

This document contains standards that are the minimum requirements for BCIT construction projects. The information in the document is organized using the MasterFormat® and SectionFormat® systems. It is not a specification; it is intended to supplement the Consultant's own documents. Do not use this information as a standalone specification.

**SECTION 03 30 00
CAST-IN-PLACE CONCRETE**

PART 1 - GENERAL

1.1 SUMMARY

- .1 Provide cast-in-place concrete with accessories for a complete installation.
- .2 Provide keys and dowels in construction joints, anchor bolts, embedded metals and canning, and grouting under steel base plates.
- .3 Provide curing compounds, sealers and hardeners.
- .4 Install accessories and items supplied under other Sections.
- .5 Provide concrete pads for mechanical and electrical equipment on grade and at roof level as indicated. Pad dimensions shall be dimensions of the unit plus 100 mm (4 in.) more on each side and 200 mm (8 in.) thick.
- .6 Furnish such notification and reports and pay fees to Authorities Having Jurisdiction as required.
- .7 Obtain and pay for concrete testing as specified.

1.2 RELATED SECTIONS

- .1 03 35 43 Polished Concrete Finishing.
- .2 32 13 13 Concrete Paving.

1.3 REFERENCES

- .1 Perform work in accordance with the following referenced standards unless indicated otherwise.
- .2 ACI Detailing Manual Book by American Concrete Institute, 01/01/2004.
- .3 ACI 302.1R-15 Guide to Concrete Floor and Slab Construction.
- .4 ACI 305R-10 Guide to Hot Weather Concreting.
- .5 ACI 306R-10 Guide to Cold Weather Concreting.
- .6 ASTM A185-07 Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete (Withdrawn 2013).
- .7 ASTM D1752-04A(2013) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .8 ASTM D1751-04(2013)E1 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
- .9 ASTM C309-11 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- .10 ASTM C494/C494M-15a Standard Specification for Chemical Admixtures for Concrete.
- .11 ASTM C1017/C1017M-15a Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
- .12 ASTM C260/C260M-10a Standard Specification for Air-Entraining Admixtures for Concrete.
- .13 ASTM D994/D994M-11 Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
- .14 ASTM E1155/E1155M-14 Standard Test Method for Determining F_F Floor Flatness and F_L Floor Levelness Numbers.

- .15 CAN/CGSB 51.34-M86 Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .16 CAN/CSA-G30.18-09(R2014) Carbon steel bars for concrete reinforcement, Includes Update No. 1 (2012).
- .17 CAN/CSA S269.3-M92 (R2013) Concrete Formwork.
- .18 CAN/CSA S474-04(R2014) Concrete Structures.
- .19 CSA A23.1-14/A23.2-14 Concrete materials and methods of concrete construction / Test methods and standard practices for concrete, Includes Update No. 1 (2015).
- .20 CSA A23.3-14 Design of Concrete Structures.
- .21 CSA A23.4-16 Precast Concrete - Materials and Construction.
- .22 CSA A3000-13 Cementitious materials compendium (Consists of A3001, A3002, A3003, A3004 and A3005), Includes Update No. 1 (2014), Update No. 2 (2014), Update No. 3 (2014).
- .23 CSA O141-05(R2014) Softwood Lumber.
- .24 CSA W186-M1990 (R2012) Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .25 British Columbia Building Code, 2012 edition.

1.4 SYSTEM DESCRIPTION

- .1 The design life of concrete shall be 100 years.

1.5 COORDINATION

- .1 Cooperate with other trades to permit proper execution of Work.
- .2 Consult with other trades to ensure exact location and extent of items supplied and work required by other trades which are to be incorporated into concrete work.

1.6 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 Submittal Procedures.
- .2 Product Data: Prior to ordering materials submit the following for each manufactured material and product specified.
 - .1 Curing Compound: Manufacturer's application instructions.
 - .2 Submit special procedures proposed for casting concrete when projected temperatures are below 5°C or above 25°C.
- .3 Shop Drawings:
 - .1 Design and engineering of formwork and construction shall be the responsibility of the Contractor. It is the Contractor's sole responsibility to ensure forms are designed and built to provide adequate strength, rigidity and safety. Retain a qualified engineer to provide complete designs, drawings and instructions for forms, falsework, shoring and re-shoring for the project. Design formwork in accordance with requirements of BC Building Code 2012.
 - .2 Drawings: Minimum scale:
 - .1 Plans and Elevations: 1/8" = 1'-0" (1:100) for plans and elevations.
 - .2 Details: 1/2" = 1'-0" (1:20) for details. Show typical and non-typical details and identify locations where details will be used.
 - .3 Submit formwork drawings for architectural concrete elements. In general, show:
 - .1 Type of forming materials
 - .2 Methods of fixing reinforcing and conduit
 - .3 Direction of form material
 - .4 Form joints, construction joints, block outs, bulkheads

- .5 Locations of embedded plates and anchor bolts cast into concrete
- .6 Location of reveals, rustication strips and method of fixing to formwork
- .7 Form connection and corner details including sealing forms between construction joints.
- .8 Sleeves for plumbing lines and sprinkler pipes
- .4 Locate form joints and tie holes where shown on the architectural Drawings, where not shown, and as follows:
 - .1 Locate plywood joints and form ties symmetrically about any section of wall, building gridlines and symmetrically within plywood sheets.
 - .2 Locate ties in a uniform pattern with one row of ties located above and below construction joints.
 - .3 Where additional ties are required but are out of sequence with approved tie pattern, use approved break back tie without sleeve or cone.
 - .4 Align ties horizontally from section to section and around corners.
- .5 Allow a minimum of 15 working days for review of formwork drawings by Consultant and a further 10 working days for resubmittal incorporating adjustments made by the Consultant.
- .6 Review of formwork drawings will be for architectural features only and will not constitute acceptance of structural adequacy of formwork.
- .4 Samples:
 - .1 Submit the following samples of materials to the Consultant for approval. Approved samples shall be used as the acceptable standard for all materials used on the project.
 - .1 Forming materials, minimum 400 mm x 400 mm (16"x16") sample.
 - .2 Ties and tie cones.
 - .3 Each type of water stop, 300 mm (12") long.
 - .4 Cone hole plugs.
 - .5 Chairs and spacers for support of reinforcement in concrete slabs, walls, columns and beams.
 - .6 Gaskets, sealing materials and form jointing system incorporated into a sample with form materials.
- .5 Mix Designs and Supply:
 - .1 Submit mix designs with necessary local material information to an Independent Testing Agency for review for conformance with specifications. The Testing Agency will provide a written report to the Consultant for review. The cost of review will be paid by the Contractor. The agency shall submit reports for services rendered to the Consultant.
 - .2 Ensure Mix Design information includes:
 - .1 Name of Supplier.
 - .2 Specification and proportions by weight of each design component.
 - .3 All admixtures.
 - .4 Supply proposed mix designs to the Testing Agency and obtain approval from Owner's structural engineer minimum 14 days prior to first concrete pour.
 - .3 Follow approved mix designs and procedures on site.

- .6 Certificates and Reports:
 - .1 Material certificates and test reports including test reports. Submit reports from CSA Certified Inspection Agency.
 - .2 Submit credentials of concrete plant.
 - .3 Test Results: Submit test results of cylinder testing as directed by Consultant.

