

## PART 1 - GENERAL

<u>1.1 Related Sections</u>	.1	Section 03 30 00 Cast-in-Place 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 formwork is required.
<u>1.3 References</u>	.1	Canadian Standards Association (CSA International)
	.1	CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
	.2	CAN/CSA-O86-09, Engineering Design in Wood.
	.3	CSA O121-08, Douglas Fir Plywood.
	.4	CSA O151-09, Canadian Softwood Plywood.
	.5	CSA O153-M1980(R2008), Poplar Plywood.
	.6	CSA S269.1-1975(R2008), Falsework for Construction Purposes.
	.7	CAN/CSA-S269.3-M92(R2008), Concrete Formwork, National Standard of Canada
<u>1.4 Submittals</u>	.1	Submittals in accordance with Section 01 33 00 Submittal Procedures.
	.2	Submit shop drawings for formwork and falsework.
	.1	Submit drawings stamped and signed by professional engineer registered or licensed in the Province of New Brunswick.
	.3	Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, anchorages, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings Comply with CAN/CSA-S269.3 for formwork drawings.
	.4	Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.

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|                                               | .5 | Indicate sequence of erection and removal of formwork/falsework as directed by Departmental Representative.                                 |
| 1.5 <u>Delivery,<br/>Storage and Handling</u> | .1 | Store and manage hazardous materials in accordance with Section 01 74 21 Construction/Demolition Waste Management and Disposal.             |
|                                               | .2 | 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. |
|                                               | .2 | Place materials defined as hazardous or toxic in designated containers.                                                                     |
|                                               | .3 | Divert wood materials from landfill to a recycling facility.                                                                                |
|                                               | .4 | Divert plastic materials from landfill to a recycling facility.                                                                             |
|                                               | .5 | Divert unused form release material from landfill to an official hazardous material collections site.                                       |

## PART 2 - PRODUCTS

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| 2.1 <u>Materials</u> | .1 | Formwork materials:                                                                                                                         |
|                      | .1 | Formwork materials to be to CAN/A23.1/A23.2.                                                                                                |
|                      | .2 | Wood and wood product formwork materials to be to CSA-O121, CSA-O86 and CSA-O153.                                                           |
|                      | .2 | Form ties:                                                                                                                                  |
|                      | .1 | Use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm dia. in concrete surface. |
|                      | .3 | Form release agent: non-toxic, biodegradable.                                                                                               |
|                      | .4 | Form stripping agent: colourless mineral oil, non-toxic, and biodegradable.                                                                 |
|                      | .5 | Falsework materials: to CSA-S269.1.                                                                                                         |

## PART 3 - EXECUTION

### 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 falsework in accordance with CSA S269.1.
- .3 Fabricate and erect formwork in accordance with CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
- .4 Align form joints and make watertight.
  - .1 Keep form joints to minimum.
- .5 Build in anchors, sleeves, and other inserts required to accommodate work specified in other sections.
- .6 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

### 3.2 Formwork Removal

- .1 Leave formwork in place for following minimum periods of time after placing concrete.
  - .1 3 days for concrete wall encasement.
  - .2 3 days for sides of wall cap beam.
  - .3 3 days for building footings.
  - .4 7 days for concrete anchor wall.
  - .5 7 days for building foundation walls.
  - .6 7 days for patching of concrete deck.
- .2 Remove formwork when concrete has reached 75% of its design strength or minimum period noted above, whichever comes later.
- .3 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

## PART 1 - GENERAL

1.1	<u>Related Sections</u>	.1	Section 03 30 00 Cast-in-Place Concrete.
		.2	Section 03 41 00 Precast Structural Concrete.
		.3	Section 05 50 00 Metal Fabrications.
1.2	<u>Measurement Procedures</u>	.1	No measurement will be made under this section. Include costs in items of concrete work for which reinforcement is required.
1.3	<u>References</u>	.1	American Society for Testing and Materials International (ASTM).
		.1	ASTM A82/A82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
		.2	Canadian Standards Association (CSA)
		.1	CSA-A23.1-09, Concrete Materials and Methods of Concrete Construction/Methods and Standard Practices for Concrete.
		.2	CSA-A23.3-04 (R2010), Design of Concrete Structures.
		.3	CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
1.4	<u>Shop Drawings</u>	.1	Submit shop drawings including placing of reinforcement in accordance with Section 01 33 00 Submittal Procedures.
		.2	Indicate on shop drawings, bar bending details, lists, quantities of reinforcement, sizes, spacings, and locations of reinforcement with identifying code marks to permit correct placement without reference to structural drawings. Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada.
		.3	Detail lap lengths and bar development lengths to CSA-A23.3, unless otherwise indicated. Provide Class

B tension lap splices unless otherwise indicated.

