

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 National Building Code of Canada 2010.
- .2 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-O86S1-09, Engineering Design in Wood.
 - .3 CSA O121-08(R2013), Douglas Fir Plywood.
 - .4 CSA O151-09, Canadian Softwood Plywood.
 - .5 CSA O153-13 (R2008), Poplar Plywood.
 - .6 CAN/CSA-O325.0--07, Construction Sheathing.
 - .7 CSA O437 Series-93 (R2011), Standards for OSB and Waferboard.
 - .8 CSA S269.1-1975 (R2003), Falsework for Construction Purposes.
 - .9 CAN/CSA-S269.3-M92 (R2008), Concrete Formwork.
 - .10 CSA B111 – 1974 (R2003), Wire Nails, Spikes and Staples.
- .3 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.
 - .2 Submit shop drawings for formwork and falsework
 - .1 Each shop drawing submission shall bear stamp and signature of qualified professional engineer registered or licensed in the Ontario, Canada.
 - .3 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.
 - .4 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.
 - .5 Indicate sequence of erection and removal of formwork/falsework and proposed strengths of concrete at time of stripping forms.
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1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling 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 Divert wood or plastic materials from landfill to a recycling, reuse, or composting facility as approved by Departmental Representative.
 - .4 Divert unused form release material from landfill to an official hazardous material collection site as approved by Departmental Representative.

Part 2 Products

2.1 MATERIALS

- .1 Formwork Lumber: Plywood and wood formwork materials to CSA-O121, CAN/CSA-O86.1, CSA O437 Series and/or CSA-O153
 - .1 For concrete not exposed in finished work use square edged T&G lumber, solid one side or one side grade plywood or other material, suitable to retain concrete without leakage or distortion.
 - .2 For exposed concrete, use new, square edged, flat, smooth surfaced, high density one side overlaid Douglas Fir Plywood panels, free of holes, surface markings or other defects to CAN/CSA-A23.1.
 - .2 Pan forms: removable steel, reinforced plastic or aluminum as indicated.
 - .3 Form ties:
 - .1 For unexposed concrete, use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes wider or deeper than 25 mm in concrete surfaces. Use no wire ties.
 - .2 For exposed concrete, use snap ties complete with plastic cones and light grey concrete plugs.
 - .4 Form Liner:
 - .1 Douglas Fir high density overlay to CSA 0121.
 - .5 Form release agent: Non-staining, non-toxic, low VOC, biodegradable, 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.
 - .6 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 70 and 110s Saybolt Universal, 15 to 24 mm²/s at 40 degrees C, flashpoint minimum 150 degrees C, open cup.
 - .7 Falsework materials: to CSA-S269.1.
 - .8 Sealant: to Section 07 92 00 – Joint Sealing.
 - .9 Joint tape: non-staining, impermeable, self-release type.
 - .10 Nails, spikes, staples: galvanized to CSA B111.
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Part 3 Execution

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels and column centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Obtain Departmental Representative's approval for use of earth forms.
- .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 exposed finishes. Use new formwork materials for concrete surfaces which will be exposed to view in finished project.
- .6 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/A23.2.
- .7 Align form joints and make watertight. Keep form joints to minimum.
- .8 Locate horizontal form joints for exposed columns 2400 mm above finished floor elevation.
- .9 Use 20 mm chamfer strips on exposed corners of beams, columns, walls and curbs, unless otherwise specified.
- .10 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
 - .1 Obtain Departmental Representative's approval before forming into slabs, beams, walls or columns, openings not indicated on drawings.
- .11 Construct forms for exposed concrete with joints and tie patterns as indicated and/or as directed. Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.
- .12 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.
- .13 Clean formwork in accordance with CAN/CSA-A23.1, before placing concrete.
- .14 For walls and shearwalls, leave one side of forms open for inspection of reinforcing steel. Close form only after Departmental Representative has reviewed and approved bar placement.