1.7 QUALITY ASSURANCE

- .1 Concrete to be "controlled concrete" according to CSA A23.1.
- .2 Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.
- .3 Installer Qualifications: An experienced installer who has completed concrete work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- .4 Pre-installation Conference: Conduct conference with Contractor, Consultant, Owner's structural engineer and concrete supplier present. Agenda shall include the following items:
 - .1 Compaction Testing of sub grades, mix designs, waterproof admixtures, below grade drainage, footing drains, submittals still to be received if any, inspections by Owner's structural engineer and Authority Having Jurisdiction.

1.8 DELIVERY AND HANDLING

- .1 Deliver concrete from a plant approved by Owner's structural engineer. If problems of delivery or quality control of concrete occur, Owner's structural engineer has the authority to require a change to another supplier.
- .2 Protect concrete from damage caused by rain, snow, sun, wind and construction hazards during and after placement. Provide protection for exposed concrete corners to prevent chipping.

1.9 PROJECT CONDITIONS

- .1 Meet requirements of CAN3-A23.1, Clause 21, for protection including hot weather protection, cold weather protection, and preparation and cooling after protection.
- .2 Use special procedures when casting concrete during weather conditions projected to be below 5°C or above 25°C.
- .3 Low Temperature Conditions: Comply with the requirements of CSA A23.1 and ACI 306 for placing of concrete when the air temperature falls below 5°C. Do not place concrete if temperature is less than 0°C, unless protective enclosures and heating are provided and maintained for a minimum of 72 hours following concrete placement. Do not place concrete against reinforcement which is below 0°C.
- .4 Hot Weather Conditions: Comply with CSA A23.1 and ACI 305 for placing of concrete when the air temperature is above 30°C.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- .1 Subject to compliance with specifications, the following manufacturer are acceptable for admixtures and accessories indicated below:
 - .1 BASF - The Chemical Company, www.basf.ca, 1-514-341-5411.
 - .2 Cetco, Subsidiary of Amcol International Corp., www.cetco.com, 1-800-527-9948.
 - .3 Harry S. Peterson Co Inc., Western Construction Group, www.westerngroup.com, 773-638-5206.
 - .4 Sika Canada, www.sika.com. Distributed by Brock White Canada, www.brockwhite.com, 604-299-8551.

- .5 Tremco Commercial Sealants & Waterproofing, www.tremcosealants.com, 1-800-363-3213. Contact: Rick Seidelmann, 604-876-4029.
- .6 Grace Canada Inc., www.grace.com, 604-669-4642.
- .7 W.R. Meadows of Western Canada, www.wrmeadows.com, 1-800-661-6971.

2.2 CONCRETE MATERIALS

- .1 Materials for concrete shall conform to requirements of CSA A23.1. Do not use calcium chloride or admixtures containing chlorides, fluorides or nitrates.
- .2 Cement: GV or GVb General use hydraulic cement, conforming CSA A3001.
- .3 Aggregates: Natural sand and crushed stone and gravel conforming to CSA A23.1. Maximum size of coarse aggregate 20 mm ($\frac{3}{4}$ "). Maximum size of coarse aggregate for concrete toppings 10 mm ($\frac{3}{8}$ ") and in concrete with congested reinforcement.
- .4 Water: Potable water only. Use hot water in the mix when forecasted temperature is below 5°C.

2.3 ADMIXTURES

- .1 Air Entraining Admixture: Conforming to ASTM C260.
 - .1 Acceptable products:
 - .1 Darex AEA by Grace.
 - .2 MasterAir VR 10 by BASF.
 - .3 Or approved alternative.
 - .2 Add specified air entraining agent to all concrete exposed to weather. The amount of air entrainment to be 6% + 1%, unless noted otherwise.
- .2 Superplasticizer: Conforming to ASTM C1017.
- .3 Other Chemical admixtures: in accordance with ASTM C494 and only with prior approval of the Engineer.

2.4 FORMING MATERIALS

- .1 For Surfaces Exposed to View: Overlay Plywood: 16 mm (5/8 in.) or 19 mm (3/4 in.) Fir plywood with phenolic resin impregnated cellulose fibre sheet bonded on face. Back and all edges sealed. Product: Crezon®MDO plywood or approved alternative.
- .2 For Surfaces Concealed from View: Plywood Formply, standard 17.5 mm (11/16 in.) or 19 mm (3/4 in.) thick, sanded, fir plywood conforming to CSA 086, resin sealed and urethane coated face, back and edges sealed including cut edges.
- .3 Do not use sheets showing torn grain, worked edges, patches, holes from previous use or other defects which will impair the texture of the concrete.
- .4 Lumber Formwork and Falsework: Fabricate from lumber conforming to CSA 0141. Lumber shall be grade marked in accordance with NLGA.
 - .1 Wood for reveals in walls shall be $\frac{3}{4}$ " x $\frac{3}{4}$ " kiln dried Douglas Fir, tapered to permit removal.
- .5 Column Forms: Rectangular longest dimension 1200 mm (4 ft.) or under. Forms for rectangular columns shall have no interior ties and shall be steel forms without damage or flaws at the start of each pour, new or as new at start of work. Formwork selected must be used for all rectangular columns. Columns with a dimension greater than 1200 mm (4 ft.) shall be formed as for walls.
- .6 Column Forms (Round): Steel Forms, with no horizontal joints and with no visible vertical seams apparent on stripped concrete.
- .7 Beams: Overlay plywood with no ties used on exposed portions of beams.

- .8 Fasteners: For formwork and installation of rustication strips, bands, reglets and reveals: Galvanized or approved non-corrosive steel materials.
- .9 Form Gaskets: 3 mm (1/8 in.) or as required to suit conditions, adhesive backed foam tape, Burke or approved alternative
- .10 Forming Hardware: Compatible forming hardware system that will maintain wall thickness tolerances as specified under proposed placing and forming methods.
- .11 Form Release Agent: Chemical non-staining release agent not affecting application of finishes. Use in strict accordance with the manufacturer's recommendations. Formseal (Sika), Burke Release, Nox-crete (Grace Construction Materials) or approved alternate.
- .12 Form Sealer: Non-staining coating to seal form and provide for ease of form removal. Formfilm (W.R. Grace Company), Formseal (Sika) or pre-approved alternate.

2.5 TIES AND TIE PLUGS

- .1 Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, through bolts, or other system designed to prevent form deflection and to prevent spalling concrete surfaces upon form removal
 - .1 Form Ties: 6 mm (1/4 in.) snap ties, equipped with 32 mm (1-1/4 in.) face diameter cones which provide a one and one half 38 mm (1-1/2 in.) break-back. See Drawings for locations and patterns of cones.
 - .1 Form ties for elements not exceeding 2.0 m (6 ft.) in height: 25 mm (1") break back snap ties with appropriate hardware to suit formwork.
 - .2 Form ties for elements more than 2.0 m (6 ft.) in height: Use through bolt or heavy duty coil tie systems. Ensure formwork is specially designed to withstand pressures, placing techniques, type of tie and height of element.
 - .3 Tie cones for exposed finishes: plastic tapered cones 25 mm (1") deep and 25 mm (1") face.
 - .2 Coil Ties: 13 mm (1/2 in.) coil ties, equipped with 32 mm (1-1/4 in.) face diameter cones which when removed provide a 38 mm (1-1/2 in.) recess to receive snap plugs. See Drawings for locations and patterns of ties and cones. Burke, Dayton, Superior or approved alternative.
 - .3 Form Ties for Extra Support Areas: Shall be 10mm (3/8 in.) diameter she bolts complete with cones with 32 mm (1-1/4 in.) face diameter. See Drawings for locations and patterns.
- .2 Tie Hole Plugs: Plugs shall be concrete, flat colour matched concrete to be installed 6 mm (1/4 in.) recessed with concrete surface.
- .3 Epoxy adhesive: As recommended for use by concrete plug supplier.