- .4 Each shop drawing submitted to bear the stamp and signature of a qualified Professional Engineer registered in the Province of New Brunswick.

## PART 2 - PRODUCTS

### 2.1 Materials

- .1 Substitute different size bars only if permitted in writing by Departmental Representative.
- .2 Reinforcing steel: carbon steel, having a yield stress of 400 MPa, deformed bars to CSA-G30.18, unless indicated otherwise.
- .3 Cold-drawn annealed steel wire ties: to ASTM A82/A82M.
- .4 Chairs, bolsters, bar supports, spacers: to CSA-A23.1.

### 2.2 Fabrication

- .1 Fabricate reinforcing steel in accordance with 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 weld reinforcement.

### 3.2 Placing Reinforcement

- .1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CSA-A23.1.

- .2 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- .3 Ensure cover to reinforcement is maintained during concrete pour.

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## PART 1 - GENERAL

1.1	<u>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.
1.2	<u>Measurement Procedures</u>	.1	<u>Concrete Encasement Wall</u> : The reinforced concrete encasement wall, complete with integral wheel guard, will be measured in linear metres, (LM), of wall acceptably installed in the work. This item includes all cleaning, preparation and patching of the SSP wall surfaces as well as the anchors, ties, formwork, falsework, reinforcing, galvanized metal inserts, and embedments. Measurement to be made on the horizontal length of the new encasement wall, taken along the face of the new concrete, and will include all underwater placed concrete, above water placed concrete and wheel guard concrete.
		.2	<u>Concrete Cap Beam</u> : The cast-in-place reinforced concrete wall cap beam will be measured in linear metres, (LM), calculated from neat dimensions indicated or as authorized in writing by Departmental Representative. Concrete placed beyond dimensions indicated will not be measured.
		.3	<u>Concrete Deck Slab</u> : The cast-in-place reinforced concrete deck slab-on-grade will be measured in square metres, (M <sup>2</sup> ), calculated from theoretical neat dimensions indicated on plans or as authorized in writing by Departmental Representative. Measurements to be made on the surface area of the deck. Construction/control joints as shown will be considered incidental to this item.
		.4	<u>Concrete Anchor Walls</u> : The reinforced concrete anchor walls will be measured in cubic metres, (M <sup>3</sup> ), calculated from theoretical neat dimensions indicated on plans or as authorized in writing by Departmental Representative. Concrete placed beyond dimensions

indicated will not be measured.

- .5 Mechanical/Electrical Building Foundation: The reinforced concrete foundation will be measured as a lump sum, (LS). This item also includes supply and installation of the rigid insulation and vapor barrier. All other costs related to the Mechanical/Electrical building will be included in the Electrical pay item.
- .6 Concrete Deck – Conduit Embedment: The patching and repair of the concrete deck of Structure 411 for the embedment of the electrical conduits will be measured as a lump sum, (LS). The cost for the concrete sawcutting, removals and perimeter joints will not be included under this section but will be considered as part of the work covered by Section 02 41 13 Site Work, Preparation and Removal.
- .7 Precast Stairs: The precast stairs complete with galvanized pipe railing and landing platform, will be measured by the unit, (Unit), supplied, delivered and installed in the work.
- .8 The excavation of the harbour bottom as required to install the concrete encasement, and the haulage and disposal of excavated material in the containment cell will not be measured under this section but will be considered as part of the work as covered by Section 02 41 13 Site Work, Preparation and Removal.
- .9 All costs for concrete work related to the electrical ductbank is included in the Electrical pay item.
- .10 All costs related to the precast concrete transformer pad is included in the Electrical pay item.
- .11 Reinforcing steel will not be measured but considered incidental to the work.
- .12 Formwork and falsework will not be measured but considered incidental to the work.
- .13 No deductions will be made for volume of concrete displaced by reinforcing steel.