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.
 - .2 3 days for columns.
 - .3 28 days for beam soffits, slabs, decks and other structural members, or
 - .4 3 days when replaced immediately with adequate shoring to standard specified for falsework and approved by Departmental Representative.
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- .5 3 days for footings and abutments.
- .2 Remove formwork when concrete has reached 75 % of its design strength or minimum period noted above, whichever comes later. Replace support immediately with adequate reshoring under slabs and beams.
- .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 reshores in each principal direction not more than 3000 mm apart.
- .5 Re-use formwork and falsework subject to requirements of CAN/CSA-A23.1.
- .6 If concrete surfaces require cleaning after form removal, use only pressurized water stream so as not to alter smooth concrete finish.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 03 10 00 - Concrete Forming
- .2 Section 03 30 00 - Cast-in-Place concrete
- .3 Division 04 - Masonry Specifications

1.2 REFERENCES

- .1 National Building Code of Canada 2010.
- .2 American Concrete Institute (ACI) SP-66, ACI Detailing Manual.
- .3 "Reinforcing Steel Manual of Standard Practice" by Reinforcing Steel Institute of Ontario / Canada (RSIO / RSIC).
- .4 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 CSA G30.14-M1983(R1991), Deformed Steel Wire for Concrete Reinforcement.
 - .6 CSA G30.15-M1983(R1998), Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
 - .7 CAN/CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
 - .8 CAN/CSA-G40.21-04(R2009), Structural Quality Steels.
 - .9 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .10 CSA W186-M1990(R007), Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings and bar lists in accordance with Section 01 33 00 – Submittal Procedures. Allow ten working days for shop drawing review before commencing fabrication.
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- .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, spacing 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 Indicate (and detail) all proposed construction joints.
- .4 Show reinforced concrete and reinforced masonry walls and beams in full elevation and detail all bars. When requested, show top and bottom layer slab reinforcing on separate plans. Detail sections to fully illustrate bar placement at dowels, curbs, openings, changes of elevation, beams, stairs, and areas of congested steel, and wherever else required.
- .5 Design and detail lap lengths and bar development lengths to CAN/CSA-A23.1 and CAN3-A23.3, unless otherwise specified on drawings. Use Class "B" tension splices unless otherwise noted.
- .6 Indicate details for placement of dowels.

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.

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.
 - .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 Deformed steel wire for concrete reinforcement: to CSA G30.14.
 - .6 Welded steel wire fabric: to CSA G30.5. Provide in flat sheets only.
 - .7 Welded deformed steel wire fabric: to CSA G30.15. Provide in flat sheets only.
 - .8 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1.
 - .9 Mechanical splices: subject to approval of Departmental Representative.
 - .10 Plain round bars: to CAN/CSA-G40.21.
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2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1, ANSI/ACI 315, and RSIO/RSIC 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.
- .5 Discard and re-fabricate bars having extra bends, cracks, splits, kinks or excessive rust.

2.3 SOURCE QUALITY CONTROL

- .1 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel to be supplied, showing physical and chemical analysis, corresponding to identification tagging of material at the fabrication plant, at least 4 weeks prior to commencing reinforcing work.
- .2 Inform Departmental Representative of proposed source of material to be supplied. Unidentified reinforcement shall not be allowed.

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 during field bends.

3.2 PLACING REINFORCEMENT

- .1 Place reinforcing steel to CAN/CSA-A23.1 and as indicated on reviewed shop drawings. Set tie wires so that ends are directed into concrete, not toward exposed concrete surfaces. Un-coated metal tie wires shall not project more than 5mm into the concrete cover.
 - .2 Do not tack weld reinforcing unless shown on the Structural Drawings, or approved by the Departmental Representative.
 - .3 Do not displace reinforcing to accommodate sleeves, inserts, waterstops, reglets, or other cast-in hardware.
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- .4 Arrange for reinforcing steel personnel to be present at all times concrete is poured to ensure that reinforcing remains in place as tied, and to take remedial action as required.
- .5 Maximum chair spacing unless otherwise required by the Drawings or by "Reinforcing Steel Manual of Standard Practice":

Bar Size	Chair Spacing
10M	600mm
15M	1200mm
20M	1600mm
25M	2000mm

Provide additional chairs and support bars as deemed necessary by the Departmental Representative.