2.6 REINFORCEMENT

- .1 Use new reinforcement, free from loose scale, rust, oil or other coatings which will decrease the bond to concrete at the time of placing concrete.
- .2 Reinforcing Steel, Deformed: CAN/CSA G30.18, billet steel grade 400W, weldable.
- .3 Reinforcing Steel, Plain: CAN/CSA G30.18, billet steel, Grade 300R, 400R or 500R as indicated, bars, galvanized.
- .4 Cold Drawn Steel Wire, Plain: ASTM A82, galvanized.
- .5 Cold Drawn Steel Wire, Deformed: ASTM A496, wire size to suit application, galvanized.
- .6 Welded Steel Wire Reinforcement, Plain: ASTM A185, in flat sheets or coiled rolls, galvanized.
- .7 Welded Steel Wire Reinforcement, Deformed: ASTM A497, in flat sheets or coiled rolls, galvanized.

- .8 Reinforcing Steel Mat, Deformed: ASTM A184, 60 ksi (420 MPa) yield grade; deformed steel bars or rods, galvanized.
- .9 Galvanized Reinforcing Bars: ASTM A615, Grade 60, deformed bars, ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized, and chromate wash treated after fabrication and bending.
- .10 Reinforcing Mesh:
 - .1 For sidewalks and ramps: Sized to suit application, galvanized.
 - .2 Reinforcing Slabs on Grade: 6" x 6" x 6 gauge.
 - .3 Reinforcing Sidewalks: 6" x 6" x 6 gauge.

2.7 REINFORCEMENT ACCESSORIES

- .1 Chairs, bolsters, bar supports, spacers: Use only non-rusting, galvanized, plastic coated steel, or plastic supports and accessories. Use chairs of sufficient strength to suit construction activities.
- .2 Wire for tying reinforcement: No. 16 AWG or heavier black soft-annealed wire.
- .3 Coil loop inserts and dowel replacement inserts: to develop full capacity of bars, for dowel replacement where pre-approved by the Consultant. Submit product data to the Engineer for approval.

MIXES

- .4 Proportions: As recommended in CSA A23.1. To be a guide for the water cement ratio to give durable concrete. Minimum cement content for concrete exposed to view to be 300 kg per cubic metre, unless otherwise specified.
- .5 Strengths, Slumps, Sizes of Aggregates: See Structural Drawings.
- .6 Consistency: Proportion concrete materials to provide a workable mix that can be handled, placed and worked into angles and corners of forms and around reinforcing steel and inserts.
 - .1 Proportion mix to ensure that concrete will not easily segregate or cause excessive water to collect on the surface.

2.8 JOINT FILLERS

- .1 Control Joints in slabs on grade: Use zip-strip type control joints for slabs on grade only in areas covered with carpet. Exposed concrete floors and floors with other finishes to have saw-cut control joints. Locations of saw-cut joints to align with tile joints.
- .2 Locations: Exterior Walks and Driveways:
 - .1 Expansion Joint Filler: Flexible, lightweight, non-staining, polyethylene, closed-cell expansion joint filler, chemical-resistant, ultraviolet stable, non-absorbent, low-density, compressible foam conforming to ASTM D3575. Acceptable product: Deck-O-Foam by W.R. Meadows-Sealtight, or approved alternative.
 - .2 Contraction/Expansion Joint Filler: Cellular fibres bonded and saturated with asphalt, non-extruding, recovers a minimum of 70% after compression, to ASTM D1751. Acceptable product: Fibre Expansion Joint W.R. Meadows-Sealtight, or approved alternative.
- .3 Locations: Floor Slabs:
 - .1 Contraction Joint: Rigid, pre-formed, two piece, pre-assembled plastic contraction joint that produces a straight-line crack on the surface of concrete slabs and locks into the aggregate just below the surface. Acceptable product: Speed-E-Joint by Sealtight, by W.R. Meadows, or approved alternative.
 - .2 Expansion Joint Filler: Flexible, non-staining, polyethylene closed-cell joint filler, to ASTM D3575. Acceptable product: Deck-O-Foam or Sealtight, both by W.R. Meadows, or approved alternative.

- .3 Expansion Joint Cap: For forming clean joints. Acceptable product: Snap-Cap by Sealtight, by W.R. Meadows, or approved alternative.

2.9 JOINT FILLERS AND SEALERS

- .1 Provide joint fillers and sealers at location and to details shown on Drawings. Where not shown, submit diagram of proposed locations for Consultant's review.
- .2 Take care to construct clean joints free from foreign material which might impair proper joint function.
- .3 Anchor joint filler material to previously poured concrete surface.
- .4 Unless shown otherwise extend joint filler for full depth of joint and terminate 25 mm (1in.) below top of joint. Fill two 25 mm (1 in.) space with joint sealer.
- .5 Construction joints shall conform to CSA A23.1. In beams and slabs, construction joint locations shall be approved by the Owner's structural engineer prior to their installation. Proper key and dowels or extensions of reinforcing shall be provided at all construction joints.

2.10 ACCESSORIES

- .1 Adhesive: Epoxy adhesive: Hilti HIT-RE 500 VF3 adhesive or approved alternative. Use for installing reinforcement into drilled holes and where specified.
- .2 Backer Rod: 10 mm (3/8 in.) diameter polyethylene or urethane foam. Rodofam or approved alternative for insertion into pre-grooved form panel edges to prevent leakage between individual plywood forming components.
- .3 Covers:
 - .1 Absorptive Cover: AASHTO M182, Class 2, burlap cloth made from jute or kenaf.
 - .2 Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
 - .3 Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
- .4 Cast-in-place construction and control joints for walls and suspended slabs: Purpose-made keyed, galvanized steel, sized to suit slab or wall thickness.
- .5 Curing Compounds: Liquid membrane forming, curing compound meeting requirements of ASTM C309. Florseal, clear (Sika), or Masterseal (Master Builders) or pre-approved alternate.
- .6 Curing Compounds: to CSA A23.1 white Type 1 - chlorinated rubber, suitable for interior use and compatible with floor finish adhesives. Do not use curing compounds on slabs that are to receive waterproofing systems.
- .7 Grout: Non-shrink grout, pre-mixed cementitious grout. Target or approved alternative. Use under all steel base plates and where specified.
- .8 Hardener: Silica aggregate based concrete hardener, non-metallic. Acceptable Product: 785 Genflor Non-Metallic Hardener by W.R. Meadows or approved alternative.
- .9 Joint Sealant: self-levelling two (2) part polyurethane type, to CGSB 19.24 Type 1. Colour as selected by the Consultant from standard range.
 - .1 Products: Iso-Flex 880 GB, Self-Levelling Sealant as manufactured by Harry S. Peterson Co. Inc., Sternson RC2-SL, Vulkem 245, or other pre-approved sealant.
 - .2 Primers and bond breakers: Provide as required to install the perimeter joint sealant system in accordance with sealant manufacturer's recommendations.
- .10 Premoulded Joint Filler: Asphalt impregnated fibreboard to ASTM D1752, 6 mm (1/4") thick unless detailed otherwise.
- .11 Primers and bond breakers: Provide as required to install the perimeter joint sealant system in accordance with sealant manufacturer's recommendations.

