

CONCRETE FORMWORK AND ACCESSORIES**Part 1 General****1.1 RELATED SECTIONS**

- .1 Section 03 20 00 - Concrete Reinforcing
- .2 Section 03 30 00 - Cast-in-Place Concrete

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of test and Standard Practices for Concrete.
 - .2 CSA-O86S1-09, Engineering Design in Wood.
 - .3 CSA O121-08(R2013), Douglas Fir Plywood.
 - .4 CSA O151-09, Canadian Softwood Plywood.
 - .5 CSA S269.1-1975 (R2003), Falsework for Construction Purposes.
 - .6 CSA B111-1974 (R2003), Wire Nails, Spikes and Staples.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Each drawing submitted shall bear the signature and stamp of a qualified professional engineer registered in Canada.
- .3 Clearly indicate method and schedule of construction, materials, arrangement of joints, ties, shores, braces, liners, and locations of temporary embedded parts. Give proposed strengths of concrete at time of stripping forms.

Part 2 Products**2.1 MATERIALS**

- .1 Formwork lumber: plywood and wood formwork materials to CSA O121 and CSA O86.1.
 - .1 Exposed surfaces: new, square-edged, flat, smooth surfaced panels, free of holes, surface markings or other defects.
 - .2 Concealed surfaces: square edged, T & G lumber, plywood or other material, suitable to retain concrete without leakage or distortion.
 - .3 Plywood: Douglas Fir, to CSA 0121, solid one side or medium density overlaid one side grade. High density overlaid grade for architectural concrete. Sound undamaged sheets with clean, true edges.

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- .4 Lumber: to CAN/CSA-0141.
- .2 Nails, spikes, staples: galvanized, to CSA B111.
- .3 Form release agent: non-staining, chemically active release agent 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 Form ties: removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger or deeper than 25mm dia. in concrete surface. Wire ties not permitted. For architectural concrete use snap ties with plastic cones and concrete plugs.
- .5 Joint tape: non-staining, impermeable, self-release type.

Part 3 Execution**3.1 ERECTION**

- .1 Do concrete formwork to CAN/CSA-A23.1 except where specified otherwise.
- .2 Conform to National Building Code of Canada, 2010.
- .3 Verify lines, levels and column centres before proceeding with formwork and ensure dimensions agree with drawings.
- .4 Construct forms to produce finished concrete conforming to the shape, dimensions, locations and levels shown on the drawings within the tolerances required by CAN/CSA-A23.1.
- .5 Obtain Departmental Representative's consent for use of earth forms. Hand trim sides and bottoms and remove loose earth before placing concrete.
- .6 Acquire Departmental Representative's review before framing openings in slabs, beams or columns not detailed on drawings.
- .7 Align form joints and make watertight. Keep form joints to a minimum.
- .8 Use 20mm chamfer strips on exposed corners of beams, columns, walls and curbs, unless otherwise specified.
- .9 Form chases, slots, openings, drips, recesses, expansion and control joints as detailed.
- .10 Set anchors, ties, bolts, nailers, templates, cast-in hardware and shelf angles, steel connection units or other inserts into forms and secure against displacement during concreting.

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- .11 For walls and shear walls, leave one side of form open for inspection of reinforcing steel. Close form only after Departmental Representative has reviewed bar placement.
- .12 Leave formwork in place for following minimum periods of time after placing concrete:
 - .1 Three days for walls, sides of beams, columns and footings.
 - .2 Twenty-eight days for beam soffits, slabs and other structural members, or three days when replaced immediately with adequate approved reshores and when concrete has reached at least 75% of specified 28 day strength.
- .13 Re-use of formwork subject to requirements of CAN/CSA-A23.1.
- .14 Use new formwork for concrete surfaces which will be exposed to view.
- .15 Construct form to produce architectural exposed concrete surfaces to the shape & patterns according to architectural drawings.

