

Part I GENERAL

I.1 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .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 O121-2008, Douglas Fir Plywood.
 - .3 CSA O151-09, Canadian Softwood Plywood.
 - .4 CSA O153-M1980(R2008), Poplar Plywood.
 - .5 CSA-O325-07, Construction Sheathing.
 - .6 CSA O437 Series-93(R2006), Standards for OSB and Waferboard.
 - .7 CSA-O86-09, Engineering Design in Wood.
 - .8 CSA S269.1-1975(R2003), Falsework for Construction Purposes.
 - .9 CAN/CSA-S269.3-M92(R2008), Concrete Formwork, National Standard of Canada.
- .2 ACI 301-10 - Specifications for Structural Concrete for Buildings.
- .3 ASCC (American Society of Concrete Contractors) - "Guide for Surface Finish of Formed Concrete".

I.2 SHOP DRAWINGS

- .1 Submit shop drawings for formwork and falsework in accordance with Section 01 00 20 – General Requirements.
- .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 CAN/CSA-S269.3 for formwork drawing.
- .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 Construction Manager.
- .5 Each shop drawing submission shall be stamped and signed by a qualified professional engineer registered or licensed in Province of Manitoba, Canada.

I.3 WASTE MANAGEMENT

- .1 Separate and recycle waste materials in accordance with Section 01 00 20 – General Requirements.

Part 2 PRODUCTS

2.1 MATERIALS

- .1 Formwork materials:
 - .1 Use wood and wood product formwork materials to CSA-O121, CAN/CSA-O86.1, CSA-O153.
- .2 Form ties:
 - .1 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 liner:
 - .1 Plywood: Douglas Fir to CSA O121, Canadian Softwood Plywood to CSA O151.
- .4 Form release agent: non-toxic, chemically active release agent containing compounds that react with free lime in concrete resulting in water soluble soaps.
- .5 Form stripping agent: colourless mineral oil, non-toxic free of kerosene, with viscosity 15 to 24 mm²/s at 40°C, flashpoint minimum 150°C, open cup.
- .6 Falsework materials: to CSA-S269.1.
- .7 Sealant: to Section 07 92 00 - Joint Sealers.

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 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .3 Fabricate and erect falsework in accordance with CSA S269.1. and COFI Exterior Plywood for Concrete Formwork.
- .4 Do not place shores and mud sills on frozen ground.
- .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 and joints where exposed to view, 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 until the concrete has reached 75% of its design strength.
- .2 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.
- .3 Re-use formwork and falsework subject to requirements of CAN/CSA-A23.1.

END OF SECTION

Part 1 General

I.1 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CAN/CSA-G30.18-09, Billet-Steel Bars for Concrete Reinforcement, A National Standard of Canada.
 - .3 CSA-G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .4 CAN/CSA-G164-M92(R2003)(withdrawn), Hot Dip Galvanizing of Irregularly Shaped Articles, A National Standard of Canada.
 - .5 CSA W186-M1990(R2007), Welding of Reinforcing Bars in Reinforced Concrete Construction.
 - .6 CSA A23.3-0, Design of Concrete Structures
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A82-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - .2 ASTM A185/A185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .3 ASTM A775/A775M-07b, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- .3 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

I.2 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.
- .3 Detail lap lengths and bar development lengths to CAN3-A23.3, unless otherwise indicated.

Part 2 Products

2.1 MATERIALS

- .1 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.

- .2 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1.

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 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis.
- .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 that develop cracks or splits.

3.2 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on approved placing drawings and in accordance with CAN/CSA-A23.1.
- .2 Use plain round bars as slip dowels in concrete. Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint. When paint is dry, apply a thick even film of mineral lubricating grease.
- .3 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- .4 Ensure cover to reinforcement is maintained during concrete pour.

3.3 FIELD TOUCH-UP

- .1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcing steel with compatible finish to provide continuous coating.

END OF SECTION

Part I General

I.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .3 CSA A283-06, Qualification Code for Concrete Testing Laboratories.
 - .4 CSA A23.3-09, Design of Concrete Structures
 - .5 CAN/CSA S474-09, Concrete Structures
- .2 American Concrete Institute (ACI)
 - .1 ACI 301 - Specifications for Structural Concrete for Buildings.
 - .2 ACI 309R-96, Guide for the Consolidation of Concrete.
 - .3 ACI 308.1-11 - Standard Specification for Curing Concrete.
 - .4 ACI 308R-01 - Guide to Curing Concrete.
- .3 American Society for Testing and Materials International (ASTM)
 - .1 ASTM C260-01, Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C309-03, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C494 / C494M - 11 Standard Specification for Chemical Admixtures for Concrete.
 - .4 ASTM C1017 / C1017M - 07 Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - .5 ASTM C1610/C1610M-10 - Standard Test Method for Static Segregation of Self-Consolidating Concrete Using Column Technique.
 - .6 ASTM C267-01(2006) - Test Methods for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacing and Polymer Concretes.
 - .7 ASTM E329-11 – Agencies Engaged in Construction Inspection and/or Testing.
 - .8 ASTM C39/C39M-11a - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .5 USACE CRD-C48 - Method of Test for Water Permeability of Concrete.
- .6 ASCC (American Society of Concrete Contractors) - "Guide for Surface Finish of Formed Concrete".

I.2 STANDARD

- .1 Concrete materials and methods of construction to CAN/CSA-A23.1 unless otherwise specified.

I.3 TESTING AND INSPECTION

- .1 Concrete testing to CAN/CSA-A23.1 by testing laboratory designated by Departmental Representative.

- .2 Give Departmental Representative minimum of seven (7) days notice prior to each concrete pour.