- .6 Place welded wire fabric in as long lengths as practical lapping at least one mesh, (200mm minimum) and tie, unless noted on the Drawings.
- .7 Obtain Departmental Representative's approval of reinforcing steel and position before placing concrete. Give 24 hours notice prior to the time at which approval is required. Ensure that one side of formwork is left open for inspection of reinforcing steel.
- .8 Ensure that all steel is in place, and tied, at the time at which the Departmental Representative's approval has been requested, and prior to the start of concrete placing.
- .9 Clean reinforcing and forms before placing concrete, and adjust reinforcing and forms immediately before concrete is poured, as required, to ensure bars and inserts are placed correctly.
- .10 Obtain approval from Departmental Representative for all construction joint locations. Ensure additional reinforcement at construction joints is available before commencing pour.
- .11 Do not force reinforcing steel inserts or anchor bolts into fresh or semi-hardened concrete.
- .12 Ensure cover to reinforcement is maintained during concrete pour.
- .13 Protect epoxy and paint coated portions of bars with covering during transportation and handling.

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 1 General

1.1 RELATED SECTIONS

- .1 Section 03 10 00 - Concrete Forming and Accessories
- .2 Section 03 20 00 - Concrete Reinforcing
- .3 Division 04 - Masonry Specifications
- .4 Section 05 12 23 - Structural Steel for Buildings

1.2 REFERENCES

- .1 National Building Code of Canada 2010.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C494/C494M-13, Standard Specification for Chemical Admixtures for Concrete.
 - .3 ASTM C1017/C1017M-07, Standard Specification for Chemical Admixtures for use in Producing Flowing Concrete.
- .3 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A3000-08, Cementitious Materials Compendium.
 - .2 CAN/CSA-A23.1-09, Concrete Materials and Methods of Concrete Construction
 - .3 CAN/CSA-A23.2-09, Test Methods and Standard Practices for Concrete.

1.3 SAMPLES

- .1 Submit samples in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Where requested, submit samples of proposed colour of cement and type of proposed aggregate, for all exposed-aggregate and other architecturally-exposed concrete, for approval by Departmental Representative. Minimum sample panel size 600x600x75.

1.4 CERTIFICATES

- .1 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 17.
 - .2 Provide certification that plant, equipment, and all materials to be used in concrete comply with the requirements of CAN/CSA-A23.1.
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1.5 QUALITY ASSURANCE

- .1 Inspection and testing of concrete and concrete materials shall be carried out by a designated testing laboratory in accordance with CAN/CSA-A23.1 and A23.2.
- .2 Costs of tests will be paid by Departmental Representative.
- .3 Departmental Representative will take 3 control cylinders of each strength of concrete from each pour, and not less than 3 from each 60m³ of concrete or part thereof. Handle, store and cure in accordance with CAN/CSA-A23.1.
- .4 Departmental Representative will prepare one additional test cylinder when concrete is being placed at temperatures of 10°C or less, and cure at site under same conditions as concrete it represents.
- .5 Provide equipment and make slump tests with air entrainment tests in accordance with CAN/CSA-A23.2.
- .6 Field-cured (pull-out) cylinders shall be prepared to verify in-situ concrete strengths for stripping of formwork, particularly in cold weather. Pull-out cylinders shall be cast and stored on site until time of testing, in accordance with the recommendations of the Testing Agency. Alternate means of establishing in-situ strength shall be to the approval of the Departmental Representative.
- .7 Maintain accurate records of poured concrete items to indicate date, quantity, mix identification, admixtures, design slump, design density, aggregate size, design strength, time of batching, time of delivery, location of pour in building, quality, air temperature, and test samples taken. File duplicate copies of concrete delivery slips. Make these records available for inspection at all times.
- .8 Testing Agency shall advise Contractor and Departmental Representative, of concrete in non-conformance with this Specification, and/or where rejection of the concrete is deemed warranted. Concrete shall be rejected by the Contractor if the specified requirements of CAN/CSA-A23.1 and this Specification are not met.
- .9 Permit access to the batching plant by the Testing Agency.