- .14 Heating of water and aggregates and providing cold weather protection will not be measured but considered incidental to work.
- .15 Cooling of concrete and providing hot weather protection will not be measured but considered incidental to work.
- .16 Supply and installation of concrete additives as recommended by the concrete supplier will not be measured but considered incidental to work.

### 1.3 References

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
  - .2 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - .3 ASTM C494/C494M-13, Standard Specification for Chemical Admixtures for Concrete.
  - .4 ASTM C881/C881M-10, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
  - .5 ASTM D1751-04(2008), Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  - .6 ASTM E1643-98 – Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
  - .7 ASTM E1745-97 – Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
- .2 Canadian Standards Association (CSA)
  - .1 CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

- .2 CSA A283-06 (R2011), Qualification Code for Concrete Testing Laboratories.
- .3 CSA-A3000-08, Cementitious Materials Compendium.

- .3 Underwriters Laboratories of Canada (ULC)
  - .1 CAN/ULC-S701-05, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.

#### 1.4 Certificates

- .1 Submit certificates in accordance with Section 01 33 00 Submittal Procedures.
- .2 Provide certification indicating the concrete supplier is certified in accordance with the Atlantic Provinces Ready Mix Concrete Association Program or equivalent.
  - .1 Only concrete supplied from such certified plants shall be acceptable to the Departmental Representative.
  - .2 Plant certification shall be maintained for the duration of the fabrication and erection until the warranty period expires.
- .3 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA-A23.1.
- .4 Provide mix design in compliance with CSA-A23.1 to provide concrete of quality, yield and strength as specified under 2.2 Mix Design. Mix design to be prepared by and stamped by an engineer licensed to practice in the Province of New Brunswick.
- .5 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.

1.5 Waste Management  
and Disposal

- .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

2.1 Materials

- .1 Blended hydraulic cement: Type GUb-F/SF to CSA-A3001.
- .2 Supplementary cementing materials: to CSA-A3001.
- .3 Water: to CSA-A23.1.
- .4 Aggregates: to CSA-A23.1/A23.2. Coarse aggregates to be normal density.
- .5 Air entraining admixture: to ASTM C260.
- .6 Chemical admixtures: to ASTM C494/C494M. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Concrete retarders: to ASTM C494/C494M water

based, low VOC, solvent free. Do not allow moisture of any kind to come in contact with the retarder film.

- .8 Curing Compound:
  - .1 To CSA-A23.1, and ASTM C309.
  - .2 Acceptable Products:
    - .1 Kure-N-Seal WB by BASF Building Systems.
    - .2 Florseal WB 18 by Sika Canada.
    - .3 1100 Cure by W.R. Meadows.
- .9 Premoulded Joint Filler:
  - .1 Bituminous impregnated fiber board to ASTM D1751.
- .10 Joint Sealer for horizontal joints:
  - .1 Sikaflex 2C NS/SL supplied by Sika Canada, or approved alternate.
- .11 Joint Sealer for vertical joints:
  - .1 Sikaflex 2C NS as supplied by Sika Canada, or approved alternate.
- .12 Anchorage Adhesive (Above Water): to ASTM C881/C881M, Type IV, Grade 3, Class A, B, and C.
  - .1 Acceptable Products:
    - .1 Epcon Acrylic 7 by ITW Ramset/Red Head.
    - .2 HIT HY200 Injection Adhesive System by HILTI.
    - .3 Acrylic-Tie Anchoring System by Simpson Strong-Tie.
    - .4 Alternate Materials: Approved by addendum in accordance with Instructions to Tenderers.
- .13 Anchorage Adhesive (Below Water): to be C6 Fast Curing Epoxy by ITW Red Head, or approved alternate.
- .14 Precast Concrete Stairs: to be as supplied by White's Precast Concrete.
  - .1 To be complete with galvanized pipe hand/guardrail.