- .12 Reglets: Type I Springlock Flashing Reglet for casting into concrete manufactured from 24 gauge galvanized steel or P.V.C. Plastic for concealed locations and .020 stainless steel for exposed locations as manufactured by Westex Manufacturing Ltd., Vancouver, B.C. or approved alternative.
- .13 Sacking and Patching Compound: Single component sacking mix and topping compound consisting of Portland cement and graded washed silica aggregates with polymer modification. Product: Sack & Patch by Raeco, Inc.
- .14 Repair Materials: Bonding agent shall be Daraweld-C or other approved. Cement types and aggregates shall be determined by job site mix. Other materials proposed for use will be considered based on successful performance based on prototype construction.
- .15 Safety Treads for stairs: Recessed cast aluminum, Dimensions 9.5 mm (3/8 in.) thick by 19 mm (2-1/16 in.) wide. Total depth 28.5 mm (1-1/8 in.). Provide in stair width less 75 mm (3 in.) at each edge. Provide multiple strips to provide coverage required by code. Acceptable Product: Type WP 24 A by Spectra Safety Treads or approved alternative.
- .16 Sealer: Refer to Section 09 90 00 Painting and Coating.
- .17 Stripping Gaskets: Resilient rectangular material non-absorbent and non-staining at junctions of formwork and at junctions for forms with columns and beams as required to permit removal and re-use of formwork without damage.
- .18 Vapour barrier under slabs on grade: 10 mil polyethylene to CAN/CGSB 51.34.
- .19 Wall Joint Filler: Rodofoam GR meeting ASTM D1752, Type 1. Thickness as detailed.
- .20 Waterstops: PVC extruded waterstop, minimum (6"x3/8"~150mm x 10mm) to suit conditions and as detailed. Koroseal 600-B, Durajoint type 5A, or pre-approved alternate. Use exterior type waterstop for basement walls below grade and where detailed.

2.11 FORMWORK FABRICATION

- .1 Design and engineering of formwork, shoring and falsework is the responsibility of the Contractor. Retain a Professional Engineer or Workers' Compensation Board approved Designer to provide complete designs, drawings and instructions for forms, false work, shoring and re-shoring for the project.
- .2 Construct forms complying with British Columbia Building Code 2012 and CSA S269.3 to the exact sizes, shapes, lines and dimensions shown and as required to obtain accurate alignment, location, grades, level and plumb work in finish structure.
 - .1 Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage concrete surfaces. Kerf wood inserts for forming keyways, reglets and recesses for ease of removal.
 - .2 Provide temporary openings where interior area of formwork is inaccessible for clean-out, inspection before concrete placement and for placement of concrete. Brace temporary closures and set tightly to temporary openings on forms in as many inconspicuous locations as possible commensurate with design requirements. Form intersecting planes to provide true, clean cut corners.
 - .3 Construct forms and falsework with sufficient strength to structurally support the Work, and withstand the pressure resulting from placement and vibration of the concrete, and maintain them rigidly in position during concrete placement.
 - .4 Construct forms sufficiently tight to prevent loss of mortar from the concrete. Back joints with extra studs or girts to maintain true, square intersections.
- .3 Corner treatment:
 - .1 Form corners accurately to produce uniformly straight lines and tight edge joints on exposed concrete.
 - .2 Tape or caulk joints to prevent leakage at corners of walls, columns and beams.

- .4 Joints:
 - .1 Locate plywood joints and form ties as indicated on the Drawings, the reviewed shop drawings or otherwise pre-approved by the Consultant
 - .2 Locate plywood joints and form ties symmetrically about any section and from each end and symmetrical within plywood sheets.
- .5 Apply form release agent in accordance with manufacturer's recommendations prior to placing of reinforcing steel. Remove any excess coating.
- .6 Wet down forms prior to placing concrete. Do not permit standing water to accumulate in forms.
- .7 Grease form tie bolts using silicone grease to facilitate removal without spalling of the concrete.
- .8 Consultant may review forms prior to placing concrete solely for purpose of determining cleanliness, and general conformance with the contract Drawings. Such review will not relieve the Contractor of responsibility to construct and erect forms safely and in accordance with WorkSafe BC requirements.
- .9 Thoroughly clean and wash all forms before reusing.
- .10 Gaskets:
 - .1 Use form gaskets at loose joints where tolerances of adjacent panel members are such that leakage cannot be avoided.
 - .2 Use foam tape form gaskets principally at the following locations:
 - .1 Locations of abutting plywood components use foamed backing rod.
 - .2 Locations of abutting gang forms use foam tape thickness to suit.
 - .3 Junctions between forms, such as beam sides to soffits use foam tape thickness to suit.
- .11 Camber formwork to compensate for construction deflections plus deadload deflections.
- .12 Frame openings in walls, parapets, beams, floor and roof slabs where indicated on Drawings. Locate temporary openings in formwork for cleaning and inspection on side of forms where concrete surface will be concealed on completion.
- .13 Ties:
 - .1 Generally place ties symmetrically about any section and from each end and also symmetrically with plywood sheets. Locate form ties in a uniform pattern as indicated, with one row of ties located above and below construction joints.
 - .2 Where additional ties are needed but are out of sequence with approved tie pattern, use approved break back tie without sleeve or cone.
 - .3 Design and install ties to prevent the loss of paste or moisture. Keep ties left in concrete a minimum of 38 mm (1-1/2 in.) back from concrete surface. Tie Systems shall not leak. Grease form tie bolts using silicone grease to facilitate removal without spalling concrete. Remove ties and cones with a special tool as recommended by tie manufacturer.
 - .4 Snap ties will be permitted on forming of structural elements not exceeding 1200 mm (4 ft.) in height. Use coil ties on forming systems exceeding 1200 mm (4 ft.) in height. Specially design formwork to withstand increased pressures of liquid head placing techniques utilized with coil ties.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Examine areas to receive concrete with Installer present.
- .2 Ensure bearing surfaces have been reviewed and accepted by Owner's geotechnical consultant.

