
PART 1 - GENERAL

1.1 REFERENCES

- .1 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Section 03 20 00 - Concrete Reinforcing.
- .3 Section 03 30 00 - Cast-In-Place Concrete.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA), (Latest Edition).
 - .1 CAN/CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CAN/CSA A23.3, Design of Concrete Structures.
 - .3 CSA-O86S1, Supplement No. 1 to CAN/CSA-O86-01, Engineering Design in Wood.
 - .4 CSA O121, Douglas Fir Plywood.
 - .5 CSA O151, Canadian Softwood Plywood.
 - .6 CSA S269.1, Falsework for Construction Purposes.
 - .7 CAN/CSA-S269.3 (R2013), Concrete Formwork.

1.3 SUBMITTALS

- .1 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
- .2 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms
- .3 Indicate sequence of erection and removal of formwork/falsework as directed by Departmental Representative.
- .4 Each shop drawing submission shall bear stamp and signature of qualified professional engineer licensed in Province of Nova Scotia, Canada

1.4 RESPONSIBILITY

- .1 Contractor to design for method and schedule of construction,
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shoring, stripping and re- shoring procedures, materials, arrangement of joints, ties, liners, and locations of temporary embedded parts. Comply with CAN/CSA-S269.3(R2013) for formwork drawings.

- .2 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms upon request from Departmental Representative.

1.5 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.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, handle and store formwork materials to prevent weathering, warping or damage detrimental to the strength of the materials or to the surface to be formed.
- .2 Ensure that formwork surfaces that will be in contact with concrete are not contaminated by foreign matter, handle and erect the fabricated formwork so as to prevent damage.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Formwork materials:
 - .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-0121.
 - .2 For concrete with special architectural features, use formwork materials to CSA- A23.1/A23.2.
 - .2 Tubular column forms: round, spirally wound laminated fiber forms, internally treated with release material.
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- .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 dia. in concrete surface. Holes are to be filled with non-shrink grout.
 - .2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.
 - .3 Form tie: assemblies and systems in liquid-containment structures shall be suitable for providing a liquid-tight structure. Form tie assemblies for liquid containment structures shall leave no metal or other material except concrete within 38 mm of the formed surface.

- .4 Form liner:
 - .1 Plywood: medium density overlay Douglas Fir to CSA O121, Canadian Softwood Plywood to CSA O151, T and G thickness as indicated.

- .5 Form release agent: chemically active release agents containing compounds that react with free lime in concrete resulting in water insoluble soaps, non-toxic, biodegradable.

- .6 Form stripping agent, colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 15 or 24 mm²/s at 40°, flashpoint minimum 150°C, open cup.

- .7 Falsework materials: to CSA-S269.1.

- .8 Sealant: to Section 07 92 00 - Joint Sealants.

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. Any pilasters are to be formed and poured monolithically with walls. Review all drawings and check dimensions prior to construction for proper fit and report any discrepancies before proceeding with the work.

 - .2 Obtain Departmental Representative's approval before framing openings not indicated on drawings.

 - .3 Assemble formwork so that concrete is not damaged during its removal.
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- .4 Fabricate and erect falsework in accordance with CSA S269.1.
 - .5 Refer to architectural drawings for concrete members requiring architectural exposed finishes.
 - .6 Fabricate and erect formwork in accordance with CAN/CSA-S269.3(R2013), to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
 - .7 Align form joints and make watertight. Keep form joints to minimum.
 - .8 Locate horizontal form joints for joints for walls and pilasters below top of finished grade.
 - .9 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
 - .10 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
 - .11 Construct forms for architectural concrete, and place ties as indicated and/or as directed.
 - .12 Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.
 - .13 Provide 48 hours notice to Departmental Representative for inspection prior to concrete placement.
 - .14 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Ensure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
 - .15 Secure all anchors and dowels in place using ties, chairs, templates, and forms as required to prior to placing concrete.
 - .16 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.
 - .17 Do not use water to clean out completed forms, unless formwork and concrete construction proceed within a heated enclosure.
 - .18 Construction Joints:
 - .1 Form construction joints where required and as approved.
 - .2 Build waterstops into forms, supported against displacement by pouring of concrete. Locate waterstops at construction joints in pits and trenches below floor levels, and as indicated on
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drawings. Do not install waterstops between footings and walls, or between slabs on fill and walls except where indicated on drawings.