- .2 All components to be to NBC 2010 minimum requirements.
- .3 Rise and run to suit grades and floor height of electrical/mechanical building.
- .4 Minimum concrete strength to be 35 MPa.
- .5 To include fabrication, supply, delivery and installation on site.
- .15 Refer to Section 05 50 00 for metal fabricated assemblies to be installed in concrete items.
- .16 Smooth Bar Dowels: Steel rod to CSA G40.21, Grade 300W. Ends cut and filed free of burrs.
- .17 Vapour Retarder (Vapour Barrier) : Polyolefin film to ASTM E1745, Class A, minimum 10 mil thickness, for underslab application.
  - .1 Acceptable Products:
    - .1 Moistop Ultra 10 by Fortifiber,
    - .2 VaporBlock 10 by Raven Industries,
    - .3 Perminator 10 by W.R. Meadows.
- .18 Rigid insulation: Extruded polystyrene insulation (XPS): to CAN/ULC S701, Type IV, shiplapped edge, CFC free and HCFC free, thickness as indicated. Use high compressive strength under building foundations (min 275 kPa). Use low density insulation at end wall beam below slab.

## 2.2 Mix Design

- .1 The contractor shall be responsible for the concrete mix design.
- .2 It shall be the responsibility of the Contractor to ensure that the mixture proportions shall be properly batched, mixed, placed and cured such that the concrete conforms to the specifications.
- .3 Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1, to give following properties:
  - .1 Cement: GUb-F/SF.
  - .2 Minimum compressive strength at 28 days: 35 MPa.
  - .3 Minimum cement content: 400 kg/m<sup>3</sup> of

- concrete.
- .4 Maximum water/cement ratio: 0.40.
- .5 Class of exposure: C-1.
- .6 Nominal size of coarse aggregate: 20 mm.
- .7 Slump at time and point of discharge: 50 to 100 mm.
- .8 Air content: 5 to 8 %.

### PART 3 - EXECUTION

#### 3.1 Preparation

- .1 Inform Department Representative before placing concrete. Provide 24 hours notice prior to placing of concrete.
- .2 Pumping of concrete is permitted only after review of equipment and mix.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Prior to placing of concrete advise Departmental Representative 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 SSP Wall Preparation

- .1 Clean all fouling, marine growth, loose and unsound materials and corrosion from full outer surfaces of existing steel sheet piling.
- .2 Clean all exposed, (front and back), surfaces of existing steel plates and angles at top of steel sheet pile wall that will be encased and/or embedded in concrete.
- .3 Clean by waterjet or other approved method.
- .4 Review and obtain approval from Departmental Representative for the adequacy of cleaning.

- |                                  |    |                                                                                                                                                                                                                                                     |
|----------------------------------|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                  | .5 | Degree of cleaning to meet requirements of CSA A23.1 for bonding fresh concrete to existing surfaces and to CSA W59-03 and AWS D3.6M:1999 for proper fit and welding of formwork ties to existing SSP.                                              |
|                                  | .6 | Forms are not to be placed over a cleaned surface and left without placing concrete for a period more than 72 hours.                                                                                                                                |
| <u>3.3 Construction</u>          | .1 | Do cast-in-place concrete work in accordance with CSA-A23.1.                                                                                                                                                                                        |
| <u>3.4 Finishing</u>             | .1 | Only ACI (American Concrete Institute) certified or other pre-approved concrete finishers are to be utilized in finishing all concrete works.                                                                                                       |
|                                  | .2 | Finish concrete in accordance with CSA-A23.1.                                                                                                                                                                                                       |
|                                  | .1 | Float surfaces with wood or metal floats or power finishing machines and bring surfaces to true grade or dimensions.                                                                                                                                |
|                                  | .2 | Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible.                                                                                                           |
|                                  | .3 | Broom finish surface of deck with coarse bristle obtaining a coarse textured finish with a non-slip finish. All brush strokes to be in the direction perpendicular to traffic. To be as approved by Departmental Representative prior to placement. |
|                                  | .4 | All formed surfaces to be smooth form finish.                                                                                                                                                                                                       |
| <u>3.5 Site Tolerance</u>        | .1 | Concrete tolerance in accordance with CSA-A23.1.                                                                                                                                                                                                    |
|                                  | .1 | Deck slab surface to be to Table 22, Class B, non-slip, straight edge, value $\pm 6$ mm.                                                                                                                                                            |
| <u>3.6 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 CSA-A23.1 and Section 01 45 00 Testing and Quality Control.                      |
|                                  | .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 CSA-A23.2.

