

## **PART 1 – GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 01 74 21 – Construction/ Demolition Management and Disposal.
- .2 Section 03 20 00 – Concrete Reinforcing.
- .3 Section 03 30 00 - Cast-in-Place Concrete.
- .4 Section 03 35 00 - Concrete Finishing.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA)
  - .1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction.
  - .2 CSA-O86-09, Engineering Design in Wood (Limit States Design).
  - .3 CSA S269.1-1975(R2003), Falsework for Construction Purposes.
  - .4 CAN/CSA-S269.3-M92 (R2013) Concrete Formwork.
- .2 Council of Forest Industries of British Columbia (COFI)
  - .1 COFI Exterior Plywood for Concrete Formwork.
  - .2 Underwriters' Laboratories of Canada (ULC)
    - .1 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

### **1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangements of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1-1975(R2003), for falsework drawings. Comply with CAN/CSA-S269.3-M92(R2003) for formwork drawings.
- .3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.
- .4 Indicate sequence of erection and removal of formwork/falsework as directed by Departmental Representative.

- .5 Each shop drawing submission shall bear stamp and signature of qualified professional engineer registered or licensed in the Province of Nova Scotia.

#### **1.4 RESPONSIBILITY**

- .1 Contractor to design for method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, ties, liners, and locations of temporary embedded parts. 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 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 which will be in contact with concrete are not contaminated by foreign matter. Handle and erect the fabricated formwork so as to prevent damage.
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## **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-A23.1/A23.2.
  - .2 For concrete with special architectural features, use high density overlay plywood to CSA O121 A23.1/A23.2.
  - .3 The form facing material shall be free from surface defects and meet deflection requirements in accordance with CAN/CSA S269.3.
  - .4 Rigid insulation board: CAN/ULC-S701.
- .2 Falsework materials: to CSA S269.1.
- .3 Form ties:
  - .1 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 Patch all form tie holes and finish surface to remove all evidence of tie holes and/or patching.
  - .3 Adjustable in lengths to permit tightening and alignment of forms.
  - .4 Flat tie for Architectural exposed concrete to include plastic cones leaving no metal within 20 mm of surface.
- .4 Form release agent: non-toxic, biodegradable, low VOC, chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing concrete from sticking to forms.
- .5 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 15 to 24 mm<sup>2</sup> /sat 40°C, flashpoint minimum 150°C, open cup.

## **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. The walls are to be formed and poured monolithically. 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 for use of earth forms framing
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openings not indicated on drawings.

- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
  - .4 Assemble formwork so that concrete is not damaged during its removal.
  - .5 Fabricate and erect falsework in accordance with CSA S269.1 and COFI exterior plywood for concrete formwork.
  - .6 Do not place shores and mud sills on frozen ground.
  - .7 Provide site drainage to prevent washout of soil supporting mud sills and shores.
  - .8 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
  - .9 Align form joints and make watertight. Keep form joints to a minimum.
  - .10 Locate horizontal form joints for walls and pilasters below top of finished grade.
  - .11 Where concrete is to remain exposed, use 25 mm chamfer strips on external corners and 25 mm fillets at interior corners, joints, unless specified otherwise.
  - .12 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
  - .13 Prior to placing concrete, the elevations of forms shall be checked to verify drainage slopes.
  - .14 Provide 48 hours notice to Departmental Representative for inspection prior to concrete placement.
  - .15 Build in anchors, dowels, sleeves, and other inserts required to accommodate Work specified in other sections.
  - .16 Clean formwork as erection proceeds, to remove foreign matter. Remove cuttings, shavings and debris from within forms. Flush completely with water to remove remaining foreign matters. Ensure that water and debris drain to exterior through clean-out ports.
  - .17 During cold weather, remove ice and snow from within forms, do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and concrete construction proceed within a heated enclosure.
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- .18 Patch all form tie holes and finish surface to remove all evidence of tie holes and/or patching.
- .19 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 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.
- .20 Build inserts, anchor bolts, miscellaneous frames, flashing reglets, weather bars, holes, sleeves, and items otherwise specified as supplied and located under the Work of other Sections into formwork. Imbed no wood in concrete for purposes of anchorage.
- .21 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .22 Clean formwork in accordance with CSA A23.1/A23.2 before placing concrete.

### **3.2 REMOVAL AND RESHORING**

- .1 Notify Departmental Representative prior to form removal.
- .2 Form removal times are dependent on proper curing in accordance with CAN/CSA-A23.1, CSA S269.1 and CAN/CSA-S269.3. 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. Contractor shall pay for the concrete cylinder strength tests to demonstrate concrete strength prior to form removal.
- .3 Remove formwork progressively and in accordance with the reference code requirements, and so that no shock loads or imbalanced loads are imposed on the structure.
- .4 Leave formwork in place for following minimum periods of time after placing concrete.
  - .1 3 day for footings.

