

**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 CAN/CSA-A23.1-04/A23.2-04, Concrete Materials and Methods of Concrete Construction / Methods of Test and Standard Practices for Concrete.
  - .2 CAN/CSA-086-01, Engineering Design in Wood and O86S1-05, Supplement No. 1 to CAN/CSA-086-01, Engineering Design in Wood.
  - .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, Standards for OSB and Waferboard.
  - .8 CSA S269.1-1975 (R2003), Falsework for Construction Purposes.
  - .9 CAN/CSA-S269.3-M92 (R2003), Concrete Formwork.
- .2 Council of Forest Industries of British Columbia (COFI)
  - .1 COFI Exterior Plywood for 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 reshoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. 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.

**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.
- .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:
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- .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-0121, CAN/CSA-086.1, CSA 0437 Series, or CSA0153.
- .2 Form ties:
  - .1 For concrete not designated 'Architectural', 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, low VOC.
- .4 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene.
- .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 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 and COFI Exterior Plywood for Concrete Formwork.
- .5 Do not place shores and mud sills on frozen ground.
- .6 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .7 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.
- .8 Align form joints and make watertight. Keep form joints to minimum.
- .9 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
- .10 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.
- .11 Clean formwork in accordance with CAN/CSAA23.1, before placing concrete.

#### **3.2 Removal and Reshoring**

- .1 Leave formwork in place for following minimum periods of time after placing concrete.
  - .1 3 days for footings and abutments.

- .2 Remove formwork when concrete has reached 70% 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.

END OF SECTION

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**PART 1 - GENERAL**

**1.1 Related Sections**

- .1 Section 03 10 00 - Concrete Forming and Accessories.
- .2 Section 03 30 00 - Cast-in-Place Concrete.
- .3 Section 05 12 23 - Structural Steel for Buildings.

**1.2 References**

- .1 Reinforcing Steel Institute of Canada
  - .1 RSIC Manual of Standard Practice (2004).
- .2 Canadian Standards Association (CSA)
  - .1 CAN/CSA-A23.1-04/A23.2-04 - Concrete Materials and Methods of Concrete Construction / Methods of Test and Standard Practices for Concrete.
  - .2 CAN3-A23.3-04, Design of Concrete Structures.
  - .3 CSA G30.3-M1983 (R1998), Cold Drawn Steel Wire for Concrete Reinforcement.
  - .4 CSA G30.14-M1983 (R1998), Deformed Steel Wire for Concrete Reinforcement.
  - .5 CAN/CSA-G30.18-M92 (R1998), Billet-Steel Bars for Concrete Reinforcement.
  - .6 CSA W186-M1990, Welding of Reinforcing Bars in Reinforced Concrete Construction.

**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, spacing, 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.
- .3 Detail lap lengths and bar development lengths to CAN3-A23.3, unless otherwise indicated.

**1.4 Waste Management and Disposal**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - General Instructions.

**PART 2 - PRODUCTS**

**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.
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- .3 Reinforcing steel: weldable low alloy steel deformed bars to CAN/CSA-30.18.
- .4 Epoxy Coating of reinforcement: to ASTM A775/A775M.
- .5 Epoxy patching material: to ASTM D3963/D3963M, Annex, A1.
- .6 Cold-drawn annealed steel wire ties: to CSA G30.3.
- .7 Deformed steel wire for concrete reinforcement: to CSA G30.14.
- .8 Welded steel wire fabric: to CSA G30.5. Provide in flat sheets only.
- .9 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1.
- .10 Mechanical splices: subject to approval of Departmental Representative.
- .11 Plain round bars: to CAN/CSA-G40.21.
- .12 Anchor rods: in accordance with Section 05 12 23 - Structural Steel for Buildings: Materials.

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

END OF SECTION

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**PART 1 - GENERAL**

**1.1 Related Sections**

- .1 Section 03 10 00 - Concrete Forming and Accessories.
- .2 Section 03 20 00 - Concrete Reinforcing.
- .3 Section 05 12 23 - Structural Steel for Buildings.

**1.2 References**

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM C 260-06, Standard Specification for Air-Entraining Admixtures for Concrete.
  - .2 ASTM C 494/C495M-10, Standard Specification for Chemical Admixtures for Concrete.
- .2 Canadian Standards Association (CSA)
  - .1 CAN/CSA A3000-08, Cementitious materials compendium

**1.3 Samples**

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 At least 2 weeks prior to commencing work, inform Departmental Representative of proposed source of aggregates and provide access for sampling.
- .3 At least 2 weeks prior to commencing work, submit to Departmental Representative samples of following materials proposed for use:
  - .1 10 kg of each type of Portland cement.
  - .2 3 kg of each type of supplementary cementing material.
  - .3 5 L of each admixture.
  - .4 5 L of curing compound.
  - .5 2 m length of each type of joint filler.
  - .6 1 m length of each type of waterstops.

