Submit to the Departmental Representative the method for handling the Pre-Cast Concrete panels and anchor blocks for review. |

PART 1 - GENERAL

<u>1.1 SECTION INCLUDES</u>	.1	Materials and installation for concrete underwater by tremie or pumped concrete method.
<u>1.2 RELATED SECTIONS</u>	.1	Section 01 74 21 - Construction/Demolition Waste Management And Disposal.
	.2	Section 03 20 00 - Concrete Reinforcing.
	.3	Section 03 30 00 - Structural Concrete.
	.4	Section 31 62 16.16 - Steel H-Pile.
<u>1.3 MEASUREMENT PROCEDURES</u>	.1	The supply and placement of underwater concrete will not be measured separately for Payment. Cost of doing this work shall be considered incidental to Section 31 62 16.16 - Steel H-Pile.
<u>1.4 REFERENCES</u>	.1	Canadian Standards Association (CSA International) .1 CAN/CSA-A23.1/A23.2-14 , Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
<u>1.5 DEFINITIONS</u>	.1	Tremie concrete is placed underwater through tube called tremie pipe. .1 Tremie pipe has a hopper at upper end and may be open ended or may have foot valve, plug or travelling plug to control flow of concrete. .2 Concrete is placed in hopper and sufficient head of concrete is maintained in tremie pipe to provide desired rate of flow.

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| <u>1.5 DEFINITIONS
(Cont'd)</u> | .2 | Pumped concrete method of placing concrete underwater uses concrete pump with discharge line used in similar manner to a tremie pipe. |
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| <u>1.6 WASTE
MANAGEMENT AND
DISPOSAL</u> | .1 | Separate waste materials for reuse and recycling in accordance with Section 01 74 21 Construction/Demolition Waste Management and Disposal. |
| | .2 | Remove from site and dispose of packaging materials at appropriate recycling facilities. |
| | .3 | Divert unused concrete materials from landfill to local quarry or facility approved by the Departmental Representative. |
| | .4 | Divert chemical additive materials from landfill to official hazardous material collections site approved by the Departmental Representative. |
| | .5 | Do not dispose of unused chemical additive materials into sewer systems, into lakes, streams, onto ground or in any other location where it will pose health or environmental hazard. |

PART 2 - PRODUCTS

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| <u>2.1 MATERIALS</u> | .1 | Concrete materials: to Section 03 30 00 - Structural Concrete. |
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| <u>2.2 MIXES</u> | .1 | GUB-F-SF Portland cement (General use cement with fly ash and silica fume). |
| | .2 | Minimum compressive strength at 28 days: 35 MPa. |
| | .3 | Class of exposure: C1. |
| | .4 | Maximum water cement ratio by mass: 0.40. |
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| <u>2.2 MIXES</u>
(Cont'd) | .5 | Minimum cement content: 400 kg/m3. |
| | .6 | Nominal size of coarse aggregate: 20 mm. |
| | .7 | Fine aggregate content: 42 to 45 % of total aggregate mass. |
| | .8 | Slump at point and time of submergence discharge: 170 mm \pm 40 mm. |
| | .9 | Air content at discharge: 6 to 9%. |

PART 3 - EXECUTION

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| <u>3.1 INSTALLATION</u> | .1 | Do concrete work in accordance with Section 03 30 00 - Structural Concrete and Section 03 20 00 - Concrete Reinforcement and to CAN/CSA-A23.1/A23.2. Testing for concrete to CAN/CSA-A23.1/A23.2, except where specified otherwise. |
| | .2 | Place concrete in one continuous operation to full depth required.
.1 Supply complete equipment for every phase of operation.
.2 Provide sufficient supply of concrete to complete pour without interruption. |

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| <u>3.2 TREMIE CONCRETE</u> | .1 | Provide water-tight tremie pipe sized to allow free flow of concrete. Diameter of tremie pipe to be minimum 200 mm or eight times the maximum size of coarse aggregate. |
| | .2 | Provide hopper at top of tremie pipe and means to raise and lower tremie pipe. |
| | .3 | Provide plug or foot valve at bottom of tremie pipe to permit filling pipe with concrete initially. |
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- 3.2 TREMIE CONCRETE (Cont'd)
- .4 Start placement with tremie pipe full of concrete. Keep bottom of pipe buried minimum 300 mm in freshly placed concrete. Control rate of flow by varying depth of pipe bottom in concrete.
 - .5 If seal is lost, allowing water to enter pipe, withdraw pipe immediately. Refill pipe, and continue placing as specified.
 - .6 Do not vibrate, disturb or puddle concrete after placement.
- 3.3 PUMPED CONCRETE
- .1 Follow procedures as for tremie method in placing concrete using discharge line from concrete pump as tremie pipe.
 - .2 Pump discharge line to have minimum diameter of 125 mm.