

PART 1 - GENERAL

1.1 RELATED WORK

- .1 Concrete Reinforcement Section 032000
- .2 Cast-In-Place Concrete Section 033000

1.2 REFERENCES

- .1 CSA-A23.1, Concrete Materials and Methods of Concrete Construction.
- .2 CSA-A23.2, Methods of Test and Standard Practices for Concrete.
- .3 CSA-A23.3, Design of Concrete Structures
- .4 CSA-O86, Consolidation - Engineering Design in Wood.
- .5 CSA O121, Douglas Fir Plywood.
- .6 CSA O151, Canadian Softwood Plywood.
- .7 CSA O153, Poplar Plywood.
- .8 CSA O437, CSA Standards for OSB and Waferboard.
- .9 CSA S269.1, Falsework for Construction Purposes.
- .10 CSA S269.2, Access Scaffolding for Construction Purposes
- .11 CSA-S269.3, Concrete Formwork.

1.3 FORMWORK DESIGN

- .1 All formwork must be designed by a Professional Engineer Licensed in the Province of Construction. Upon request of the Departmental Representative the Professional Engineer must supply written confirmation that all formwork has been designed to support all appropriate loads and in accordance with applicable standards.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121, CSA-O86, CSA O437 Series and CSA-O153.

- .2 For concrete with special architectural features, use formwork materials to CSA-A23.1.
- .3 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 diameter in concrete surface.
 - .2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs
- .4 Form release agent:
 - .1 Chemically active, non-staining, release agents containing compounds that react with free lime in concrete resulting in water insoluble soaps. Non-toxic, biodegradable, low VOC.
- .5 Form stripping agent:
 - .1 Colourless, non-staining, mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 70 and 110 s Saybolt Universal at 40 degrees C, and having a minimum flashpoint of 150 degrees C. Form release agents must be compatible with waterproofing systems where applicable.
- .6 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 and for 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 Refer to architectural drawings for concrete members requiring architectural exposed finishes.
- .6 Do not place shores and mud sills on frozen ground.
- .7 Provide site drainage to prevent washout of soil supporting mud sills and shores.

- .8 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.
- .9 Align form joints and make watertight. Keep form joints to minimum.
- .10 Locate horizontal form joints in exposed columns and walls 2400 mm above finished floor elevation.
- .11 Use 25 mm chamfer strips on exterior corners and 25 mm fillets at interior corners unless specified otherwise.
- .12 Form all chases, slots, openings, drips, recesses, expansion and control joints. Also form pockets in concrete walls for cladding anchorage as required.
- .13 Build in anchors, inserts, sleeves, miscellaneous frames, flashing reglets, weather bars, holes, and other inserts required to accommodate work of other sections. This includes all embedded items as required to support cladding elements and structural steel framing support. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes.
- .14 Clean formwork in accordance with CSA-A23.1, before placing concrete.
- .15 Construct forms for surfaces to receive membrane type waterproofing with taped joints and edges of plywood backed to prevent separation
- .16 Construction Joints:
 - .1 Form construction joints where required and as approved by the Departmental Representative.
 - .2 Costs of additional reinforcing steel resulting from splicing reinforcing bars, etc. as required to form construction joints in walls, slabs, etc. will be at the expense of the formwork contractor.
- .17 Waterstops:
 - .1 Build waterstops into forms. Support against displacement by pouring of concrete. Locate waterstops at construction joints in pits and trenches below floor levels, and as indicated on Drawings.
 - .2 Use preformed waterstop corners and intersections where they are available to suit conditions.
 - .3 Join waterstops to preformed corners and intersections, and between lengths with butted and welded connections in accordance with manufacturer's recommendations.
- .18 Holes Cast into Concrete During Construction:
 - .1 Install all sleeves, ducts, pipes, and other openings.
 - .2 No sleeves, ducts, pipes or other openings shall pass through beams or column except where indicated or approved by Departmental Representative.

- .3 Ensure that where sleeves or pipes pass through slabs and walls they are fabricated of PVC, cast iron or galvanized steel. Sleeves shall not be spaced closer than three diameters on centre from adjacent sleeves unless approved by Departmental Representative.
- .4 Where approved by Departmental Representative, set sleeves and openings as indicated or specified elsewhere. Provided they are shown on structural drawings, sleeves, pipes or openings, that are not greater than 450 mm square, or 450 mm in diameter, may pass through walls and slabs provided that no more than two reinforcing bars are interrupted and additional reinforcing steel is incorporated as per details on structural drawings. Contact Departmental Representative before installing any openings greater than 150 mm x 150 mm or 150 mm diameter that are not shown on structural drawings.
- .5 Check locations and sizes of sleeves and openings shown on drawings.