.3 Use preformed waterstop corners and intersections where they are available to suit conditions.

.4 Join waterstops to preformed corners and intersections, and between lengths with butted and welded connections in accordance with manufacturer's recommendations.

3.2 REMOVAL AND RESHORING

- .1 Notify Departmental Representative prior to form removal.
- .2 No construction loads exceeding the combination of superimposed dead load plus specified live load shall be supported on any unshored portion of the structure under construction.
- .3 Form removal times are dependent on proper curing in accordance with CAN/CSA- A23.1, CSA S269.1 and CAN/CSA-S269.3(R2013). Contractor shall provide written evidence of concrete strength to the Departmental Representative 24 hours prior to form removal to show that suitable strength has been achieved.
- .4 Remove formwork progressively and in accordance with the reference code requirements, and so that no shock loads or unbalanced loads are imposed on the structure.
- .5 Leave formwork in place for following minimum periods of time after placing concrete.
 - .1 3 days for walls and sides of beams.
 - .2 1 day for footings and abutments.
 - .3 28 days for suspended slabs and beams.
- .6 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.
- .7 Re-use formwork and falsework subject to requirements of CSA-A23.1A23.2.

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Section 03 10 00 - Concrete Forming and Accessories.
- .3 Section 03 30 00 - Cast-In-Place Concrete.

1.2 REFERENCES

- .1 American Concrete Institute (ACI)
 - .1 ANSI/ACI 315, Details and Detailing of Concrete Reinforcement.
 - .2 ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structure.
- .2 American Society for Testing and Materials International (ASTM)
 - .3 ASTM A185/A185M, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - .4 ASTM A497/A497M, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
- .3 Canadian Standards Association (CSA)
 - .1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of test and Standard Practices for Concrete.
 - .2 CSA-A23.3, Design of Concrete Structures.
 - .3 CAN/CSA-G30.18, Billet-Steel Bars for Concrete Reinforcement, A National Standard of Canada.
 - .4 CAN/CSA G30.3, Cold Drawn Steel Wire for Concrete.
 - .5 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .6 CAN/CSA W47.1-03, Certification of Companies For Fusion Welding.
 - .7 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.3 SUBMITTALS

- .1 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
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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

- .2 Detail splice lengths to CAN/CSA-A23.3 as follows:
 - .1 All splices to be tension lap splices, Class "B".
 - .2 No more than 50% of the reinforcing to be spliced at any given location.
- .3 All corners and intersections to have corner bars, same size and spacing as main bars.
- .4 Provide tension lap with main bars.
- .5 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 concrete.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management Disposal.

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 Cold-drawn annealed steel wire ties: minimum 1.5 mm diameter to CAN/CSA G30.3.
 - .4 Welded steel wire fabric: to ASTM A185/A185M. Provide in flat sheets only.
 - .5 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.
 - .6 Mechanical splices: subject to approval of Departmental Representative.
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- .7 Plain round bars: to CSA-G40.20/G40.21.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2, ACI 315, and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Match dowels from footings to vertical reinforcing in wall.
- .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, minimum 4 weeks prior to commencing reinforcing work. Mill certificate shall be in accordance with CAN/CSA G30.18. Mill certificate shall correspond to heat number(s) identified on bar bundles.
- .2 Upon request inform Departmental Representative of proposed source of material to be supplied.

2.4 CLEANING

- .1 Clean reinforcing to CAN/CSA-A23.1/A23.2,. All reinforced bars are to be free of scale rust and contamination at time of placing in forms.