3.2 PREPARATION

- .1 Schedule:
 - .1 Keep Consultant and Owner's structural engineer informed of schedule for concrete work to give sufficient time to plan for reviews of critical work.
 - .2 Provide Consultant at least 24 hours' notice for required reviews.
- .2 Drawing Review:
 - .1 Read structural, architectural, mechanical and other Drawings and review for detail dimensions, locations of doors, windows, block outs, recesses, inserts, anchors, reglets, reveals, and other items.
 - .2 Before starting work report discrepancies between structural, mechanical, electrical and architectural Drawings to the Consultant immediately for instructions.
 - .3 Verify location of anchor bolts and embedded steel and ensure that work prepared by other trades is at proper elevation, level and true prior to placing concrete.
 - .4 Check locations and sizes of sleeves and openings shown on structural Drawings with architectural, mechanical and electrical Drawings.
- .3 Notify other trades sufficiently in advance to ensure that provision is made for openings, inserts and attachments.
- .4 Protect adjacent surfaces from damage due to work in this Section.
- .5 Pump excavations for footings and forms clear of water before placing concrete.
- .6 Subgrade Review:
 - .1 Do not place concrete for footings or slabs on grade until the subgrade is reviewed and accepted by the Owner's Geotechnical Engineer.
 - .2 Obtain Consultant's acceptance of slopes for slabs prior to placing concrete for slabs on grade and suspended slabs.
- .7 Formwork:
 - .1 Ensure formwork is completed, reinforcement is secured and in place; expansion joint material, anchors, and other embedded items have been positioned, and entire preparation is reviewed by structural engineer prior to placing concrete.
 - .2 Thoroughly wash and clean formwork and ensure it is free of dirt and debris. Wet down formwork to eliminate suction as far as practicable and drain wash water away.
- .8 Reinforcement Review:
 - .1 Before placing concrete, obtain Consultant's acceptance of reinforcement. In foundation walls and beams leave one side of formwork open until reinforcement has been reviewed.
 - .2 Do not eliminate or displace reinforcement to accommodate hardware. Where inserts cannot be located as indicated, obtain approval of modifications from Consultant before placing concrete.
 - .3 Ensure reinforcing steel is in place for the section of work being constructed prior to Consultant's review. Incomplete work will not be approved for placing concrete.
- .9 Vapour barrier:
 - .1 Install vapour barrier over prepared building areas of slabs-on-grade. Lap membranes minimum 150 mm (6 in.) at joints and seal using tape or sealant, to produce continuous installation. Seal punctures in membrane before placing concrete. Use patching material at least 150 mm (6 in.) larger than puncture and seal using tape or sealant.

- .10 Sleeves and Inserts:
 - .1 Provide and cast-in sleeves, frame-outs, inserts and fastening devices shown on Drawings, unless specified otherwise.
 - .2 Ensure sleeves and openings greater than 300 x 300 mm (12 x 12 in.) not indicated on structural Drawings are approved by the Consultant.
 - .3 Ensure sleeves, inserts and fastening devices required and supplied by other trades, but not shown on Drawings are installed. Ensure installation is checked and verified by respective trades.
 - .4 Ensure anchor bolts and other anchoring devices for beams, columns and wall panels supplied by other trades are installed in accordance with reviewed Shop Drawings.
- .11 Ensure openings and driven fasteners required in concrete work after concrete is placed have been reviewed by the Consultant.
- .12 Paint exposed threads of anchor bolts with a mixture of molybdenum disulphide in oil before nuts are installed.

3.3 FALSEWORK

- .1 Erect falsework and support, brace, and maintain it, to safely support vertical, lateral and asymmetrical loads applied until such loads can be supported by in-place construction. Construct falsework so that adjustments can be made for take-up and settlement.
- .2 Provide wedges, jacks or chamfer strips to facilitate vertical adjustments. Carefully inspect falsework and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure. Make necessary adjustments to produce work of required dimensions.

3.4 INSTALLATION - CAPILLARY BREAK AND VAPOUR BARRIER UNDER SLABS

- .1 Place slabs on grade over capillary break of minimum 6" (150mm) thick crushed free-draining gravel on subgrade compacted to at least 100% Standard Proctor Maximum Dry Density unless noted otherwise on Drawings.
- .2 Vapour barrier: Install vapour barrier over prepared building areas of slabs-on-grade. Lap vapour barrier minimum 150 mm (6 in.) at joints and seal using tape or sealant, to produce continuous installation.
 - .1 Carry vapour barrier up vertical walls to top of slab, where vapour barrier abuts vapour barrier of wall above, unless indicated otherwise.
 - .2 Seal punctures in vapour barrier. Use patching material at least 150 mm (6 in.) larger than puncture and seal using tape or sealant. Seal laps, joints and service penetrations before placing concrete.
 - .3 Inspect vapour barrier before covering and make repairs immediately. Repair misaligned or inadequately lapped seams, punctures or other damage.

3.5 MIXING AND TRANSPORTING

- .1 Mixing:
 - .1 Mix concrete in a mechanical batch mixer of a type approved by the Consultant and meeting requirements of CSA A23.1.
 - .2 Mixing time shall conform to CSA A23.1. Rotate mixers at rate recommended by equipment manufacturer.
- .2 Transporting:
 - .1 Transport concrete from the mechanical batch mixer to the project site in agitating or non-agitating equipment conforming to CSA A23.1.
 - .2 Provide equipment for chuting, pumping and pneumatically conveying concrete of such size and design to ensure a practically continuous flow of concrete at delivery end.

- .3 Convey concrete in accordance with CSA A23.1, Section 14.2.
- .4 Do not use concrete which has started to stiffen. Do not re-temper concrete which has started to stiffen with additional water or cement for use.

3.6 CONCRETE PLACEMENT

- .1 Place concrete in accordance with British Columbia Building Code 2012 and CSA A23.1.
- .2 Do not place concrete until formwork and reinforcement has been reviewed and accepted by Consultant.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Deposit concrete in forms as close as is practicable to its final position to avoid segregation due to re-handling of flow and in approximately horizontal lifts to maintain a level surface.
- .5 To prevent segregation, ensure vertical height of free fall of concrete does not exceed 1200 mm (48 in.). Place concrete as close as possible to final position.
- .6 When placing has started, carry on in a continuous operation until placement of panel or section is completed. Keep top surface level throughout pour.
- .7 Thoroughly and uniformly consolidate concrete while it is being placed by means of vibrators or finishing machines to secure a dense, homogeneous structure, close bond with reinforcing and smooth formed surfaces.
 - .1 Supplement vibrating by hand spading with suitable tools to assure proper and adequate consolidation.
- .8 Place concrete so that a uniform appearance of visually exposed surface will be obtained.
- .9 Place concrete in as dry a condition as possible, consistent with good workmanship, never exceeding the maximum slump.

3.7 SLABS ON GRADE - EXTERIOR AND INTERIOR

- .1 Exterior slabs on grade: Reinforce with 6" x 6" (152 mm x 152 mm) welded wire mesh reinforcement placed 1" (25 mm) from top of slab, unless noted otherwise.
- .2 Interior concrete slabs on grade: reinforce with 10M @ 12" (10M @ 300 mm) each way placed at centre of slab, unless noted otherwise.
- .3 Concrete toppings: reinforce with 6" x 6" (152 mm x 152 mm) welded wire mesh reinforcement, unless noted otherwise.
- .4 Control Joints:
 - .1 Provide control joints in slabs on grade as indicated on Drawings. Where not indicated, provide joints at maximum 12 ft. (3.5m) centres each way.
 - .1 Provide joint filler in sawcut control joints.
- .5 Screed for thickness and finish as specified.
- .6 Slope slabs to drains. Slope exterior slabs away from building and to prevent ponding of water.

3.8 CURING

- .1 Cure and protect concrete. Initial Curing:
 - .1 Maintain concrete above 10°C during the first 7 days after placing concrete. Do not allow any part of the concrete to become dry, even for a short period of time.
 - .2 Apply curing compound immediately after placing concrete and maintain so as to prevent loss of water from the concrete during the curing period.
 - .3 Thoroughly saturate water-absorptive coverings when placed over slabs and maintain for a period of at least 7 days.
 - .4 Weight or tie down curing mats or blankets sufficiently to prevent the surface from being exposed to currents of air.