End of Section

CONCRETE REINFORCING**Part 1 General****1.1 RELATED SECTIONS**

- .1 Section 03 10 00 - Concrete Formwork and Accessories
- .2 Section 03 30 00 - Cast-in-Place Concrete

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1-09, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN3-A23.3-09, Design of Concrete Structures for Buildings.
 - .3 CSA G30.3-M1983(R1998), Cold Drawn Steel Wire for Concrete Reinforcement.
 - .4 CSA G30.5-M1983(R1998), Welded Steel Wire Fabric for Concrete Reinforcement.
 - .5 CAN/CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
 - .6 CSA W186-M1990 (R2007), Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.3 SOURCE QUALITY CONTROL

- .1 Upon request, provide Departmental Representative with certified copy of mill test report of steel supplied, showing physical and chemical analysis.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Clearly indicate bar sizes, spacing, location and quantities of reinforcement and mesh, with identifying code marks to permit correct placement without reference to structural drawings. Prepare drawings in accordance with "Reinforcing Steel Manual of Standard Practice".
- .3 Detail placement of reinforcing where special conditions occur.
- .4 Show walls and beams in full elevation and detail all bars.
- .5 Design and detail lap lengths and bar development lengths to CAN3-A23.3, unless otherwise specified on drawings.

CONCRETE REINFORCING**1.5 SUBSTITUTIONS**

- .1 Substitution of different size bars permitted only upon written approval of Departmental Representative.

Part 2 Products**2.1 MATERIALS**

- .1 Reinforcing bars: billet steel, grade 400, deformed bars to CSA G30.18.
- .2 Welded steel wire fabric: to CSA G30.5. Provide in flat sheets only.
- .3 Chairs, bolsters, bar supports, spacers: adequate for strength and support of reinforcing construction conditions.
- .4 Use chairs with plastic coated feet where slab and beam soffits will be exposed.
- .5 Mechanical splices: subject to approval of Departmental Representative.

2.2 FABRICATION

- .1 Fabricate reinforcing to CAN/CSA-A23.1.
- .2 Fabricate to tolerances specified by "Reinforcing Steel Manual of Standard Practice".
- .3 Acquire Departmental Representative's review of locations of reinforcement splices other than shown on steel placing drawings.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar list.

Part 3 Execution**3.1 PLACING REINFORCEMENT**

- .1 Do reinforcing work in accordance with CAN/CSA-A23.1-04 and welding of reinforcing with CSA W186-M1990 (R2007), except where indicated otherwise.
- .2 Detail reinforcing to "Reinforcing Steel Manual of Standard Practice", by Reinforcing Steel Institute of Canada.
- .3 Conform to National Building Code, 2005.
- .4 Maximum chair spacing:

10M	-	600mm
15M	-	1200mm
20M	-	1600mm
25M	-	2000mm

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- .5 Obtain Departmental Representative's review of reinforcing steel and position before placing concrete.
- .6 Clean reinforcing before placing concrete.
- .7 Ensure welded wire fabric is adequately supported at centre of slab (or where indicated) during concrete placing.

3.2 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.

End of Section

CAST IN PLACE CONCRETE**Part 1 General****1.1 RELATED SECTIONS**

- .1 Section 03 10 00 - Concrete Forming and Accessories
- .2 Section 03 20 00 - Concrete Reinforcement

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM).
 - .1 National Building Code of Canada 2010.
 - .2 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .3 ASTM C494/C494M-13, Specification for Chemical Admixtures for Concrete..
 - .4 ASTM C1017M-07, Standard Specification for Chemical Admixtures for use in Producing Flowing Concrete.
- .2 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1-09, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN/CSA-A23.2-09, Test Methods of Standard Practices for Concrete.
 - .3 CAN/CSA A3000-08, Cementitious Materials Compendium.

Part 2 Products**2.1 MATERIALS**

- .1 Portland cement: to CAN/CSA-A3000, Type 10.
- .2 Slag cement: cementitious hydraulic slag, to CAN/CSA-A363.
- .3 Water, fine aggregates, normal density coarse aggregates: to CAN/CSA-A23.1.
- .4 Air entraining admixture: to ASTM C260.
- .5 Chemical admixtures: to ASTM C494.
- .6 Pozzolanitic mineral admixtures: to ASTM C1017.
- .7 Superplasticizing admixtures: to ASTM C494.

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- .8 Non-shrink grout: premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, of pouring consistency, capable of developing compressive strength of 50 MPa at 28 days.
- .9 Dry Pack: compound consisting of non-metallic aggregate, cement and sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compressive strength of 35 MPa at 28 days.
- .10 Premoulded joint filler: Bituminous impregnated fiber board: to ASTM D1751.
- .11 Dampproof membrane: Kraft/polyethylene membrane:
 - .1 Lamination: 0.15mm polyethylene film asphalt bonded both sides to asphalt treated kraft.
 - .2 Reinforcement: 13 x 13mm glass fibre cross directional scrim embedded in asphalt laminate.
 - .3 Membrane adhesive: as recommended by membrane manufacturer.