PART 3 - EXECUTION

3.1 FIELD BENDING

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.
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- .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/A23.2.
- .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 Provide all chairs, braces, lateral support, headers, ties, etc. To secure reinforcing as well as dowels in place during construction.
- .4 Prior to placing concrete, obtain Departmental Representative approval of reinforcing material and placement.
- .5 Ensure cover to reinforcement is maintained during concrete pour.
- .6 Under no circumstances will concrete trucks be permitted to travel over the reinforcing during concrete placing operations.
- .7 After reinforcing is placed and prior to closing of forms, notify the Departmental Representative for inspection of the Work.
- .8 Reinforcement shall be adequately supported by metal chairs, spacers or hangers and secured against displacement within the tolerances permitted and in accordance with ANSI/ACI 315 and CAN/CSA A23.1.

3.3 STORAGE

- .1 Store reinforcing steel to prevent deterioration, contamination or disfigurement.

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Section 03 10 00 - Concrete Forming and Accessories.
- .3 Section 03 20 00 - Concrete Reinforcing.
- .4 Section 03 35 00 - Concrete Finishing.

1.2 MEASUREMENT PROCEDURES

- .1 Cast-in-place concrete will not be measured but will be paid for as a fixed price item.

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C260, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
 - .4 ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
 - .5 ASTM D624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
 - .6 ASTM D1751, Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
 - .3 Canadian Standards Association (CSA)
 - .1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CAN/CSA-A23.2, Methods of Test for Concrete.
 - .3 CAN3-A266.4, Guidelines for the Use of Admixtures in concrete.
 - .4 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of
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A3001, A3002, A3003, A3004 and A3005).

.5 CSA-A3001, Cementitious Materials for Use in Concrete.

1.4 SAMPLES

- .1 At least 4 weeks prior to commencing work, inform Departmental Representative of proposed source of aggregates and provide access for sampling.

1.6 CERTIFICATES

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

1.7 SUBMITTALS

- .1 At least 4 weeks prior to commencing work, inform Departmental Representative of proposed source of aggregates and provide access for sampling.
 - .2 Minimum 4 weeks prior to starting concrete work, submit concrete mix design showing:
 - .1 Maximum aggregate size.
 - .2 Concrete strength.
 - .3 Cement type.
 - .4 Content of cement, fly ash, waste, coarse aggregate, fine aggregate, additives, and air.
 - .5 Air Content (%).
 - .6 Exposure classification.
 - .7 Slump at time of discharge.
 - .8 Cement content (kg/m³).
 - .9 Water-to-cement ratio.
 - .10 Proposed admixtures.
 - .11 Fineness modulus of fine aggregates.
 - .3 Submit testing results and reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.
 - .4 Certificates:
 - .1 Minimum 4 weeks prior to starting concrete work submit to Departmental Representative manufacturer's test data and
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certification by qualified independent inspection and testing laboratory that following materials will meet specified requirements:

- .1 Portland cement.
 - .2 Blended hydraulic cement.
 - .3 Supplementary cementing materials.
 - .4 Grout.
 - .5 Admixtures.
 - .6 Aggregates.
 - .7 Water.
 - .8 Waterstops.
 - .9 Waterstop joints.
 - .10 Joint filler.
- .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/A23.2.
- .3 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA-A23.1/A23.2.

1.8 SOURCE QUALITY CONTROL

- .1 Have all concrete produced and delivered by a ready-mix plant that is a member of the Atlantic Concrete Association (ACA) and holds a current "Certificate of Ready Mixed Concrete Production Facilities" issued by the Association. Submit a copy of this certificate to the Departmental Representative for approval.