I.4 SAMPLES

- .1 Submit samples in accordance with Section 01 00 20 – General Requirements.
- .2 At least four (4) weeks prior to commencing work inform Departmental Representative of proposed source of aggregates and provide access for sampling.

I.5 CERTIFICATES

- .1 Submit certificates in accordance with Section 01 00 20 – General Requirements.
- .2 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.
- .3 Provide certification that plant, equipment and materials to be used in concrete comply with requirements of CAN/CSA-A23.1.

I.6 WASTE MANAGEMENT

- .1 Separate and recycle waste materials in accordance with Section 01 00 20 – General Requirements.

Part 2 Products

2.1 MATERIALS

- .1 Portland cement: to CAN/CSA-A5.
- .2 Supplementary cementing materials: to CAN/CSA-A23.5.
- .3 Water: to CAN/CSA-A23.1.
- .4 Aggregates: to CAN/CSA-A23.1.
- .5 Air entraining admixture: to ASTM C260.
- .6 Chemical admixtures: to ASTM C494. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Concrete retarders: to ASTM C494. Do not allow moisture of any kind to come in contact with the retarder film.
- .8 Non-shrink grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents.
 - .1 Compressive strength: 50 MPa at 28 days
- .9 Polyethylene film: 15 mil thickness to CAN/CGSB-51.34.
- .10 Curing compound: to CAN/CSA-A23.1 and to ASTM C309.

.11 Pre-moulded joint fillers:

.1 Bituminous impregnated fibre board: to ASTM D1751.

2.2 MIXES

.1 Proportion concrete in accordance with CAN/CSA-A23.1, to give quality and yield for concrete as indicated. Refer to Structural Drawings, General Notes for mix proportions and strengths.

Part 3 Execution

3.1 PREPARATION

- .1 Obtain Departmental Representative's approval before placing concrete. Provide seven (7) days 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 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 COLD WEATHER REQUIREMENTS

- .1 When the air temperature is at or below 5°C or when there is a probability of it falling to that limit during the placing or curing period, cold weather requirements shall be applicable.
- .2 Provide heating equipment or heating plant on the job ready for use when concrete is being placed during cold weather. Such equipment shall be adequate for the purpose of maintaining the required temperature during the placing and curing of the concrete. The methods used for heating shall be acceptable to the Departmental Representative. Equipment inducing carbon monoxide gas free to come into contact with concrete work shall not be acceptable.
- .3 Concrete shall not be placed on or against reinforcing, formwork, ground or any surface that is at a temperature less than 5°C.
- .4 When being placed the concrete shall have a temperature of not less than 10°C nor more than 30°C
- .5 The temperature of the concrete at all surfaces shall be maintained at not less than 20°C for three days, or at not less than 10°C for five (5) days after placing.
- .6 Means shall be provided to humidify the air within enclosures and to keep the concrete and formwork continuously moist if dry heat is used.

- .7 The concrete shall be kept above freezing temperature for a period of seven (7) days and shall be kept from alternate freezing and thawing for at least fourteen (14) days after placement.
- .8 At the end of the specified protection period, the temperature of the concrete shall be reduced gradually at a rate not exceeding that shown in Table 17 of CSA CAN3-A23.1-M77.
- .9 Accelerator or so-called antifreeze compounds shall not be permitted unless otherwise approved by Departmental Representative.
- .10 All protective coverings shall be kept clear of the concrete to permit free circulation of air and shall be maintained intact for at least twenty-four (24) hours after the artificial heat is disconnected.

3.3 CONSTRUCTION

- .1 Do cast-in-place concrete work in accordance with CAN/CSA-A23.1.
- .2 Anchor bolts.
 - .1 Set anchor 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 (4") diameter. Drilled holes to be minimum 25 mm (1") larger in diameter than bolts used to manufacturer's recommendations.
 - .3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.
 - .4 Set bolts and fill holes with grout.
 - .5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.
- .3 Grout under base plates and machinery using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.
- .4 Finishing.
 - .1 Interior flat slabs to be exposed or other covering requiring a smooth surface: Initial finishing operations followed by final finishing comprising of mechanical floating and steel trowelling as specified in CAN/CSA-A23.1. to produce hard, smooth, dense trowelled surface free from blemishes; minimum finishing tolerance classification: Flat unless noted otherwise.
 - .2 Exterior flat slabs are to receive a light broom finish. Edges to be tooled with edging tool to provide 12mm radius rounded edge and 75mm smooth border.
 - .3 Use procedures acceptable to Departmental Representative or those noted in CAN/CSA-A23.1 to remove excess bleed water. Ensure surface is not damaged.
 - .4 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible.
 - .5 Rub exposed sharp edges of concrete with carborundum to produce 3 mm (1/8") radius edges unless otherwise indicated.
- .5 Joint fillers.

- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative. When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
- .2 Locate and form construction, expansion joints as indicated. Install joint filler.

3.4 CURING

- .1 Cure and protect concrete in accordance with CAN/CSA A23.1.

3.5 WATER STOPS

- .1 Install water stops to provide continuous water seal. Do not distort or pierce water stop in such a way as to hamper performance. Do not displace reinforcement when installing water stops. Use equipment to manufacturer's requirements to field splice water stops. Tie water stops rigidly in place.
- .2 Use only straight heat sealed butt joints in field. Use factory welded corners and intersections unless otherwise approved by Departmental Representative.

3.6 SITE TOLERANCE

- .1 Concrete tolerance in accordance with CAN/CSA-A23.1 and to tolerance schedule as indicated.

3.7 FIELD QUALITY CONTROL

- .1 Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory in accordance with CAN/CSA-A23.1 and Section 01 00 20 – General Requirements.
- .2 Non-destructive Methods for Testing Concrete shall be in accordance with CAN/CSA-A23.2.

END OF SECTION