3.2 REMOVAL AND RESHORING

- .1 Leave formwork in place for following minimum periods of time after placing concrete:
 - .1 3 days for walls and sides of beams and columns.
 - .2 28 days for beam soffits, slabs, decks and other structural members, or 7 days when replaced immediately with adequate shoring to standard specified for falsework.
 - .3 2 days for footings and abutments.
- .2 Be responsible for the safety of the structure, both before and after removal of the forms, until concrete has reached its specified 28 day strength.
- .3 Strip formwork only when no damage will result from the stripping.
- .4 Take care in removing plywood forms. Do not jerk them loose or use metal pinch bars, but use wood wedges and gradually force the panels loose. Leave plywood forms in place as long as possible and until other adjacent formwork is stripped to permit maximum shrinkage away from concrete and to protect surfaces. Take particular care to prevent damage to external corners of concrete.
- .5 Provide all necessary re-shoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.
- .6 Re-use formwork and falsework subject to requirements of CSA-A23.1.
- .7 Movement and displacement of formwork during construction, variations in excess of specified tolerances, and marked and disfigured surfaces that cannot be repaired by methods acceptable to Departmental Representative will be considered defective Work performed by the Section.
- .8 Reconstruct defective formwork and replace concrete and reinforcement placed in defective formwork at no additional cost.

3.3 QUALITY OF FORMWORK

- .1 Particular attention must be paid to the quality of all concrete exposed to view upon completion of the project including retaining walls. In exposed surfaces, form ties must be minimal, regular and neat and be plugged properly upon removal of formwork.
- .2 For the above-mentioned elements the following special precautions must be taken:
 - .1 All plywood form panels should be new at the start of this project.
 - .2 Concrete shall be smooth form finish as described in CSA A23.1
 - .3 Take special care in vibrating concrete in these elements.
 - .4 All joints in formwork, both horizontally and vertically must be aligned.
- .3 Any concrete falling short of these requirements shall be removed and replaced at the formwork contractors expense.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

- .1 Concrete Formwork Section 031000
- .2 Cast-In-Place Concrete Section 033000

1.2 REFERENCES

- .1 CSA-A23.1, Concrete Materials and Methods of Concrete Construction.
- .2 CSA-A23.2, Methods of Test and Standard Practices for Concrete.
- .3 CSA-A23.3, Design of Concrete Structures
- .4 CSA-G30.18, Billet-Steel Bars for Concrete Reinforcement.
- .5 CSA-G40.21, Structural Quality Steels.
- .6 CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles
- .7 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .8 ASTM A-185, Standard Specification for Steel Welded Wire Reinforcement, Plain for Concrete
- .9 ASTM A-775, Standard Specification for Epoxy Coated Reinforcing Steel Bars
- .10 RSIC, Reinforcing Steel Manual of Standard Practice

1.3 SHOP DRAWINGS

- .1 Submit shop drawings including placing of reinforcement in accordance with Section 013300.
- .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.
- .3 Detail lap lengths and bar development lengths to CSA A23.3, unless otherwise indicated. Provide Type B tension lap splices to CSA A23.3 unless otherwise indicated.

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 CSA-G30.18, unless indicated otherwise.
- .3 Reinforcing steel: weldable low alloy steel deformed bars to CAN/CSA-G30.18.
- .4 Welded steel wire fabric: to ASTM A185. Provide in flat sheets only.
- .5 Epoxy Coating of non-prestressed reinforcement: to ASTM A775.
- .6 Galvanizing of non-prestressed reinforcement: to CSA-G164.
- .7 Chairs, bolsters, bar supports, spacers to CSA-A23.1.
- .8 Mechanical splices: subject to approval of Departmental Representative.
- .9 Plain round bars: to CSA-G40.21.

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 unless indicated otherwise.
- .2 Upper mat of reinforcing steel (10M @ 177 c/c each way) within outdoor skating track and rink shall be galvanized. Refer to drawings
- .3 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.
- .4 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
- .5 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, prior to commencing reinforcing work.

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 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. Give Departmental Representative 24 hours notice.
- .4 Use chairs to support all reinforcing steel to ensure proper positioning and that cover to reinforcement is maintained during concrete pour. Chairs must also be used to support reinforcing steel in slabs on grade and footings.
- .5 Supply 20M dowels 600 long at 600 c/c all around perimeter (inside and outside) of rink and skating trail as detailed on refrigeration drawings. These dowels are used as part of the formwork support system.