- .5 Where wooden forms are used, keep wet at all times until removal.
- .6 Do not use membrane curing compounds on surfaces to be painted, covered with plaster, sealer or other surfaces where curing compound would adversely affect subsequent construction.
- .2 Apply curing compound in accordance with manufacturer's written instructions.
 - .1 Cure slabs on grade, suspended slabs and toppings by applying curing compound after final troweling at a rate not less than 150 sq ft/gallon after initial steel troweling.
 - .2 Apply second coat to finish slab at a rate of 150 sq ft/gallon.
- .3 In hot weather moist cure with ponded water for a period of not less than 7 days. Wet down entire surface being cured at least two times a day, and more frequently during hot weather.
- .4 Duration of curing: continue final curing until the cumulative number of days, or fractions thereof, not necessarily consecutive, where the temperature of the air in contact with the concrete is above 10°C has totalled seven (7) days beyond the initial curing period. Prevent rapid drying of concrete following the curing period.
- .5 Curing formed surfaces: Keep steel forms heated by the sun and all wood forms in contact with the concrete wet during the curing period. Where forms are to be removed during the curing period, apply curing compounds and employ one of the above methods for the balance of the curing period.
- .6 Do not allow any spot on the surface temperature of the concrete to exceed 35°C during the curing period.
- .7 Prevent drying of the concrete around any heating units. Wet down exposed concrete surfaces within the vicinity of heating units with a hose stream at least once every 24 hours.
- .8 Protect fresh concrete from rain, flowing water and mechanical injury.
- .9 At the end of the curing period, discontinue artificial heating such that the fall in temperature at any point in the concrete will not exceed 5°C in 24 hours.

3.9 FORMWORK REMOVAL

- .1 Do not remove concrete forms until the concrete has attained sufficient strength to prevent damage either by removal of the forms or by subsequent construction activities.
- .2 Formwork not supporting concrete, such as sides of beams, walls, columns and similar parts of the Work may be removed after cumulative curing at not less than 25°C for 24 hours (600 degree-hours) after placing concrete, or after the concrete has attained at least 10 MPa as verified by testing field cured concrete cylinders, or by other testing methods approved by the Consultant, and provided concrete is sufficiently hard not be damaged by form removal operation and provided that curing and protection operations are maintained.
- .3 Form facing material may be removed 24 hours after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports, provided that curing and protection operations are maintained and providing concrete is sufficiently hard not to be damaged.
- .4 For cantilever slabs and beams, re-shoring to remain in place for a minimum of 8 weeks. Schedule work accordingly.
- .5 Forms for footings are not to be removed until a minimum of 24 hours after placing concrete.
- .6 Remove form ties carefully to avoid marking concrete and allow for patching or filling with tie plugs.
- .7 Install tie hole plugs in visually exposed concrete.
 - .1 Ensure the portion of tie remaining in concrete after removal (if any) is inserted at least 25 mm (1") from the outer concrete surface. Fill resulting recesses as specified.
 - .2 Tie hole plugs for exposed finishes: Install colour matched concrete plugs with 6 mm (1/4") recess from adjacent concrete surface.

- .3 Tie hole plugs for concealed finishes, including foundation walls and other elements below grade. Remove tie cones and patch tie holes flush with surrounding surface.
- .8 Reuse of Forms:
 - .1 Thoroughly clean and wash all forms before reusing.
 - .2 Apply new form coating compound material to concrete contact surfaces as specified for new formwork.
 - .3 When forms are reused for successive concrete placement, thoroughly clean surfaces, and remove fins and laitance. Replace split, frayed, de-laminated or otherwise damaged form facing material.

3.10 FIELD QUALITY CONTROL

- .1 Obtain and pay for concrete testing by an independent testing agency acceptable to Consultant.
- .2 Cooperate fully with testing agency.
- .3 Ensure sampling, testing and inspection is carried out by an independent Concrete Testing Agent. Ensure concrete tests are performed in accordance with the requirements of CSA A23.2.
- .4 The Concrete Testing Agent will:
 - .1 Review proposed mix designs.
 - .2 Take samples of concrete as it is delivered to the point of final deposit. Make one set of three test cylinders for every 80 cubic yards (80 cubic metres) of concrete placed but not less than one set each day if less than 80 cubic yards (80 cubic metres) are placed unless prior approval from the Consultant has been obtained for small quantity pours.
 - .3 Record concrete temperature, air temperature, location of pour, mix number and element type for each set of test cylinders made.
 - .4 Make one additional concrete cylinder during cold weather when air temperature is forecast below 5°C within 72 hours of concrete placement. Test additional cylinder as directed by Consultant.
 - .5 Test concrete for air content and slump from each day's pour at time concrete cylinders are made.
 - .6 Test one cylinder at 7 days and two cylinders at 28 days. Compressive strength is defined as the average strength of two 28 day cylinders taken from a single batch.
 - .7 Notify the Contractor and Consultant immediately if the results of these tests are not in accordance with Specifications.
 - .8 Send copies of all results to the Consultant, Owner and Contractor.
- .5 For the first 24 hours after moulding, keep the cylinders moist in a storage box on site, constructed and located so that its interior air temperature is between 17°C and 25°C. Transport the cylinders at the end of the 24 hour period to the laboratory for subsequent curing and testing.
- .6 Field Cured Cylinders: Strength of concrete at time of stripping forms to be determined by testing field cured concrete cylinders. Costs for testing field cured cylinders to assist Contractor with formwork or shoring removal to be paid for by Contractor. Field cured cylinders to be kept on site until time of testing.
- .7 Notify the Testing Agency at least 24 hours prior to each concrete pour.
- .8 If testing of concrete cylinders indicates concrete below the specified strength, core samples of the in-situ concrete shall be taken and tested to verify the concrete meets Specifications. Costs of retesting and remedial work to repair concrete, if required, to be paid by Contractor.
- .9 In the event that concrete does not meet the Specifications after retesting, the Consultant will require remedial measures or require the concrete be removed and replaced at no extra cost to Owner.

3.11 TOLERANCES

- .1 Ensure formwork is designed, constructed and finished so that concrete surfaces will conform to the following tolerances.
 - .1 Failure to meet tolerances will result in the Contractor, filling and grinding sub-standard surfaces at no additional cost to Owner.
 - .2 Should filing and grinding be deemed by the Consultant to be impossible, remove and reconstruct the concrete section at no additional cost to Owner.

.2 Tolerance limits:

- .1 Deflection of form plywood between supports and deflection of studs and walers is not to exceed the span of the member divided by 400.
- .2 Variation from the plumb: not more than 3 mm (1/8") in any 3 m (10 ft.) height of wall or column (non-accumulative), nor more than (1/4"~6mm) in the total height of a wall or column.
- .3 Variation in alignment (imperial): Maximum deviation from required dimension to nearest grid:

Dimension	Maximum Deviation
0.0 to 1 foot	1/8"
Over 1 foot to 6 feet	1/4"
Over 6 feet to 20 feet	3/8"
Over 20 feet to 40 feet	1/2"
Over 40 feet	1/2"

- .4 Variation in alignment (metric): Maximum deviation from required dimension to nearest grid:

Dimension	Maximum Deviation
0.0 to 0.3 metres	2 mm
Over 0.3 metres to 1.6 metres	4 mm
Over 1.6 metres to 5.0 metres	8 mm
Over 5.0 metres to 9.0 metres	12 mm
Over 9.0 metres to 27 metres	18 mm

- .3 Variation in level or from the grades specified for top surfaces of exterior slabs, beams, walls and parapets:
 - .1 Within 4 mm (1/6") in 3 m (10 ft.) determined by placing a 3 m (10 ft.) straight edge anywhere on or parallel to the concrete in any direction;
 - .2 Within 6 mm (1/4") in any pour or 6 m (20 ft.) length.
 - .3 Within 10 mm (3/8") over entire area of member.
 - .4 No abrupt irregularities, fins or projections.
- .4 Concrete construction that exceeds the tolerance limits shall be remedied or removed and replaced by the Contractor at no extra cost to the Owner.
- .5 Concrete supporting masonry walls shall be located horizontally within 6 mm (1/4") of the specified location. Masonry walls are not to overhang the concrete foundation wall by more than 10 mm (3/8").