1.9 QUALITY ASSURANCE

- .1 Minimum 4 weeks prior to starting concrete work, submit proposed quality control procedures in accordance with Section 01 45 00 - Testing Quality Control for Departmental Representative approval for following items:
 - .1 Falsework erection.
 - .2 Hot weather concrete.
 - .3 Cold weather concrete.
 - .4 Curing.
 - .5 Finishes.
 - .6 Formwork removal.
 - .7 Joints.
 - .2 Site Meetings: Convene pre-installation meeting one week prior to beginning concrete works.
 - .1 Ensure key personnel attend.
 - .2 Verify project requirements.
 - .3 Health and Safety Requirements: do construction occupational
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health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.10 DELIVERY, STORAGE AND HANDLING

- .1 Concrete hauling time: maximum allowable time for concrete to be delivered to site of Work and discharged not to exceed 120 minutes after batching.
 - .1 Modifications to maximum time limit must be agreed to Departmental Representative and concrete producer as described in CSA A23.1/A23.2.
 - .2 Deviations to be submitted for review by Departmental Representative.
- .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
- .3 Waste Management and Disposal:
 - .1 Divert unused concrete materials from landfill to local facility approved by Departmental Representative.
 - .2 Provide an appropriate area on the job site where concrete trucks can be safely washed.
 - .3 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by the Departmental Representative.
 - .4 Unused admixtures and additive materials must not be disposed of into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.
 - .5 Prevent admixtures and additive materials from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with inert, noncombustible material and remove for disposal. Dispose of waste in accordance with applicable local, Provincial and National regulations.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Portland cement:
 - .1 Type GU to CAN/CSA-A23.1/A23.2 and CAN/CSA-A5.
 - .2 Supplementary cementing materials: Type F fly ash replacement to CAN/CSA A3001.
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- .3 Water: to CAN/CSA-A23.1.
 - .4 Aggregates: to CSA-A23.1.
 - .5 Coarse aggregates to be normal density to CSA-A23.1/A23.2.
 - .6 Admixtures:
 - .1 Air entraining admixture: to ASTM C260.
 - .2 Chemical admixtures: to ASTM C494, 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 to CSA A23.1/A23.2.
 - .1 Compressive strength: 55 MPa @ 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 50 MPa at 28 days.
 - .9 Ribbed waterstops: extruded PVC of sizes indicated shop welded corner and intersecting pieces.
 - .1 Tensile strength: to ASTM D412, method A, Die "C".
 - .2 Elongation: to ASTM D412, method A, Die "C", minimum 275%.
 - .3 Tear resistance: to ASTM D624, method A, Die "B".
 - .10 Premoulded joint fillers:
 - .1 Joint filler shall be flexible, lightweight, non-staining, polyethylene, and closed cell. It shall be a chemical-resistant, ultraviolet stable, non-absorbent, low density, compressible foam and have the following requirements:
 - .1 Density, ASTM D1751: 2.0 Ibs/cu.ft. (32.04 kg/cu. m)
 - .2 Compression, ASTM D3575:
 - .1 10% Deflection: 10 psi (69 KPa) maximum.
 - .2 80% Deflection: 125 psi (862.49 KPa) max.
 - .3 Tensile Strength, ASTM D3575: 55 psi (379.50 KPa)
 - .4 Water Absorption, ASTM D3575: 0.5% vol. maximum.
 - .5 Temperature Stability: -40°C to 71°C (-40°F to 160°F).
 - .6 Joint filler shall be supplied with a pre-scored removable strip to provide a uniform sealant reservoir in the joint.
 - .11 Dampproof membrane:
 - .1 Polyethylene membrane:
 - .1 Polyethylene films, minimum 15 mil thickness.
 - .2 Puncture Resistance: 3000 grams ASTM D-1709.
 - .3 Water Vapour Permeance: less than 0.02 perms, ASTM F-
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1249/ASTM E-96.

.4 Membrane tape as recommended by membrane manufacturer to seal all joints.

- .12 Bonding adhesive: as approved by Departmental Representative.
- .13 Weep hole tubes: galvanized steel.
- .14 Joint Sealants:
 - .1 For vertical joints: non-sag elastomeric sealant.
 - .2 For horizontal isolation joints: self-leveling polyurethane elastomeric sealant to CAN/CGSB 19.13-M87 Classification C-1-25-B-N.
 - .3 Sawcut joint filler: two-component semirigid epoxy-only filler with a shore a hardness at 28 days of greater than or equal to 90, per ASTM D22.40.
 - .4 Primer to be compatible with sealant.
- .15 Concrete floor sealer: Ensure compatibility with floor finishes. As per Section 03 35 00 - Concrete Finishing.
- .16 Curing compound: to CAN/CSA-A23.1 and in accordance with Section 03 35 00 - Concrete Finishing.
- .17 Concrete shall have a unit weight of 2350 kg/m³.