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; and the Waste Reduction Workplan.
- .2 Use trigger operated spray nozzles for water hoses.
- .3 Designate a cleaning area for tools to limit water use and runoff
- .4 Carefully coordinate the specified concrete work with weather conditions
- .5 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .6 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, noncombustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations

- .7 Choose least harmful, appropriate cleaning method which will perform adequately

Part 2 Products

2.1 MATERIALS

- .1 Portland Cement shall conform to CAN/CSA-A3000-08, Type GU, or as otherwise indicated on Drawings, or in the Soil Report, from the same source for the entire project.
- .2 Supplementary cementing materials shall conform to CAN/CSA-A23.5. Cementitious hydraulic slag shall conform to CAN/CSA-A363. Blended hydraulic cement shall conform to CSA-A362. Pozzolanitic mineral admixtures shall conform to CAN/CSA-A23.5.
- .3 Water, fine aggregates, and normal density coarse aggregates shall conform to CAN/CSA-A23.1. Coarse aggregate size to meet the requirements of CAN/CSA-A23.1, Clause 14.2.2., and the Drawings. Coarse aggregates for slab-on-grade to be 20mm (minimum) crushed stone. Coarse aggregates for ready-mix masonry grout to be pea-gravel.
- .4 Admixtures shall conform to ASTM C260, C494, C1017, and C979.
- .5 Non-shrink grout shall be premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, of pouring consistency, and containing not less than 50% by mass of cement and not more than 0.06% soluble chloride ion by mass of cement, with an expansion of not less than 0.04% at 28 days, capable of developing compressive strength of 50 MPa at 28 days.
- .6 Dry pack shall be premixed compound 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 a compressive strength of 50MPa at 28 days.
- .7 Membrane-Forming Curing Compound: chlorinated rubber resin formulation to meet specified requirements of CAN/CSA-A23.1 and to ASTM C309, Type I, subject to the approval of the Departmental Representative. Curing compounds are not to be used for slabs to receive a waterproofing membrane, traffic-resistant wearing course, surface sealers, ceramic tile or other bonded finishes.
- .8 Polypropylene Fibres: 20mm length, 100% Virgin Polypropylene Synthetic Fibres.

2.2 CONCRETE MIXES

- .1 Provide product that is classified as a Regionally Manufactured Material such that at least 80% of the mass of the concrete is extracted and processed regionally.
- .2 Prepare concrete mix designs, and be responsible for all mix design costs including related testing.
- .3 Base design on CAN/CSA-A23.1, Table 5, Alternative Number 1, to produce concretes having the 28 day compressive strengths and slumps specified on the structural drawings. Obtain specified slumps by using an approved water reducing admixture.
- .4 Concrete for slabs to receive resilient sheet flooring shall meet flooring manufacturer's requirements while providing adequate workability and compliance with specified
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slumps.

- .5 Design mix to meet the specified exposure requirements of CAN/CSA-A23.1, with the appropriate water/cement ratio and entrained air content given in Tables 2, 3 and 4 of A23.1. Refer to Drawings for required design exposure classifications.
- .6 Concrete for all exposed work shall be of uniform colour and aggregate, and shall be to the approval of the Departmental Representative.
- .7 Only use admixtures which have been tested and accepted in mix designs. Obtain the approval of the Departmental Representative before using chemical admixtures, or supplementary cementing materials.
- .8 The use of calcium chloride or chloride-containing admixtures is strictly prohibited, for all concrete mixes.
- .9 Design concrete with normal rate of hardening. If advantageous to employ modified rates of hardening to facilitate Work and to improve workmanship, Departmental Representative may give approval for use of admixtures.
- .10 Where testing or inspection indicates excessive bleeding, segregation, poor workability of fresh concrete, or insufficient strength of hardened concrete, then mixes shall be redesigned to acceptable standards.
- .11 Submit, to the Departmental Representative in writing, proposed mix designs for each proposed concrete mix, at least 20 days prior to the start of work. Specify intended use for each mix design. Mix designs may be adjusted when job conditions or other circumstances warrant, provided revised mixes are submitted for review in the above manner. Failure to make the necessary submissions may be cause for the classification of the Work as being defective.
- .12 Proceed with concreting operations with the approved mix designs but if, at any time, tests of job concretes indicate failure to meet strength, slumps, density, air content and rate of hardening requirements, or if appearance is unacceptable, adjust the standard proportions to meet requirements. Advise Departmental Representative of changes to approved mix designs during progress of Work.
- .13 Concrete mix design to contain minimum 25% recycled content.
- .14 Use of Slag or fly ash as a partial replacement of cement:
 - .1 The use of slag or fly ash shall be maximized as much as is practical with the following considerations and restrictions:
 - .2 Floor finishing must be able to commence 4 hours after the commencement of placing of concrete and must be able to be completed within an 8 hour time period or less.
 - .3 The strength of the concrete on site for suspended slabs must be at 75% of the specified strength at 3 days.
 - .4 The concrete shall have sufficient strength and stiffness to allow formwork for all vertical surfaces to be removed 24 hours after placing of concrete.
 - .5 The specified strength of the concrete on site for columns and shear walls must be reached at 56 days or less, unless otherwise noted.

