

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 03 20 00 - Concrete Reinforcing.
- .2 Section 03 37 26 - Underwater Concreting.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1-04, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN/CSA-O86-01 (R2006), Engineering Design in Wood (Limit States Design).
 - .3 CSA O121-M1978 (R2003), Douglas Fir Plywood.
 - .4 CSA O151-04, Canadian Softwood Plywood.
 - .5 CSA O153-M1980 (R2003), Poplar Plywood.
 - .6 CAN3-O188.0-M78, Standard Test Methods for Mat-Formed Wood Particleboards and Waferboard.
 - .7 CSA O437 Series-93 (R2001), Standards for OSB and Waferboard.
 - .8 CSA S269.1-1975 (R2003), Falsework for Construction Purposes.
 - .9 CAN/CSA-S269.3-M92 (R2003), Concrete Formwork.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings for formwork and falsework in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply

with CSA S269.1, for falsework drawings Comply with CAN/CSA-S269.3 for formwork drawings.

- .3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.
- .4 Indicate sequence of erection and removal of formwork/falsework as directed by Departmental Representative.
- .5 Each shop drawing submission shall bear stamp and signature of qualified Professional Engineer registered or licensed in Province of Nova Scotia, Canada.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and the Waste Reduction Workplan.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .4 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Formwork materials:
 - .1 Use formwork materials to CAN/CSA-A23.1.
- .2 Form ties:
 - .1 Removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25mm diameter in concrete surface.
- .3 Form release agent: non-toxic, chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing set of film of concrete in contact with form.
- .4 Falsework materials: to CSA-S269.1.
 - .1 Materials required to bear grade marks, or be accompanied with certificates, test reports or other proof of conformity.
- .5 Premoulded joint fillers:
 - .1 Bituminous impregnated fibreboard to ASTM D1751.
- .6 Bond Breaker:
 - .1 Impermeable tube formed of polyvinylchloride, rubber or similar material to the approval of the Departmental Representative. Internal diameter equal to dowels.

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 Obtain Departmental Representative's approval for use of earth forms framing openings not indicated on drawings.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Fabricate and erect falsework in accordance with CSA S269.1.
- .5 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CAN/CSA-A23.1.
- .6 Align form joints and make watertight. Keep form joints to minimum.
- .7 Use 25mm chamfer strips on external corners and/or 25mm fillets at interior corners, joints, unless specified otherwise.
- .8 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .9 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

- .10 Clean formwork in accordance with CAN/CSA-A23.1, before placing concrete.

3.2 REMOVAL AND RESHORING

- .1 Leave formwork in place for following minimum periods of time after placing concrete.
 - .1 5 days for structural members.
- .2 Remove formwork when concrete has reached 75% of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.
- .3 Provide all necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.
- .4 Space reshoring in each principal direction at not more than 3000 mm apart.
- .5 Re-use formwork and falsework subject to requirements of CAN/CSA-A23.1.

3.3 JOINT FILLERS

- .1 Locate and form expansion joints as indicated. Install joint filler in all joints.

3.4 JOINT SEALANT

- .1 Fill expansion and control joints with sealer as per manufacturer instructions.

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 37 26 - Underwater Concreting. |
| <u>1.2 REFERENCES</u> | .1 | American Concrete Institute (ACI) .1 ACI 315R-80 (or latest edition), Manual of Engineering and Placing Drawings for Reinforced Concrete Structure. |
| | .2 | American National Standards Institute/American Concrete Institute (ANSI/ACI) .1 ANSI/ACI 315-80 (or latest edition), Details and Detailing of Concrete Reinforcement. |
| | .3 | Canadian Standards Association (CSA) .1 CAN/CSA-A23.1-14 (or latest edition) Concrete Materials and Methods of Concrete Construction. .2 CSA-A23.3-14 (or latest edition), Design of Concrete Structures for Buildings. .3 CSA G30.3-M1983(R1998) (or latest edition), Cold Drawn Steel Wire for Concrete Reinforcement. .4 CSA G30.5-M1983(R1998) (or latest edition), Welded Steel Wire Fabric for Concrete Reinforcement. .5 CSA G30.14-M1983(R1998) (or latest edition), Deformed Steel Wire for Concrete Reinforcement. .6 CSA G30.15-M1983(R1998) (or latest edition), Welded Deformed Steel Wire Fabric for Concrete Reinforcement. .7 CAN/CSA-G30.18-09 (R2014) (or latest edition), Carbon Steel Bars for Concrete Reinforcement. |

.8 CAN/CSA-G40.21-13 (or latest edition), Structural Quality Steels.
.9 CSA W186-M1990 (R2012) (or latest edition), Welding of Reinforcing Bars in Reinforced Concrete Construction.

- .4 American Society for Testing and Materials (ASTM)
.1 ASTM A123/ASTM A123M, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
.2 ASTM C881/ASTM C881M-15, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

1.3 SHOP DRAWINGS

- .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, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacings and locations of chairs, spacers and hangers. Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada. ANSI/ACI 315 and ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structure.