END OF SECTION

PART 1 - GENERAL

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- .1 Concrete Formwork Section 031000
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1.2 REFERENCES

- .1 CSA-A23.1, Concrete Materials and Methods of Concrete Construction.
- .2 CSA-A23.2, Methods of Test and Standard Practices for Concrete.
- .3 CSA-A23.3, Design of Concrete Structures
- .4 CSA-A3000, Cementitious Materials Compendium.
- .5 ASTM C260, Specification for Air-Entraining Admixtures for Concrete.
- .6 ASTM C494, Specification for Chemical Admixtures for Concrete.
- .7 CAN/CGSB-37.2, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.
- .8 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .9 ASTM C939 Test Method for Flow of Grout for Preplaced-Aggregate Concrete
- .10 ASTM D412, Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension
- .11 ASTM D624, Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer
- .12 ASTM D1653, Test Methods for Water Vapour Transmission of Organic Coating Films
- .13 ASTM D1751, Specification for Preformed Expansion Joint Fillers
- .14 ASTM D2240 Test Method for Rubber Property—Durometer Hardness
- .15 ASTM C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete

1.3 CERTIFICATES

- .1 Submit certificates in accordance with Section 013300.
- .2 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CSA-A23.1.
- .3 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA-A23.1. Ready-mix Plant must be a member of the Atlantic Provinces Ready Mixed Concrete Association and must hold a current "Certificate of Ready Mixed Concrete Production Facilities" as issued by the Association.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Portland cement with fly ash replacement: to CSA-3000.
- .2 Supplementary cementing materials: to CSA-A3000.
- .3 Water: to CSA-A23.1.
- .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. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Concrete retarders: to ASTM C494 low VOC, solvent free.
- .8 Shrinkage compensating grout: premixed compound consisting of aggregate, cement, water reducing and plasticizing agents. Compressive strength: 55 MPa psi at 28 days.
- .9 Waterstops: Specially formulated mixture of natural sodium bentonite and butyl rubber specifically manufactured as a waterstop such as Waterstop-RX or approved equal.
- .10 Premoulded joint fillers:
 - .1 Bituminous impregnated fiber board: to ASTM D1751.
- .11 Weep hole tubes: plastic.
- .12 Dampproof membrane:
 - .1 0.25 mm polyethylene film to CAN/CGSB-51.34
- .13 Dampproofing:
 - .1 Emulsified asphalt, mineral colloid type, unfilled: to CAN/CGSB-37.2.
- .14 Control Joint Filler:

- .1 Two component, quick setting, semi-rigid, solvent free, self leveling, polyurea; Minimum tensile strength of 4.5 Mpa; minimum elongation of 200% as per ASTM D412, and a minimum Shore A Hardness of 85 as per ASTM D2240.
- .15 Curing and Sealing Compound:
 - .1 Shall be an acrylic emulsion and water based curing compound, clear in colour. Product shall meet the requirements of ASTM C 309 and shall have a maximum VOC content of 300 ounces per cubic foot. (300 grams per litre)
- .16 Surface Hardener:
 - .1 Shall be mineral, non metallic, shake applied. Minimum hardness shall be 6.5-7 on Mohs scale. Minimum compressive strength at 28 days shall be 7200 psi (50 MPa).

2.2 CONCRETE MIXES

- .1 Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1 to give the following properties for all concrete:
 - .1 Type GU Portland cement.
 - .2 Minimum compressive strength at 28 days: Refer to structural drawings
 - .3 Nominal size of coarse aggregate: 20 mm.
 - .4 Slump at time and point of discharge: as per structural drawings
 - .5 Air content: as per Table 4 of CSA Standard A23.1
 - .6 Chemical admixtures: in accordance with CSA – A3000.
 - .7 Replace 20% of cement by mass with flyash in accordance with CAN/CSA-A23.5. If floor hardener is to be used in slabs, contact supplier of hardener regarding compatibility between hardener and flyash and adjust flyash content as necessary.
 - .8 Class of exposure shall be to Table 1 of CSA A23.1
 - .9 Concrete Mix design to meet requirements of Table 2 in CSA A23.1 for appropriate class of exposure
 - .10 All concrete to meet requirements of Tables 1 through 4 of CSA A23.1.