- .6 The amount of fly ash or slag must be adjusted for site temperature conditions at the time of placing of concrete to ensure that the requirements above can be met.
- .7 The fly ash content for all C-1 concrete shall not exceed 15% replacement of cement.
- .8 Submit for review the amount of fly ash or slag as a percentage of replacement of cement for each mix design.
- .9 At the completion of the project, provide in writing the overall average of the percentage replacement of cement with the use of slag and/or fly ash for all concrete supplied for the project.
- .10 Polypropylene fibres: Where specified, add 1 kg/m³, in small quantities at plant, with minimum 7 minutes mixing time.

Part 3 Execution

3.1 PREPARATION

- .1 Obtain Departmental Representative's approval for planned sequence and form of communications before each concrete pour. See Clause 3.2.5 Placing of Concrete.
 - .2 Pumping of concrete is permitted only after approval of equipment and mix.
 - .3 Anchor reinforcement and inserts to ensure they will not be displaced 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 Plan locations of sawn control joints in slabs on grade and arrange to have equipment on site and ready to cut joints as soon as surface has hardened sufficiently to resist ravelling. Place joints at 4m max spacing each way, unless otherwise noted on drawings. See CSA A23.1 Clause 7.3.
 - .6 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. Provide additional reinforcing as directed.
 - .4 Check locations and sizes of sleeves and openings shown on structural, architectural and mechanical drawings. Report discrepancies to Departmental Representative for direction.
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- .5 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .7 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 diameter. Drilled holes to be minimum 25 mm larger in diameter than bolts used to manufacturers recommendations.
 - .3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.
 - .4 Set bolts and fill holes with shrinkage compensating epoxy grout.
 - .5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.
- .8 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .9 Drainage holes and weep holes:
 - .1 Form weep holes and drainage holes in accordance with Section 03 10 00. If wood forms are used, remove them after concrete has set.
 - .2 Install weep hole tubes and drains as indicated.
- .10 Dovetail anchor slots:
 - .1 Install continuous vertical anchor slot to forms where masonry abuts concrete wall or columns.
 - .2 Install continuous vertical anchor slots at 800 mm c/c where concrete walls are masonry faced.
- .11 Obtain Geotechnical Consultant's approval of foundation bearing surfaces for bearing capacity, depths, and dimensions, prior to placing concrete. Assist Geotechnical Consultant as required. Maintain accurate records of as-built founding elevations, and submit record drawings to Departmental Representative.
- .12 For slabs-on-grade, obtain written approval of Geotechnical Consultant prior to concreting that the underfloor drainage system (if required) has been satisfactorily installed, that compaction tests have been carried out and that any necessary recompaction has been completed.
- .13 Obtain Departmental Representative's review of conduit routing in slabs prior to placing concrete.