3.7 Vapour Retarder  
Installation

- .1 Install in accordance with manufacturer's written instructions and ASTM E1643 supplemented by following paragraphs:
- .1 Overlap joints a minimum of 150 mm and apply acoustic sealant full length of seam, seal with manufacturer's tape.
  - .2 Seal around mechanical and electrical services, or other penetration with pipe boot.
  - .3 Seal to perimeter foundation with acoustical sealant.
  - .4 Repair damaged areas by cutting patches of vapour retarder, overlapping damaged area 150 mm and applying acoustic sealant around full perimeter of puncture taping four sides with tape.

3.8 Rigid Insulation  
Installation

- .1 Install insulation in largest possible size to cover areas indicated on Plans, closely butted together at sides, ends, and against walls.
- .2 Extend insulation to the full thickness shown over entire area to be insulated. Neatly cut and fit insulation tightly around obstructions, projections such as pipes, conduits, hangers and other elements.
- .3 Offset both vertical and horizontal joints in multiple layer applications.



## PART 1 - GENERAL

<u>1.1 Related Sections</u>	.1	Section 01 74 21 Construction/Demolition Waste Management And Disposal.
	.2	Section 03 30 00 Cast-in-Place 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 underwater placed concrete is required.
<u>1.3 References</u>	.1	Canadian Standards Association (CSA International) .1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Methods for Concrete.
<u>1.4 Definitions</u>	.1	Tremie concrete is concrete placed underwater through a tube called a 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 a hopper and a sufficient head of concrete is maintained in tremie pipe to provide desired rate of flow.
	.2	Pumped concrete method of placing concrete underwater uses a concrete pump with a discharge line used in a similar manner to a tremie pipe.
<u>1.5 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 Departmental Representative.
	.4	Divert chemical additive materials from landfill to official hazardous material collections site approved by

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

### 2.1 Materials

- .1 Concrete materials: to Section 03 30 00 Cast-in-Place Concrete and as specified herein.

### 2.2 Concrete Mix

- .1 Use Type GUb-F/SF Portland cement (General purpose cement with fly ash and silica fume) in the concrete mix design to satisfy the following criteria:
  - .1 Minimum compressive strength at 28 days: 35 MPa.
  - .2 Class of exposure: C1.
  - .3 Maximum water cement ratio by mass: 0.40.
  - .4 Minimum cement content: 400 kg/m<sup>3</sup>.
  - .5 Nominal size of coarse aggregate: 20 mm.
  - .6 Fine aggregate content: 42 to 45 % of total aggregate mass.
  - .7 Slump at point and time of discharge: 150 mm to 170 mm.
  - .8 Air content at discharge: 6 to 9%.

## PART 3 - EXECUTION

### 3.1 Installation

- .1 Do concrete work in accordance with Section 03 30 00 Cast-in-Place Concrete and as specified herein.
- .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.
  - .3 Placement to be by one of the two methods describe in cl. 3.1.3 and 3.1.4.
- .3 Tremie method.
  - .1 Provide water-tight tremie pipe sized to allow

- free flow of concrete. Diameter of tremie pipe to be minimum 125 mm.
- .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.
  - .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.

.4 Pumped concrete method.

- .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.

3.2 Environmental  
Requirements

- .1 Surplus concrete shall not be dumped at sea but recuperated and disposed of off site. Any cleaning of tremie pipes and other equipment on site shall be carried out in a manner that the run off water will be filtered before entry to sea.