2.2 MIXES

- .1 Proportion normal density concrete in accordance with CSA-A23.1/A23.2, Alternative 1 Performance.
 - .2 Co-ordinate construction methods to suit concrete mix proportions and parameters.
 - .3 Identify and immediately report to Departmental Representative when concrete mix design and parameters pose anticipated problems or deficiencies related to construction.
 - .4 All concrete mixes to contain Type F fly ash replacement to a minimum of 10% and a maximum of 15% unless noted otherwise.
 - .5 All concrete mixes to contain minimum Portland cement (Type as specified) of 335 kg/m³.
 - .6 All concrete shall conform to the following requirements unless noted otherwise herein.
 - .1 Mix 1 for mud slabs, concrete fill for excavation under footing and masonry block grouting (where mud slabs, concrete fill
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for excavation under footing and thrust blocks are located within boundary indicated on Structural drawings.

- .1 Type GU Portland cement.
- .2 Minimum compressive strength at 28 days: 20 MPA.
- .3 Air content 4-7%, exposure classification: N.
- .4 Slump at time of discharge: as per CAN/CSA A23.1, not to exceed 80 mm.
- .5 Nominal size of coarse aggregate: 10 mm.
- .2 Mix 2 for footings, foundation walls, pilaster, beams, and floor slab, and slab-on-grade.
 - .1 Type GU Portland cement.
 - .2 Minimum compressive strength at 28 days, 30 MPA.
 - .3 Exposure classification: N.
 - .4 Nominal size of coarse aggregate 20 mm.
 - .5 Slump at time and point of discharge: to CAN/CSA-A23.1, not to exceed 80 mm.
 - .6 Air content: maximum 3 to 6%.
 - .1 Non-air entrained concrete can be used in slabs that are not subject freezing - thaw cycles. Please note, even during construction the concrete need to be protected from freezing - thawing.
 - .7 Chemical admixtures: in accordance with ASTM C494/C494M.
- .7 Slump values are before addition to plasticizer. Add plasticizer as approved by Departmental Representative to achieve workability. Plasticizer to be supplied by mix plant.
- .8 In sufficient time before placement, the Contractor shall submit the concrete mix design to the Departmental Representative for approval.
- .9 Obtain Departmental Representative's approval before using chemical admixtures other than those specified.
- .10 Use of Calcium Chloride not permitted.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Obtain Departmental Representative approval before placing concrete. Provide 24 h notice prior to placing of concrete.
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- .2 Place consolidate, finish, cure, and protect concrete to CAN/CSA A23.1 except where specified otherwise.
 - .3 Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.
 - .4 During concreting operations:
 - .1 Development of cold joints not allowed.
 - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
 - .5 Pumping of concrete is permitted only after approval of equipment and mix.
 - .6 Do not place slab-on-grade concrete until all buried services have been installed and tested. Do not place slab-on-grade until building is closed-in and fill has been placed to the specified requirements.
 - .7 Ensure reinforcement and inserts are not disturbed during concrete placement.
 - .8 Prior to placing of concrete obtain Departmental Representative approval of proposed method for protection of concrete during placing and curing in adverse weather.
 - .9 Protect previous Work from staining.
 - .10 Clean and remove stains prior to application for concrete finishes.
 - .11 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
 - .12 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
 - .13 Do not place load upon new concrete until authorized by Departmental Representative.
 - .14 Place concrete in dry conditions.
 - .15 Unless noted otherwise, place footings on bedrock minimum bearing capacity 200 kPa (SLS) and meeting the specified requirements. Geotechnical Engineer shall confirm bearing capacity in writing prior to the placement of concrete. Geotechnical Engineer shall
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verify bedrock elevations.