**1.4 Certificates**

- .1 Submit certificates in accordance with Section 01 33 00 - Submittal Procedures.
  - .2 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 following materials will meet specified requirements:
    - .1 Portland cement.
    - .2 Supplementary cementing materials.
    - .3 Grout.
    - .4 Admixtures.
    - .5 Aggregates.
    - .6 Water.
  - .3 Provide 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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### **1.5 Quality Assurance**

- .1 Minimum 2 weeks prior to starting concrete work, submit proposed quality control procedures for Departmental Representative's approval for following items:
  - .1 Falsework erection.
  - .2 Hot weather concrete.
  - .3 Cold weather concrete.
  - .4 Curing.
  - .5 Finishes.
  - .6 Formwork removal.

### **1.6 Waste Management and Disposal**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Do not leave any excess concrete on site. Remove off site and dispose off in accordance with all federal, provincial and regional environmental standards.
- .3 Prior to concrete pours, designate a location for cleaning out concrete trucks off site.
- .4 Use trigger operated spray nozzles for water hoses.
- .5 Designate a cleaning area for tools to limit water use and runoff.
- .6 Carefully coordinate the specified concrete work with weather conditions.
- .7 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .8 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, non-combustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.
- .9 Choose least harmful, appropriate cleaning method which will perform adequately.

## **PART 2 - PRODUCTS**

### **2.1 APPROVALS**

- .1 All materials to be new and approved by the Departmental Representative.
- .2 All concrete mixes to be approved by the Departmental Representative.

### **2.2 Materials**

- .1 Portland cement: to CAN/CSA-A5.
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- .2 Supplementary cementing materials: to CAN/CSA-A23.5.
- .3 Water: to CAN/CSA-A23.1-04/A23.2-04.
- .4 Aggregates: to CAN/CSA-A23.1-04/A23.2-04. Coarse aggregates to be normal density.
- .5 Air entraining admixture: to ASTM C 260.
- .6 Chemical admixtures: to ASTM C 494. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents.
  - .1 Compressive strength: 30 MPa at 28 days.
- .8 Non premixed dry pack grout: composition of non metallic aggregate Portland cement with sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compressive strength of 30 MPa at 28 days.

### **2.3 Mixes**

- .1 Proportion normal density concrete in accordance with CAN/CSA-A23.1, Alternative 1 to give following quality:
  - .1 Cement: Type GU Portland cement.
  - .2 Minimum compressive strength at 28 days: 30 MPa.
  - .3 Class of exposure: F-1.
  - .4 Nominal size of coarse aggregate: 15 mm.
  - .5 Air content: 5 to 8%.
  - .6 Chemical admixtures: in accordance with ASTM C 494.

### **2.4 FORMWORK MATERIAL**

- .1 To CAN/CSA-A23.1/A23.2.
- .2 Form stripping agent to be non-staining, colourless mineral oil, free of kerosene with a Saybolt Universal Viscosity of 70 minimum and 110 seconds maximum at 38 degree Celsius, and minimum flash-point of 150 degrees Celsius open cup.

## **PART 3 - EXECUTION**

### **3.1 Preparation**

- .1 Obtain Departmental Representative's approval before placing concrete. Provide 48 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 obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing.
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- .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.
  - .2 Sleeves and inserts.
    - .1 No sleeves, ducts, pipes or other openings shall pass through joists, beams, column capitals or columns, except where indicated or approved by Departmental Representative.
    - .2 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 x 100 mm not indicated, must be approved by Departmental Representative.
    - .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Departmental Representative before placing of concrete.
    - .4 Check locations and sizes of sleeves and openings shown on drawings.
    - .5 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
  - .3 Anchor rods and bolts.
    - .1 Set anchor rods and bolts to templates under supervision of appropriate trade prior to placing concrete.
    - .2 With approval of Departmental Representative, grout anchor bolts in preformed holes or holes drilled after concrete has set. Formed holes to be minimum 100 mm diameter. Drilled holes to be to anchor bolt manufacturer's recommendations.
    - .3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.
    - .4 Set bolts and fill holes with shrinkage compensating grout or epoxy grout, as specified on drawings.
    - .5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.
  - .4 Drainage holes and weep holes:
    - .1 Form weep holes and drainage holes in accordance with Section 03 10 00 - Concrete Forming and Accessories. If wood forms are used, remove them after concrete has set.
    - .2 Install weep hole tubes and drains as indicated.
  - .5 Grout under base plates and machinery using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.
  - .6 Finishing.
    - .1 Finish concrete in accordance with CAN/CSA-A23.1.
    - .2 Use procedures acceptable to Departmental Representative to remove excess bleed water. Ensure surface is not damaged.
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- .3 Use curing compounds compatible with applied finish on concrete surfaces. Applied finish on concrete: none. Provide written declaration that compounds used are compatible.
- .4 Provide swirl-trowelled finish unless otherwise indicated.

**3.3 Site Tolerance**

- .1 Concrete tolerance in accordance with CAN/CSA-A23.1.

**3.4 Field Quality Control**

- .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 and Section 01 45 00 - 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 CAN/CSA A23.2.

END OF SECTION

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