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| 1.4 WASTE MANAGEMENT AND DISPOSAL | .1 | Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and the Waste Reduction Workplan. |
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PART 2 - PRODUCTS

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| 2.1 MATERIALS | .1 | Substitute different size bars only if permitted in writing by Departmental Representative. |
| | .2 | Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise. |
| | .3 | Reinforcing steel: weldable low alloy steel deformed bars to CAN/CSA-30.18. |
| | .4 | Cold-drawn annealed steel wire ties: to CSA G30.3. |
| | .5 | Welded steel wire fabric: to CSA G30.5. Provide in flat sheets only. |
| | .6 | Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1. |
| | .7 | Mechanical splices: subject to approval of Departmental Representative. |
| | .8 | Epoxy resin adhesive: to ASTM C881/C881M. Epoxy adhesive shall be an injectable two-component, hybrid adhesive. The two components are to be separated by means of a dual-cylinder foil pack attached to a manifold which keep component A and component B separate. Containers shall be designed to accept static mixing nozzle which thoroughly blends component A and component B and allows injection of the mixed |

adhesive directly into the drilled hole. Only injection tools and static mixing nozzles supplied by the manufacturer may be used. Injection adhesive shall be formulated to include the resin and hardener to provide optimal curing speed, high strength and stiffness. Injection adhesive anchor system technical data shall be submitted to the Department Representative for review, prior to installation.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1, ANSI/ACI 315, and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada. ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures unless indicated otherwise.
- .2 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

- .1 Provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 2 weeks prior to commencing reinforcing work.

- .2 Upon request inform Departmental Representative of proposed source of material to be supplied.

PART 3 - EXECUTION

3.1 FIELD BENDING

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars which develop cracks or splits.

3.2 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CAN/CSA-A23.1.
- .2 Use approved type chairs to locate the reinforcing steel at the proper grade.
- .3 Tie reinforcement where spacing in each direction is:
 - .1 Less than 300mm: tie at alternate intersections.
 - .2 300mm or more: tie at each intersection.
- .4 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- .5 Ensure cover to reinforcement is maintained during concrete pour.
- .6 Ensure epoxy adhesive anchors/dowels are installed as per manufacturer's instructions.

3.3 CLEANING

- .1 Clean reinforcing before placing concrete to CAN/CSA-A23.1.

PART 1 - GENERAL

- 1.1 REFERENCE STANDARDS
- .1 Do concrete work in accordance with CSA standard A23.1-14 (or latest edition), Concrete Materials and Methods of Concrete Construction, except where stricter standards specify otherwise.
 - .2 Do testing for concrete in accordance with CSA standard A23.2-14 (or latest edition), Methods of Test for Concrete, except where stricter standards specify otherwise.
 - .3 CAN/CSA-A3000-18 (or latest edition), Cementitious Materials Compendium.
 - .4 ASTM C494/ASTM C494M-17 (or latest edition), Standard Specification for Chemical Admixtures for Concrete.
- 1.2 DEFINITIONS
- .1 Tremie concrete is placed underwater through a tube called a tremie pipe. Tremie pipe has a hopper at upper end and may be open ended or may have a foot valve, plug or travelling plug to control flow of concrete. Concrete is placed in 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.

1.3 SAMPLES

- .1 Submit shop drawings in accordance with Section 01 33 00 - Shop Drawings, Product Data, Samples and Mock-up.

1.4 CERTIFICATES

- .1 Minimum 2 weeks prior to starting concrete work submit to Departmental Representative, manufacturer's test data and certification by qualified independent inspection and testing laboratory that the following materials will meet specified requirements:
 - .1 Cement Type 50
 - .2 Admixtures
 - .3 Aggregates
 - .4 Water
- .2 Provide certification that plant, equipment and materials to be used in concrete comply with requirements of CSA standard A23.1.
- .3 Provide certification that mix proportions selected will produce concrete of specified quality, yield, strength, and will comply with CSA standard A23.1.

1.5 READY-MIX CONCRETE SUPPLY

- .1 Provide with each load of concrete delivered to site, duplicate delivery slips containing the following:
 - .1 Name of ready-mix batch plant.
 - .2 Serial number of ticket.
 - .3 Date and truck number.
 - .4 Name or number of project.
 - .5 Class of concrete or mix.
 - .6 Amount of concrete in cubic metres.
 - .7 Time of loading or first mixing of aggregate, cement and water.

- .8 Time and discharge of concrete begins and ends.
- .9 Type and quantity of admixtures added at plant.
- .10 Quantity of water added at plant.

PART 2 - PRODUCTS

2.1 ADMIXTURES

- .1 Admixture will be subject to approval of Departmental Representative. Admixtures will only be permitted to correct deficiencies in mix or to improve placement of concrete.
- .2 Departmental Representative may withdraw prior approval of admixture if conditions encountered during course of work indicate unsatisfactory performance.
- .3 Do not use calcium chloride or materials containing calcium chloride.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Do concrete work in accordance with CSA standard A23.1

3.2 PREPARATION

- .1 Notify Departmental Representative at least 24 hours in advance of intention to commence underwater work.
- .2 Concrete must be pumped from wharf approach to the area(s) of work. Access to the wharf by concrete truck is prohibited due to loading restrictions.

- .3 Place concrete in one continuous operation to full depth required. Provide sufficient supply of concrete to complete pour without interruption and supply complete equipment for every phase of operation.

3.3 TREMIE METHOD

- .1 Provide tremie pipe which is watertight and sufficiently large to allow free flow of concrete. Diameter of tremie pipe to be not less than 200 mm or less than eight times maximum size of coarse aggregate.
- .2 Provide hopper at top of tremie pipe and means to raise and lower tremie.
- .3 Provide plug or foot valve at end of tremie pipe to permit filling pipe with concrete initially.
- .4 Start pour with tremie pipe full of concrete and keep end of pipe buried in freshly placed concrete by at least 300 mm. Control rate of flow by increasing or decreasing depth of end in concrete.
- .5 If seal is lost, allowing water to enter pipe, with draw pipe immediately.
- .6 If tremie operation is interrupted so that a horizontal construction joint has to be made, cut surface laitance by jetting, within 24 to 36h and remove loose material by pumping or air lifting before placing next lift.
- .7 Do not place concrete in flowing water. Do not vibrate, disturb or puddle concrete after it has been placed.