- .16 Ensure that foundation bearing materials are free from water and frost. Remove previously frozen bearing materials.
- .17 All dowels shall be placed before concrete footings are poured.
- .18 All exterior footings shall be founded at least 1.2 m below finished exterior grade.
- .19 Maintain adequate frost protection to all soils under footings and slab-on-grade for entire duration of work.
- .20 Bond fresh concrete to hardened concrete to CANCSA A23.1.
- .21 Do not permit vertical free fall of concrete mix to exceed 1500 mm.
- .22 Concrete trucks or any other vehicles are not permitted to drive on damp proof membrane or reinforcing mats.

3.2 CONSTRUCTION

- .1 Do cast-in-place concrete work in accordance with CSA-A23.1/A23.2.
 - .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.
 - .6 Pipes passing through walls of a liquid-containing structure shall include an integral water stop.
 - .3 Construction joints:
 - .1 Construction joint locations shall be approved by the Departmental Representative wherever they are not specifically designated on the drawings.
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.2 Construction and isolation joints for slab-on-grade shall be located and constructed as with existing joints.

.3 Surface of concrete construction joints shall be cleaned and laitance removed.

.4 Immediately before new concrete is placed, all construction joints shall be wetted and standing water removed.

.5 Locate construction joints in wall and footings so as to least impair the strength of the structure and to the Departmental Representative's approval. Construction joints shall be keyed and dowelled. Refer to typical construction joints detailed on drawings.

.4 Sawcut Control Joints.

.1 Sawcut by soft-cut method as early as practicable or alternatively use the wet method, no sooner than twelve (12) hours and no later than twenty-four (24) hours after concrete placement. Ensure that reinforcement and work of other sections are located below cutting line.

.2 Chalk used for chalk-lining sawcuts shall not be red, blue or any colour with a dye that would stain the floor. Use white or light grey chalk only.

.5 Finishing and Curing.

.1 Finish concrete in accordance with CSA-A23.1/A23.2 and Section 03 35 00 - Concrete Finishing.

.2 Use procedures acceptable to Departmental Representative or those noted in CSA- A23.1/A23.2, to remove excess bleed water. Ensure surface is not damaged.

.3 Protect concrete from premature drying and extremes of temperature.

.4 Wet cure using polyethylene sheets placed over sufficiently hardened concrete to prevent damage. Overlap adjacent edges 150 mm and tightly seal with sand on wood planks. Weigh sheets down to maintain close contact with concrete during the entire curing period.

.5 Where burlap is used for moist curing, place two pre-wetted layers on concrete surface and keep continuously wet during curing period.

.6 Finish concrete floor to meet requirements of CSA-A23.1/A23.2.

.7 Concrete floor to have finish hardness equal or greater than Mohs hardness in accordance with CSA-A23.1/A23.2.

.8 Provide swirl-trowelled finish for exterior walks, ramps, pads.

.9 Provide float finish for interior floor slabs.

.10 Foot traffic shall kept off curing concrete for 1 day. Erect signage, caution tape or barriers as required.

.11 Vehicles shall be kept off concrete for 7 days.

.12 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.

- .13 Apply floor sealer as per manufacturer's recommendations to areas as specified in Section 03 35 00 - Concrete Finishing.
- .6 Joint fillers.
- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative.
- .2 When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
- .3 Locate and form, isolation, construction and expansion joints as indicated. Install joint filler.
- .4 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise. Fill top 12 mm with joint sealant as specified.
- .5 Sawcut joint filler. All interior control and construction joints in slab-on-grade joint filler as specified in PART 2 - MATERIALS. Wait as long as possible after placing slab-on-grade to fill sawcut joints prior to occupancy, clean all dust and debris from the sawcuts and immediate area. Over fill sawcuts with the specified filler. Once the filler has hardened, cut joint flush with slab surface.
- .7 Dampproof membrane.
- .1 Install dampproof membrane under concrete slabs-on-grade inside building.
- .2 Lap dampproof membrane minimum 150 mm at joints and seal.
- .3 Seal punctures in dampproof membrane before placing concrete. Use patching material at least 150 mm larger than puncture and seal.
- .4 Seal all pipe and conduit penetrations through the membrane.
- .5 Seal to inside of concrete foundation walls and concrete pits.
- .6 Install membrane in accordance with manufacturer's recommendations, laid smooth without folds or bunches of material.
- .7 Ensure items that pass through membrane are properly and rigidly installed.
- .8 Concrete shall not be placed on or against any surface (including rehar) that is at a temperature below 5°C.
- .9 Concrete at time of deposit shall be between 10°C and 30°C.
- .10 Excessive honeycomb or embedded debris in any concrete shall deem it defective.
- .11 Remove and replace defective concrete.
- .12 Pour concrete continuously between predetermined construction and
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control joints.