## PART 1 - GENERAL

<u>1.1 Description</u>	.1	The work under this section includes the supply and fabrication of the precast reinforced concrete wall panels, complete with transportation to the site, storage and installation.
<u>1.2 Related Sections</u>	.1	Section 05 50 00 Metal Fabrications.
<u>1.3 Measurement Procedures</u>	.1	<u>Precast Wall Panels Type A</u> : Measure precast elements, (Type 'A' wall panels), in units supplied, delivered, stored and installed in the work.
	.2	<u>Precast Wall Panels Type B (Ladder Panels)</u> : Measure precast elements, (Type 'B' wall panels), in units supplied, delivered, stored and installed in the work. To include all costs related to embedded galvanized steel ladder components.
	.3	<u>Precast Wall Panels Type C</u> : Measure precast elements, (Type 'C' wall panels), in units supplied, delivered, stored and installed in the work.
<u>1.4 References</u>	.1	American Society for Testing and Materials International (ASTM)
	.1	ASTM A82/A82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcing.
	.2	ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
	.3	ASTM C494/C494M-13, Standard Specification for Chemical Admixtures for Concrete.
	.2	Canadian Standards Association (CSA)
	.1	CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and standard practices for Concrete.
	.2	CSA-A23.4-09, Precast Concrete - Materials and Construction.
	.3	CSA-A3000-08, Cementitious Materials Compendium.

.4 CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.

#### 1.5 Certificates

- .1 Submit certificates in accordance with Section 01 33 00 Submittal Procedures.
- .2 Provide certification indicating the concrete supplier is certified in accordance with the Atlantic Provinces Ready Mix Concrete Association Program or equivalent.
  - .1 Only concrete supplied from such certified plants shall be acceptable to the Departmental Representative.
  - .2 Plant certification shall be maintained for the duration of the fabrication and erection until the warranty period expires.
- .3 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA-A23.1.
- .4 Provide mix design in compliance with CSA-A23.1 to provide concrete of quality, yield and strength as specified under 2.2 Mix Design. Mix design to be prepared by and stamped by an engineer licensed to practice in the Province of New Brunswick.

#### 1.6 Performance Requirements

- .1 Tolerance of precast elements to CSA-A23.4, Section 12.
- .2 Length of precast elements not to vary from length indicated by more than plus or minus 10 mm.
- .3 Cross sectional dimensions of precast elements not to vary from design dimensions by more than plus or minus 5 mm.
- .4 Deviations from straight lines not to exceed 6 mm in 3.0 m.
- .5 Precast elements not to vary by more than plus or minus 6 mm from true overall cross sectional shape as measured by difference in diagonal dimensions.

1.7 Mock-Up

- .1 Contractor to manufacture a single wall panel as representative sample in accordance with CSA-A23.4, Cl. 26.2.1 for inspection and review by Departmental Representative before start of production.
- .2 Notify Departmental Representative 48 hours in advance of completion of mock-up for inspection.
- .3 When accepted, mock-up to demonstrate minimum standard of acceptance for this work.
- .4 Mock-up panel may be incorporated into work if deemed acceptable.

1.8 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 33 00 Submittal Procedures, and in accordance with CSA-A23.4.
- .2 Include the following items:
  - .1 Details of members, reinforcement and their connections.
  - .2 Finish.
  - .3 Methods of handling and erection.
  - .4 Lifting anchor system with back-up engineer-stamped design calculations.
- .3 Ensure each drawing submitted bears stamp and signature of qualified professional engineer registered or licensed in province of New Brunswick, Canada.

1.9 Qualifications

- .1 Precast concrete elements to be fabricated and erected by Contractor who has proven experience in work of this nature and shall be in strict accordance with the requirements of CSA-A23.4.
- .2 All precast fabrication, curing and protection shall be done within an enclosed, heated building, to the approval of the Departmental Representative.

1.10 Waste Management and Disposal

- .1 Separate and recycle waste materials.
- .2 Ensure emptied containers are sealed and stored safely

for disposal away from children.

- .3 Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, noncombustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.

1.11 Warranty

- .1 Contractor hereby warrants that precast elements will not spall or show visible evidence of cracking, except for normal hairline shrinkage cracks, in accordance with subsection GC32.1 of General Conditions "C".