2.2 CONCRETE MIXES

- .1 Provide certification that plant, equipment, and all materials to be used in concrete comply with requirements of CAN/CSA-A23.1.
- .2 Provide certification that mix proportions selected will produce concrete of specified quality and yield and that strength will comply with CAN/CSA-A23.1, Clause 4.4.5.
- .3 Slag cement in combination with normal Portland cement to a maximum of 25% may be used, except in suspended slabs, upon approval of Departmental Representative.
- .4 Obtain Departmental Representative's consent before using chemical admixtures.
- .5 Use of calcium chloride not permitted.

Part 3 Execution**3.1 WORKMANSHIP**

- .1 Do cast-in-place concrete work in accordance with CAN/CSA-A23.1, and testing in accordance with CAN/CSA-A23.2, except where specified otherwise.
- .2 Conform to National Building Code, 2010.

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- .3 Obtain Departmental Representative's review of reinforcing placement before placing concrete. Provide 48 hours notice prior to placing of concrete. In slab construction, ensure that all bottom steel and at least 66% of top steel is in place and inspected before commencing concrete placement.
- .4 Ensure that reinforcement and inserts are not disturbed during concrete placement.
- .5 Prior to placing of concrete in adverse weather, obtain Departmental Representative's review of proposed method for protection during placing and curing.
- .6 Maintain accurate records of poured concrete items to indicate date, location of pour quality, air temperature and test samples taken.

3.2 INSERTS

- .1 Set sleeves, ties, anchor bolts, pipe hangers and other inserts, as required by other trades, in concrete floors and walls. Also, openings as indicated or specified elsewhere. Sleeves, openings, etc., greater than 100mm square not indicated on structural drawings must be reviewed by Departmental Representative.
- .2 Do not provide for any openings through beams or columns without permission of Departmental Representative.
- .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain agreement for all modifications from Departmental Representative before placing of concrete.
- .4 Obtain Departmental Representative's review of conduit routing in slabs prior to placing of concrete.
- .5 Check locations and sizes of sleeves, openings, etc., shown on structural drawings with architectural, mechanical and electrical drawings.

3.3 GROUTING

- .1 Grout underside of steel column and beam bearing plates with non-shrink type grout to manufacturer's instructions, which results in 100% contact over grouted area.

3.4 FINISHING

- .1 Finish concrete to CAN/CSA-A23.1.
- .2 Rub exposed sharp edges of concrete walls, columns and beams with carborundum to produce 3mm radius edges unless otherwise detailed.
- .3 Sandblast exposed architectural texture wall: allow concrete to cure to sufficient strength so concrete will not be damaged. Use light sandblasting to match originally approved mock-up.

CAST IN PLACE CONCRETE**3.5 DEFECTIVE CONCRETE**

- .1 Remove defective concrete, blemishes and embedded debris and repair as directed by Departmental Representative.

3.6 INSPECTION AND TESTING

- .1 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Departmental Representative, in accordance with CAN/CSA-A23.1, Clause 4.4.
- .2 Costs of tests will be paid as per 01 45 00 – Quality Control.
- .3 Ship prepaid 3 test cylinders from each 60 cubic meters (max.) of concrete placed to designated testing laboratory.
- .4 Prepare one additional test cylinder during cold weather concreting. Cure cylinder on job site under same conditions as concrete it represents.

3.7 WINTER PROTECTION

- .1 Carry out winter concreting in strict accordance with CAN/CSA-A23.1, Clause 7.4.
- .2 Do not use unvented heaters.
- .3 Remove and replace damaged concrete at no cost to Crown.

3.8 HOT WEATHER PROTECTION

- .1 Carry out hot weather concreting in accordance with CAN/CSA-A23.1, Clauses 5.2 and 7.4, including use of approved moisture retention film, if applicable.

3.9 JOINT FILLERS

- .1 Locate and form isolation joints as indicated. Install joint filler.
- .2 Use 6 mm thick joint filler to separate slabs-on-grade from vertical surfaces. Extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.

3.10 DAMPPROOF MEMBRANE

- .1 Where indicated, install dampproof membrane under concrete slabs-on-grade inside building.
- .2 Lap dampproof membrane 150mm minimum at joints and seal. Carry up walls to top of slab.
- .3 Seal punctures in dampproof membrane before placing concrete. Use patching material at least 150mm larger than puncture and seal.

End of Section