3.12 INTERIOR FLOOR SLAB TOLERANCES

- .1 Correct defects in floors by grinding or removing and replacing defective work. Areas requiring corrective work will be identified by Consultant.
- .2 Finish surfaces to the following tolerances, in accordance with ACI 302.1 R.
 - .1 For Slabs to Receive Carpet: Specified overall values of flatness, F(F) 25; of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
 - .2 For Slabs to receive Resilient Flooring: Specified overall values of flatness, F(F) 35; of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.

3.13 CONCRETE PATCHING AND REPAIRS

- .1 Ensure areas requiring patching and repairs are reviewed by the Consultant prior to start of repairs.
- .2 Patching:
 - .1 Immediately after removal of forms, bolts, ties, nails or other metal not specifically required for construction purposes, remove or cut back to a depth of 25 mm (1 in.) from surface of concrete.
 - .2 Saturate areas requiring patching with water. Scrub surface with a neat cement paste and repair by filling with cement mortar of same general composition used in concrete.
 - .3 Press or pack mortar into depression so as to completely fill cavity and finish to match adjacent surface.
 - .4 Patch tie holes in surfaces that are to be concealed, including holes in foundations walls below grade. Remove tie cones, patch and fill to a smooth finish ready for finishes.
 - .5 Cut out loose honeycombs down to sound concrete and square off edges.
 - .6 Place a stiff, colour matching mortar in voids, and strike flush with a wood float and finish texture as required for the finish specified.
 - .7 Cure areas which have been patched, in accordance with remainder of the Work.
- .3 Repairs:
 - .1 Soak the area to be repaired with water to improve bond.
 - .2 Repair irregularities such as honeycombing or broken corners.
 - .3 Grind projections or fins larger protruding more than 6 mm (¼") from the final surface. Patch voids deeper or wider than 10 mm (3/8") if there are more than three (3) in any 250 mm x 250 mm (10" x 10") square. Patch all voids in concrete window sills.

3.14 REJECTION OF DEFECTIVE WORK

- .1 Where material or workmanship, in Consultant's opinion, fails to meet Specifications, such Work may be rejected. Replace rejected work or repair to approval of Consultant at no additional cost to Owner.
- .2 Defective Work: Work considered to be defective includes, but is not limited to:
 - .1 Concrete in which defective or inadequate reinforcing has been placed.
 - .2 Concrete incorrectly formed, or not conforming to details or dimensions on the Plans or with the intent of these documents, or concrete the surface of which is out of plumb or level beyond the specified tolerances.
 - .3 Concrete below specified 28 day strength determined by concrete cylinder tests and after testing in-situ concrete.
 - .4 Concrete containing wood, cloth, rock pockets, voids, honeycombing, cracks or cold joints not scheduled or indicated on the drawings.

- .5 Any size voids in concrete window sills that will hold water.
- .3 Where defective work is a result of poor formwork design or detailing, strengthen forms and other similar forms prior to placing new concrete for replacement work.
- .4 In the event concrete tests do not conform to Specifications, or when conditions cause doubt about the structure's safety, test portions of the structure in accordance with CAN 3-A23.2-14C. Such test shall be made at the expense of the Contractor.
 - .1 Acceptance criteria shall be 100% of the design strength of the concrete in situ. Alternative testing methods shall be evaluated by the Consultant who will indicate anticipated twenty-eight (28) day and long term strength. The Consultant will evaluate suitability of low concrete strength and indicate those which are not acceptable.
 - .2 If Contractor is dissatisfied with the decision of the Consultant, the Contractor shall immediately make a proposal for alternative rectification.

3.15 PROTECTION OF FINISHED SURFACES

- .1 Cover and protect the Work from damage by work of other sections.
- .2 Do not allow traffic on finished surfaces that would affect or disturb curing procedures.
- .3 Protect floors from contamination from oil, paint or other deleterious materials.

3.16 ADJUST AND CLEAN

- .1 Remove and clean drips or smears on exposed finished surfaces to be subsequently finished.
- .2 Remove overspray from adjacent surfaces.
- .3 As work proceeds and on completion deposit recyclable packing materials and containers in appropriate recycling containers.
- .4 As work proceeds and on completion remove and recycle excess.
- .5 At completion and during progress of the work maintain premises in a neat and orderly manner. Dispose of all rubbish, construction debris and surplus materials at least on a weekly basis.

END OF SECTION

This document contains standards that are the minimum requirements for BCIT construction projects. The information in the document is organized using the MasterFormat® and SectionFormat® systems. It is not a specification; it is intended to supplement the Consultant's own documents. Do not use this information as a standalone specification.

**SECTION 03 35 43
POLISHED CONCRETE FINISHING**

PART 1 - GENERAL

1.1 SUMMARY

- .1 Finish slabs-on-grade, monolithic suspended floor slabs, and concrete toppings.
- .2 Provide surface treatment with concrete hardener, sealer, and slip resistant coatings as indicated and specified.
- .3 Coordinate the work with concrete floor placement and concrete floor curing.

1.2 RELATED SECTIONS

- .1 03 30 00 Cast-in-Place Concrete.
- .2 07 92 00 Joint Sealants.

1.3 REFERENCES

- .1 ASTM C1028 [Withdrawn] Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method (Withdrawn 2014).
- .2 ASTM E1155-14 Determining F Floor Flatness and F Floor Levelness Numbers.
- .3 British Columbia Building Code, 2012 Edition (BCBC).
- .4 CGSB 19.24-M90 [Withdrawn] Multicomponent, Chemical-Curing Sealing Compound.
- .5 CSA-A23.1-14/A23.2-14 Concrete materials and methods of concrete construction / Test methods and standard practices for concrete, Includes Update No. 1 (2015).

1.4 PRE-INSTALLATION CONFERENCE

- .1 Convene one week prior to commencing work of this Section.
- .2 Review conditions, installation procedures, schedules and coordination with other work.
- .3 Review requirements for construction waste management and disposal.

1.5 SUBMITTALS

- .1 Submit in accordance with requirements of Division 1.
- .2 Product Data: Provide data on concrete hardener, sealer, and slip resistant treatment, compatibilities, and limitations.
- .3 Maintenance Data: Provide data on maintenance renewal of applied coatings.

1.6 QUALITY ASSURANCE

- .1 Use installers with a minimum of three (3) years experience finishing concrete.
- .2 Polished Concrete Floor Finishers: Experienced in the successful execution of similar concrete polishing and finishing systems over a minimum period of five (5) years prior to award of this contract. Provide to Consultant documentation of such evidence.
- .3 Mock-Ups:
 - .1 Construct mock-up areas under conditions similar to those which will exist during actual placing, with coatings applied.
 - .2 Coordinate location of mock-up with Consultant.