PART 2 - PRODUCTS

2.1 Materials

- .1 Cement, aggregates, water, admixtures: to CSA-A23.1 and CSA-A23.4.
- .2 Reinforcing steel: to CSA-G30.18.
- .3 Portland Cement and Supplementary Cementing Materials (SCM's) to CSA-A3000.
- .4 Aggregates: to CSA-A23.1. Coarse aggregates to be normal density.
- .5 Air Entraining Admixture: to ASTM C260.
- .6 Chemical Admixtures: to ASTM C494/C494M.
- .7 Hardware and miscellaneous materials: to CSA-A23.1.
- .8 Forms: to CSA-A23.4.
- .9 Pipe Sleeve Drains: purpose made plastic of diameter indicated on plans.
- .10 Galvanized Ladder Assemblies: as per Section 05 50 00 Metal Fabrications.

- |                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <u>2.2 Mix Design</u>         | <ul style="list-style-type: none"><li>.1 The Contractor shall be responsible for the concrete mix design.</li><li>.2 It shall be the responsibility of the Contractor to ensure that the mixture proportions shall be properly batched, mixed, placed and cured such that the concrete conforms to the specifications.</li><li>.3 Concrete.<ul style="list-style-type: none"><li>.1 Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1, to give following properties:<ul style="list-style-type: none"><li>.1 Cement: use Type GU-F-SF.</li><li>.2 Minimum compressive strength at 28 days: 35 MPa.</li><li>.3 Minimum cement content: 400 kg/m<sup>3</sup> of concrete.</li><li>.4 Class of exposure: C-1.</li><li>.5 Maximum silica fume not to exceed 10% of the total cementitious content.</li><li>.6 Nominal size of coarse aggregate: 20 mm.</li><li>.7 Maximum water cement ratio: 0.40.</li><li>.8 Air content: 4 to 7%.</li><li>.9 Slump at time and point of discharge: 75 mm to 85 mm.</li></ul></li></ul></li></ul> |
| <u>2.3 Manufactured Units</u> | <ul style="list-style-type: none"><li>.1 Manufacture units in accordance with CSA-A23.4.</li><li>.2 Mark each precast unit to correspond to identification mark on shop drawings for location with date cast on part of unit which will not be exposed.</li><li>.3 Provide hardware suitable for handling elements.</li><li>.4 Support of reinforcing shall be by hanging from top. No chairs to be used that will be exposed on formed face of wall panels.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <u>2.4 Finishes</u>           | <ul style="list-style-type: none"><li>.1 Finish surface of units to Finish Grade B to CSA-A23.4, Clause 26.2.4.</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <u>2.5 Curing</u>             | <ul style="list-style-type: none"><li>.1 Curing and protection shall be in accordance with</li></ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |



CSA-A23.4 and as noted below.

- |                                   |    |                                                                                                                                                                                    |
|-----------------------------------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                   | .2 | Wall panels shall be wet cured for a minimum period of 7 days. Concrete shall be kept in a surface damp condition for this period. Ambient temperature to be maintained above 5°C. |
| 2.6 <u>Source Quality Control</u> | .1 | Provide Departmental Representative with certified copies of quality control tests related to this project as specified in CSA-A23.4.                                              |
|                                   | .2 | Provide records from in-house quality control program to Departmental Representative for inspection and review.                                                                    |
|                                   | .3 | Upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel supplied, showing physical and chemical analysis.                   |
|                                   | .4 | Contractor shall keep complete records of supply source of concrete material, and steel reinforcement to Departmental Representative, for review upon request.                     |

## PART 3 - EXECUTION

- |                              |    |                                                                                                                                                                                                                                                |
|------------------------------|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3.1 <u>Erection</u>          | .1 | Do precast concrete work in accordance with CSA-A23.3 and CSA-A23.4.                                                                                                                                                                           |
|                              | .2 | Install precast elements as specified and as indicated on plans.                                                                                                                                                                               |
| 3.2 <u>Quality Assurance</u> | .1 | In addition to Contractor's Source Quality Control, inspection and testing of concrete and concrete materials may be carried out by a Testing Laboratory designated by Departmental Representative in accordance with CSA-A23.1 and CSA-A23.4. |
|                              | .2 | Inspection and testing by Departmental Representative will not augment or replace Contractor's quality control nor relieve him of his contractual responsibility.                                                                              |

3.3 Cleaning

- .1 Remove any impurities of the exposed surfaces on the concrete panels and piles.
- .2 Submit to Departmental Representative for review, proposed cleaning methods before cleaning soiled precast concrete surfaces.