PART 3 – EXECUTION

3.1 PREPARATION

- .1 Obtain Departmental Representative's approval before placing concrete. Provide 24 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 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 In locations where new concrete is dowelled to existing work, drill holes in existing concrete. Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.
- .7 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 CSA-A23.1.
- .2 Holes, sleeves and inserts cast in during construction.
 - .1 No sleeves, ducts, pipes or other openings shall pass through beams or column 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. Provided they are shown on structural drawings, sleeves, pipes or openings, that are not greater than 450 mm square, or 450 mm in diameter, may pass through walls and slabs provided that no more than two reinforcing bars are interrupted and additional reinforcing steel is incorporated as per details on structural drawings. Contact Departmental Representative before installing any openings greater than 15 mm x 150 mm or 150 mm diameter that are not shown on structural drawings.
 - .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 bolts.
 - .1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.
 - .2 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 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 and Curing:
 - .1 Finish concrete in accordance with CSA-A23.1. Provide steel trowel finish for floor slabs unless noted otherwise. Coordinate finish with Departmental Representative prior to casting slab.

- .2 Use procedures acceptable to Departmental Representative or those noted in CSA-A23.1 to remove excess bleed water. Ensure surface is not damaged.
- .3 Use curing and sealing compounds compatible with applied finish on concrete surfaces
- .7 Provide depressions to accommodate flooring as required.
- .8 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.
- .9 Waterstops.
 - .1 Install waterstops to provide continuous water seal. Do not distort or pierce waterstop in such a way as to hamper performance. Do not displace reinforcement when installing waterstops. Install as per manufacturer's specifications.
- .10 Joints
 - .1 Construction Joints – Walls and Structural Slabs:
 - .1 In general, incorporate either horizontal or vertical construction joints, in accordance with CSA-A23.1.
 - .2 Immediately before next pour, clean construction joint and brush with grout of neat cement.
 - .3 Run reinforcement through construction joints unless noted otherwise.
 - .4 Construction Joints to be keyed unless noted otherwise.
 - .2 Construction Joints – Slabs on Grade:
 - .1 In general, incorporate construction joints, in accordance with CSA-A23.1.
 - .2 Immediately before next pour, clean construction joint and brush with grout of neat cement.
 - .3 Do not continue reinforcing thru Construction Joint. At slab mid-depth, provide 12 mm diameter plain dowels, greased one side, at 600 mm centres.
 - .4 Construction Joints to be keyed.
 - .3 Slab on Grade Isolation Joints:
 - .1 Do not install isolation joints in structural slabs.
 - .2 Isolation joints around all columns to form a square or round panel. Square isolation joints shall be orientated so all corners of the square align with slab control joints.
 - .3 Install 13 mm thick premoulded joint filler where slab on grade meets vertical surfaces. Install joint filler to within 13 mm of top of slab where sealer is indicated.
 - .4 Slab on Grade Control Joints/Saw cuts:
 - .1 Discontinue reinforcing at saw cut location by stopping reinforcing 75 mm from each side of saw cut location.
 - .2 Saw 3 mm inch wide control joints into top surface of concrete slab. Depth of saw cut shall be between 1/3rd and 1/4th of total slab thickness. Do not saw-cut suspended slabs on metal deck.

- .3 Locate control joints as indicated on structural drawings. Maximum spacing of control joints in each direction shall be 30 times the slab thickness. If drawings note different spacing, drawings will govern.
 - .4 Align control joints with columns when possible. Provide control joints in two directions at all inside corners.
 - .5 Timing of cutting control joints is crucial. Cut joints as soon as possible after casting slab. Timing of cutting control joints after casting of slab will vary as weather conditions, concrete mixes, etc. change.
 - .6 Completely clean out saw-cut joints of dirt, oil, grease, and similar contaminants. Mask floor surfaces at joints while filling. Follow recommendations of joint filler manufacturer and fill all saw-cut joints with joint filler as specified.
- .11 Under-slab polyethylene film:
 - .1 Install polyethylene film under concrete slabs-on-grade inside building.
 - .2 Lap polyethylene film a minimum 150 mm at joints and seal.
 - .3 Seal punctures in polyethylene film before placing concrete. Use patching material at least 150 mm larger than puncture and seal.
 - .12 Curing and Sealing Compound:
 - .1 Install in accordance with the manufacturers recommendations. Ensure compatibility with flooring adhesives. Remove as required prior to using flooring adhesives.
 - .13 Surface Hardener:
 - .1 Install in accordance with manufacturers recommendations. Refer to manufacturer for application rates. Do not apply on concrete containing more than 3% air. Apply in floor slabs in all rooms with no finished flooring.

3.3 SURFACE TOLERANCE

- .1 Concrete tolerance in accordance with CSA-A23.1 straight edge method. Variations over the 3000 mm long strait edge shall be +/- 6 mm.

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 CSA-A23.1 and CSA-A23.2.
- .2 Testing Laboratory 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.
- .4 Inspection or testing will not augment or replace Contractor quality control nor relieve him of his contractual responsibility.

END OF SECTION