- .13 Carry out winter concreting in strict accordance with CAN/CSA-A23.1.
- .14 Carry out hot weather concreting in accordance with CAN/CSA A23.1.

3.3 SITE TOLERANCE

- .1 Concrete slab tolerances in accordance with CSA-A23.1/A23.2, F-number Method, FF = 25, FL = 20.
- .2 Finish all interior exposed concrete slabs to a tight consistent steel trowel appearance without burnishing the surface.

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/A23.2, and Section 01 45 00 - Quality Control.
 - .2 For compressive strength testing of concrete a minimum of 4 cylinders and 3 field cured cylinders are required for:
 - .1 Each day's pour.
 - .2 Each type of grade of concrete.
 - .3 Each change of supplier.
 - .4 Each 50 cubic meter or fraction thereof for footings and foundation walls, requirements of CAN/CSA A 23.1.
 - .5 Conduct at least one(1) slump and one(1) air entrainment test with each compressive strength test.
 - .3 Pay for costs of tests as specified from Cash Allowance. Costs of retesting due to deficient work will be paid for by contractor, by credit change order.
 - .4 Take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
 - .5 Non-destructive Methods for Testing Concrete shall be in accordance with CSA- A23.1/A23.2.
 - .6 Provide Certificate of Field Quality Inspection and Testing to Departmental Representative for inclusion in Commissioning Manual.
 - .7 Inspection or testing by Departmental Representative will not
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augment or replace Contractor quality control nor relieve the Contractor of his contractual responsibility.

3.5 DEFECTIVE WORK

- .1 Repairs and classification of unacceptable concrete to be in accordance with CAN/CSA- A23.1.
- .2 Remove defective concrete and embedded debris and repair as directed by Departmental Representative.
- .3 Remove to bare concrete curing compounds detrimental to application of specified finishes.
- .4 Concrete to be supplied at the minimum strength requirement at 28 days. Tests indicating strengths lower than specified will necessitate further testing as required by the Departmental Representative. Cost for such testing to be at the Contractor's expense. Should further tests confirm low values, the Departmental Representative has the right to require strengthening of the affected area or removal and replacing of the weak concrete all to the Contractor's expense.
- .5 Repair all shrinkage cracks in the completed slab-on-grade to remain exposed employing a suitable epoxy injection technique acceptable to Departmental Representative to completely seal all such cracks, all to the Contractor's expense.
- .6 Concrete tolerance in accordance with CAN/CSA-A23.1.

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-25.20, Surface Sealer for Floors.
- .2 Canadian Standards Association (CSA)
 - .1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

1.3 PERFORMANCE REQUIREMENTS

- .1 Product quality and quality of work in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Submit written declaration that components used are compatible and will not adversely affect finished flooring products and their installation adhesives.

1.4 SUBMITTALS

- .1 Product Data:
 - .1 Submit WHMIS MSDS - Material Safety Data Sheets. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for concrete floor treatment materials. Indicate VOC content.
 - .2 Include application instructions for concrete floor treatment.