3.2 CONSTRUCTION

- .1 Do cast-in-place concrete work in accordance with CAN/CSA-A23.1.
- .2 Do not place load upon new concrete until authorized by Departmental Representative.
- .3 Slabs to receive resilient sheet flooring shall:
 - .1 Have sealers and curing compounds compatible with flooring systems and acceptable to flooring manufacturer and installer,

- .2 Meet moisture and alkalinity requirements of the flooring manufacturer.
 - .3 Allow for “drying out” time acceptable to flooring manufacturer and installer. Carry out test patches to ensure that moisture content of slabs are compatible with flooring system and acceptable to flooring manufacturer and installer.
 - .4 Construction Joints
 - .1 Provide construction joints in horizontal or vertical surfaces in accordance with CAN/CSA-A23.1, and as indicated on the Drawings.
 - .2 Locate construction joints so as not to reduce the strength and appearance of the structure.
 - .3 Unless noted, locate construction joints at high points in slabs
 - .4 Unless noted, run reinforcement through construction joints, and form keys as indicated on the Drawings
 - .5 Placing of Concrete
 - .1 Obtain Departmental Representative’s approval before placing concrete. Provide Departmental Representative minimum 72 hours notice prior to placing concrete. Notify the Testing Agency in sufficient time to allow necessary tests or other preparatory work to be done. In slab construction, ensure all steel is in place and inspected before commencing concrete placement. Do not begin to place concrete until the work of other trades affecting concrete is complete. Failure to meet this requirement may be cause for classification of the Work as being defective.
 - .2 Immediately before concrete placement, moisten all absorbent material that will be in direct contact with the fresh concrete. Take care to prevent ponding.
 - .3 For concrete placed on metal deck or precast floor units, co-ordinate placement technique with deck supplier for strength and shoring requirements, so as not to damage the deck.
 - .4 Place concrete in accordance with CAN/CSA-A23.1, under the supervision of a competent foreman at all times. Do not permit disapproved or rejected materials on the site.
 - .5 Water, cement, aggregates or admixtures shall not be added to the concrete after the initial introduction of the mixing water to the batch.
 - .6 Concrete shall not be placed, if in the opinion of the Departmental Representative or Testing Agency, it cannot be placed and properly consolidated without the addition of any other water to the batch.
 - .7 In no case shall the time between batching and complete discharge of the concrete exceed 90 minutes.
 - .8 Concrete shall be completely placed within 30 minutes of leaving the transit mixer
 - .9 Ensure reinforcement and inserts are not disturbed during concrete placement and vibration.
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- .10 Place concrete in a continuous operation within planned construction joints. Deposit concrete as nearly as practicable to its final position to avoid segregation due to rehandling or flowing. Handle concrete from the point of delivery to the locations of final deposit as rapidly as practicable, using conveying methods which will prevent segregation or loss of concrete mix materials. Do not transport concrete using vibrators.
- .11 Consolidate placed concrete using mechanical vibrators supplemented by hand-spacing, rodding or tamping. Vibrate concrete evenly and uniformly but limit the duration of vibration to the minimum time necessary to consolidate the concrete and to embed the reinforcing and inserts, without causing segregation.
- .12 Do not allow vibrator to touch formwork. Take particular care to prevent formation of surface defects and honeycombing.
- .6 Hot/Cold Weather
 - .1 Place concrete in cold and hot weather as specified in CAN/CSA-A23.1, Section 7. Protect concrete from physical damage or reduced strength due to premature drying or weather extremes.
 - .2 De-icing chemicals shall not be used on the concrete formwork, or on the finished concrete.
 - .3 If rain or snow begins after concrete is placed, and before it is set, protect with waterproof covers until set.
 - .4 Obtain approval from the Departmental Representative and Testing Agency for proposed method for protection of concrete during placing and curing in adverse weather, prior to placing of concrete.
 - .5 To ensure that concrete cures without suffering damage, take precautions by protective methods, provision of heat, maintenance of humidity, free circulation of warm moist air at concrete surfaces, and other means made necessary by conditions that arise. Do not use unvented heaters.
- .7 Finishing, General
 - .1 Finish concrete in accordance with CAN/CSA-A23.1.
 - .2 Rub exposed sharp edges of concrete with carborundum to produce 3mm radius edges unless otherwise detailed.
 - .3 Refer to Architectural Drawings and Specifications for special finishes.
- .8 Finishing Slabs
 - .1 Finish concrete floor slabs to CSA-A23.1 Clause 7.5.
 - .2 Use procedures acceptable to Departmental Representative and those noted in CAN/CSA-A23.1 to remove excess bleed water. Ensure surface is not damaged.
 - .3 Steel trowel slabs to be left exposed or to receive flooring or carpeting.
 - .4 Other slabs to be screeded off to true lines and levels and left ready to receive specified finish. Depress slabs where required and/or indicated.
 - .5 Provide slab surface tolerances to CSA-A23.1, Table 22, Class A, Commercial and Industrial Floors, unless noted on drawings.