- .3 Mock up one 3m x 3m (10 ft. x 10 ft.) are of slab with polished finish.
- .4 Approved mock-ups shall be acceptable quality standard for remainder of work and may remain as part of the Work upon Consultant's approval.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to project site in original, factory-sealed, unopened packaging bearing manufacturer's name, seals and labels intact and legible with following information:
 - .1 Name of material.
 - .2 Manufacturer's stock number and date of manufacture.
 - .3 Material safety data sheet.
 - .4 CSA or other references to acceptable standards clearly indicated.
- .2 Arrange delivery and storage on the site with General Contractor and schedule deliveries accordingly. Deliver material as required for installation keeping site storage to a minimum.
- .3 Provide equipment necessary for off-loading of materials to complete the work.
- .4 Protect materials from damage, weather and store in a dry place.
- .5 Handle materials and equipment in accordance with manufacturer's recommendations and WHMIS regulations and Data Safety sheets.
- .6 Remove damaged or deteriorated materials from site for recycling.

1.8 PROJECT CONDITIONS

- .1 Environmental Requirements: Comply with CSA-A23.1, including requirements for hot weather protection and cold weather protection.
- .2 Temporary Lighting: Minimum 200 W light source, placed 2.5 m above the floor surface, for each 40 sq m of floor being finished.
- .3 Ventilation: Sufficient to prevent injurious gases from temporary heat or other sources affecting concrete.

1.9 MANUFACTURER'S REPRESENTATIVE

- .1 At no cost to Owner, provide services of manufacturer's trained concrete technician to provide direction and guidance during installation of mock-ups and during initial periods of installation. Provide three (3) days notice to manufacturer prior to initial use of products specified in this section.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Concrete Materials: Refer to Section 03 30 00 Cast-in-Place Concrete.
- .2 Concrete Densifier: Finish to exceed ADA recommendations for wet and dry surfaces tested in accordance ASTM C1028 for coefficient of friction. Acceptable product: "Liqui-Hard® Concrete Densifier and Chemical Hardener" by W.R. Meadows of Canada or approved alternative.
- .3 Concrete Enhancer: Water-based, synthetic polymer concrete floor enhancer. Acceptable product: "Bellatrix" by W.R. Meadows of Canada or approved alternative.
- .4 Water: Potable water.

2.2 ACCESSORIES

- .1 Premoulded Joint Fillers: thickness to suit joint dimension. Acceptable products: Sonneborn Polyethylene Expansion Joint Filler; Sternson Rodofam PVC Expansion Joint Filler GR Grade; or approved alternative.

- .2 Joint Sealant: Self-levelling two (2) part polyurethane type, conforming to CGSB 19.24, Type 1; Class B. Colour: As selected by Consultant from standard range. Acceptable products:
 - .1 Sikaflex-2C NS/SL; Iso-Flex 880 GC (self levelling) Sealant; Sonneborn SL2; Sternson RC-2SL; Vulkem 245; or approved alternative.
- .3 Primers, Bond Breakers, Backer Rods: As required and as recommended by manufacturer for perimeter joint sealant system.

2.3 EQUIPMENT

- .1 Use following grinding/polishing equipment:
 - .1 Three-head counter rotating variable speed floor grinding machine.
 - .2 Dust extraction system and pre-separator.
 - .3 75 kw MQ power generator or approved equivalent.
- .2 Ensure grinding/polishing equipment possess at least 775 lb of head pressure.
- .3 Edge Grinding/Polishing: Use a hand grinder with dust extraction equipment
- .4 Diamond Grinding Segments: Metal bonds: 40, 60, 80 and 150 grit.
- .5 Diamond Polishing Pads: Resin bonds: 100, 200, 400, 800, 1500, and 3000 grit.
- .6 Grinding Pads for Edges: Resin bonds: 40, 60, 80, 100, 200, 400, 800, 1500, and 3000 grit.
- .7 Equipment used for densifying and cleaning floor after grinding/polishing procedure has been performed:
 - .1 Tennant ride-on auto-scrubber or equivalent with a head pressure of 150 lb.
- .8 Follow auto-scrubber's manual for cleaning instructions after densifying and conditioning floor.
- .9 Do not allow densifier to remain inside auto-scrubber after densifying.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation.
- .2 Evaluation and Assessment: Commencement of work implies acceptance of previously completed work.

3.2 PREPARATION

- .1 Protection of In-Place Conditions: Protect adjacent surfaces not designated to receive treatment.
- .2 Surface Preparation:
- .3 Clean and prepare surfaces to receive treatment in accordance with manufacturer's instructions, ensuring stains, oil, grease, form release agents, dust and dirt are removed prior to application.
- .4 Ensure concrete is a minimum of 28 days old.

3.3 APPLICATION

- .1 Level 1 - Satin Finish: Provide "Induroshine PDS-1" by W.R. Meadows of Canada ensuring applicator follows applicable procedures incorporating grinding plates in following order.
- .2 Verify floor is clean and dry prior to polishing procedure.

- .3 Inspect and verify floor does not have curled joints, large cracks, spalling or lippage. If lippage or curled joints are present, refer to manufacturer for corrective procedures.
- .4 Using 80 grit metal bond grinding segment, grind floor surface at a rate of 46.5 m²/hr (500 sq ft/hr). Vacuum surface to remove loose particulates.
- .5 Using 150 grit metal bond grinding segment, grind floor surface at a rate of 55.7 m²/hr (600 sq ft/hr). Vacuum surface to remove loose particulates.
- .6 Flood surface with concrete densifier and scrub into floor for 45 minutes, ensuring no puddling of densifier occurs.
- .7 Squeegee off excess material.
- .8 Wait 24 hours.
- .9 Verify floor is dry and clear of debris prior to continuation of polishing procedure.
- .10 Using 100 grit resin bond polishing segment, grind floor surface at a rate of 55.7 m²/hr (600 sq ft/hr). If scratches from previous grit are still apparent, decrease rate of grinding by 9.3 m² (100 sq ft) until scratches are removed. Vacuum surface to remove loose particulates.
- .11 Using 200 grit resin bond polishing segment, grind floor surface at a rate of 65 m²/hr (700 sq ft/hr). If scratches from previous grit are still apparent, decrease rate of grinding by 9.3 m² (100 sq ft) until scratches are removed. Vacuum surface to remove loose particulates.
- .12 Using 400 grit resin bond polishing segment, grind floor surface at a rate of 65 m²/hr (700 sq ft/hr). If scratches from previous grit are still apparent, decrease rate of grinding by 9.3 m² (100 sq ft) until scratches are removed. Vacuum surface to remove loose particulates.
- .13 Using 800 grit resin bond polishing segment, grind floor surface at a rate of 93 m²/hr (1000 sq ft/hr). If scratches from previous grit are still apparent, decrease rate of grinding by 9.3 m² (100 sq ft) until scratches are removed. Vacuum surface to remove loose particulates.
- .14 Using auto-scrubber, clean floor thoroughly per manufacturer's instructions with a white non-woven pad. Replace pads approximately every 2790 m² (30,000 sq ft).

3.4 SITE QUALITY CONTROL

- .1 Non-Conforming Work: Replace damaged work which cannot be satisfactorily repaired, restored or cleaned at no cost to Owner.

3.5 PROTECTION

- .1 Keep surface dry for a minimum of 48 hours after application.
- .2 Allow 72 hours before heavy traffic is allowed.

END OF SECTION