1.5 ENVIRONMENTAL REQUIREMENTS

- .1 Temporary lighting:
 - .1 Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 sq m of floor being treated.
 - .2 Electrical power:
 - .1 Provide sufficient electrical power to operate equipment normally used during construction.
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- .3 Work area:
 - .1 Make the work area water tight protected against rain and detrimental weather conditions.
- .4 Temperature:
 - .1 Maintain ambient temperature of not less than 10°C from 7 days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.
- .5 Moisture:
 - .1 Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer.
- .6 Safety:
 - .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
- .7 Ventilation:
 - .1 Ventilate area of work as directed by Departmental Representative by use of approved portable supply and exhaust fans.
 - .2 Ventilate enclosed spaces in accordance with Section 01 50 00 - Temporary Facilities.
 - .3 Provide continuous ventilation during and after coating application.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste management: remove for reuse and return by manufacturer of pallets, crates, padding, and packing materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 CHEMICAL HARDENERS

- .1 Type 1- Sodium silicate.
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- .2 Water: potable.

2.2 SEALING COMPOUNDS

- .1 Surface sealer: to CAN/CGSB-25.20, Type 2 - water based.
- .2 Surface sealers may not be manufactured or formulated with aromatic solvents formaldehyde halogenated solvents mercury lead cadmium hexavelant chromium and their compounds.

2.3 WET CURE

- .1 Clear polyethylene film to ASTM C171, minimum thickness 0.15 mm.

2.4 MIXES

- .1 Mixing, ratios and application in accordance with manufacturer's instructions.

2.5 JOINT SEALANT

- .1 Joint sealants to Section 07 92 00 - Joint Sealants.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verify that slab surfaces are ready to receive work and elevations are as indicated on drawings by manufacturer.

3.2 PREPARATION OF EXISTING SLAB

- .1 Rub exposed sharp edges of concrete with carborundum to produce 3mm radiused edges unless otherwise indicated.
 - .2 Saw cut control joints to CSA-A23.1/A23.2, 24 hours maximum after placing of concrete.
 - .3 Use mechanical stripping to remove chlorinated rubber or existing surface coatings.
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- .4 Use protective clothing, eye protection, respiratory equipment during stripping of chlorinated rubber or existing surface coatings.

3.3 APPLICATION

- .1 After floor treatment is dry, seal control joints and joints at junction with vertical surfaces with sealant.
 - .2 Apply floor treatment in accordance with Sealer manufacturer's written instructions.
 - .3 Clean overspray. Clean sealant from adjacent surfaces.
 - .4 Thoroughly clean floor surface using a mechanical scrubber with white pads to ensure no damage is done to the surface.
 - .5 Apply "Liquid Densifier/Sealer" at a rate of 4.9 - 7.2 m²/L (200-300ft²/US gal) immediately at a time designated by the Departmental Representative. Sealer finish must be consistent and uniform in appearance and to the satisfaction of the Departmental representative. If sealer is not applied satisfactorily, it will be re-applied at no cost to the Owner.
 - .6 Select the section of the floor for the initial application. The liquid densifier/sealer shall be scrubbed into the concrete surface with a mechanical scrubber, using only white pads, at the rate specified herein, to assist the liquid to penetrate the concrete surface. In smaller areas and along the perimeter of the slab, a bristle brush may be used.
 - .7 Keep the surface wet with the densifier/sealer at all times during the application process. After the product thickens, but not more than thirty (30) minutes after initial application, the surface should then be squeegeed onto the floor area that is to be treated next.
 - .8 Continue until entire floor area has been treated. Vacuum to remove all excess liquid. Do not leave any residue on the surface. The floor may be flushed with water to assist in the removal of the excess material.
 - .9 At completion, floor must be squeegeed dry. If necessary, dry mops shall be used to dry up access water.
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3.4 PROTECTION

- .1 Protect finished installation in accordance with manufacturer's instructions.

3.5 TOLERANCES

- .1 Concrete finishing tolerance in accordance with CSA A23.1/A23.2.
- .2 A permitted variation in any part of the construction or in any section of the specification shall not be construed as permitting violation of more stringent requirements for any other part of construction or in any specification section.