- .6 Ensure that floor drains are located at low points so that no ponding will occur.
- .7 Apply non-metallic surface hardener to exposed concrete floors.
- .8 Use curing compounds compatible with applied finish on concrete surfaces.
- .9 Finishing Slabs to receive Resilient Sheet Flooring
 - .1 Use sealers, curing compounds and methods compatible with flooring system and acceptable to the flooring manufacturer and installer.
 - .2 For floors to receive Resilient Sheet Flooring, allow “drying out time” acceptable to flooring manufacturer and installer.
 - .3 Carry out test patches to ensure that moisture content of slabs is compatible and acceptable to flooring manufacturer and installer.

3.3 FORMWORK REMOVAL AND RESHORING

- .1 Refer to Section 03 10 00 for specified requirements.

3.4 CURING

- .1 Cure concrete as specified in CAN/CSA-A23.1.
- .2 Do not use curing compounds that would have a detrimental effect on bonding, adhesion, curing, appearance, or similar qualities of materials to be applied to concrete surfaces. Use only moisture curing (wet burlap with polyethylene sheeting) at a temperature of at least 10°C for surfaces where applied coatings or finishes are incompatible with curing compound, and maintain continuously moist for a minimum of 7 days.

3.5 OTHER CONCRETE

- .1 Provide electrical and mechanical equipment bases and toppings including floating slabs and toppings, isolation pads, inertia bases and other concrete pads, as required.
- .2 Provide mechanical sump pits and electrical manholes, as cast in place concrete.
- .3 Provide concrete bases for exterior lighting fixtures and other landscape features, and for buried electrical duct banks.
- .4 Unless otherwise detailed, form curbs around duct shafts, electrical shafts, pipe shafts and other floor openings for mechanical and electrical services in sprinklered and parking areas. Curbs shall be minimum 150mm wide, 100mm high, with coved bases and chamfered corners or as otherwise detailed on the Drawings. Finish with steel trowel. Unless otherwise shown on the Drawings, reinforcing shall be one 15M longitudinal bar, with 10M dowels from supporting floor slab at 400mm centres. Where curb height exceeds 400mm, provide 1-10M additional horizontal bar at mid-height.
- .5 Provide any additional cast-in-place concrete required under the work of Divisions 22, 23 and 26, but not stated above.
- .6 Refer to Mechanical, Electrical and Architectural drawings for miscellaneous concrete not indicated on structural drawings.
- .7 Provide concrete fill in landings and stair pans, for metal stairs required under the Work of Division 05.

3.6 GROUTING AND PATCHING

- .1 Grout underside of steel column and beam bearing plates with specified non-shrink type grout to Manufacturer's instructions. Provide 100% contact over grouted bearing areas.
- .2 Where new construction abuts or adjoins existing structure(s), grout joints between new and existing framing, unless shown otherwise on the Drawings.
- .3 Take necessary precautions to ensure good bond of grout to substrate and to exclude entrapped air from grouted joints.

3.7 DEFECTIVE CONCRETE

- .1 Remove damage, discoloured or defective concrete, blemishes, honeycombing, excessive laitence and embedded debris.
- .2 Where the results of specified concrete tests indicate non-compliance with the requirements of this Specification, or where such tests have not been carried out, or when conditions exist such as to cause doubt about the safety, serviceability or durability of the structure, or part thereof, the Departmental Representative shall have the right to order non-destructive testing, and/or field coring for supplementary testing. Such additional tests (including patching of core holes) shall be made at no cost to Departmental Representative.
- .3 Contractor shall submit in writing, details of proposed method of remedial work, for approval by Departmental Representative.
- .4 Where deemed necessary, doweling of reinforcing into hardened concrete shall be done using adhesive or epoxy anchorage system.
- .5 Defects shall be repaired at no cost.

END OF SECTION