- .2 3 days for walls and sides of beams.
  - .3 28 days for beam soffits and slabs or 7 days when replaced immediately with adequate shoring and concrete has achieved at least 70% of its 28 day design strength.
  - .5 Remove forms not directly supporting the weight of concrete as soon as stripping operations will not damage concrete.
  - .6 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.
  - .7 Loosen forms carefully. Do not wedge pry bars, hammers or tools against concrete surfaces.
  - .8 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.
  - .9 Re-shore beams and slabs immediately as form removal proceeds. Suspend beams and slabs shall not be left unshored for more than one (1) hour after form removal.
  - .10 Space reshoring in each principal direction at not more than 3,000 mm apart.
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## **PART 1 – GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 03 30 00 - Cast-in-Place Concrete.
- .2 Section 03 10 00 - Concrete Forming and Accessories.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA)
- .1 CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction.
- .2 CSA-A23.3-04(R2010), Design of Concrete Structures for Buildings.
- .3 RSIC-2004, Reinforcing Steel Manual of Standard Practice.
- .4 ASTM A1064/A1064M-13, Standards Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

### **1.3 SHOP DRAWINGS**

- .1 Submit reinforcing steel shop drawings for review by the Departmental Representative that are sealed and signed by a registered Engineer in the Province Nova Scotia.
  - .2 Indicate on shop drawings, bar bending details, lists, quantities of reinforcement, sizes, spacings, splice lengths 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.
  - .3 Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada. General Contractor to sign drawings indicating co-ordination with other trades.
  - .4 Detail splice lengths to 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.
  - .5 All corners and intersections to have corner bars, same size and spacing as main bars. Provide tension lap with main bars.
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## **1.4 WASTE MANAGEMENT AND DISPOSAL**

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

## **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.
- .4 Chairs, bolsters, bar supports, spacers to CSA-A23.1/A23.2, adequate for strength and support of reinforcing during construction conditions, all of which to be non-staining.
- .5 Mechanical splices: subject to approval of Departmental Representative.
- .6 Plain round bars: to CAN/CSA-G40.21-92.
- .7 Deformed steel wire for concrete reinforcement to ASTM A1064/A1064M.
- .8 Welded, steel wire fabric to ASTM A1064/A1064M
  - .1 Provide in flat sheets only.
- .9 Welded deformed steel wire fabric to ASTM A1064/A1064M.
  - .1 Provide in flat sheets only.

### **2.2 FABRICATION**

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2, ANSI/ACI 315, and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada. Shop fabricate and bend all reinforcing steel.
  - .2 Match dowels from footings to vertical reinforcing in wall or pedestal above.
  - .3 Fabricate to the following tolerances:
    - .1 Sheared length  $\pm 25$  mm.
    - .2 Stirrups, items and spirals  $\pm 10$  mm.
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- .3 Other bends  $\pm 25$  mm.
  - .4 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.
  - .5 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
  - .6 Have welding performed by workers qualified under CSA W47.1.
  - .7 Welding of reinforcing steel must receive prior approval of the Departmental Representative.
  - .8 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.
- .2 Upon request inform Departmental Representative of proposed source of material to be supplied.

## **2.4 CLEANING**

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

## **PART 3 – EXECUTION**

### **3.1 EXAMINATION**

- .1 Examine work related to this section and report discrepancies to Departmental Representative.
  - .2 Commencement of work shall imply acceptance of conditions.
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### **3.2 FIELD BENDING**

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars that develop cracks or splits.

### **3.3 PLACING REINFORCEMENT**

- .1 Place reinforcing steel as indicated on placing drawings and in accordance with CSA-A23.1/A23.2.
  - .2 Provide all chairs, braces, lateral support, headers, ties, etc. to secure reinforcing in place during construction.
  - .3 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.
  - .4 Prior to placing concrete, obtain Departmental Representative's 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 tolerance permitted and in accordance with the latest ACI Standard 315.
  - .9 For lower mat in slabs on grade, concrete blocks may be used in place of metal chairs.
  - .10 Review with the Departmental Representative, placement of reinforcement prior to concreting.
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### **3.4 STORAGE**

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

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## **PART 1 – GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 03 10 00 - Concrete Forming and Accessories.
- .2 Section 03 20 00 - Concrete Reinforcing.
- .3 Section 31 23 33.01 - Excavating, Trenching and Backfilling.

### **1.2 REFERENCES**

- .1 Canadian Standards Association (CSA).
  - .1 CSA-A23.1-04/A23.2-04, Concrete Materials and Methods of Concrete Construction.
  - .2 CSA-A23.1-04/A23.2-04, Methods of Test for Concrete.

### **1.3 SAMPLES**

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

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

### **1.5 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with the Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Use trigger operated spray nozzles for water hoses.
  - .3 Designate a cleaning area for tools to limit water use and runoff.
  - .4 Carefully coordinate the specified concrete work with weather conditions.
  - .5 Ensure emptied containers are sealed and stored safely for disposal away from children.
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- .6 Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, noncombustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.
- .7 Choose least harmful, appropriate cleaning method which will perform adequately.

## **1.6 DESIGN REQUIREMENTS**

- .1 Alternative 1 - performance; in accordance with CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

## **1.7 SUBMITTALS**

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 At least 4 weeks prior to commencing work, inform Departmental Representative of proposed source of aggregates and provide access for sampling.

## **1.8 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 45 00 – Testing and Quality Control.
- .2 Submit to Departmental Representative, minimum four weeks prior to starting concrete work, valid and recognized certificate from plant delivering concrete.
  - .1 When plant does not hold valid certification, provide test data and certification by qualified independent inspection and testing laboratory that materials used in concrete mixture will meet specified requirements.
- .3 Minimum 4 weeks prior to starting concrete work, submit proposed quality control procedures for review by Departmental Representative on following items:
  - .1 Falsework erection.
  - .2 Hot weather concrete.
    - .3 Cold weather concrete.
  - .4 Curing.
  - .5 Finishes.
  - .6 Formwork removal.
  - .7 Joints.

- .4 Quality Control Plan: submit written report, as described in PART 3 - VERIFICATION, to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.
- .5 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

## **1.9 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.

## **PART 2 – PRODUCTS**

### **2.1 MATERIALS**

- .1 Portland cement: Type GU to CSA-A23.1/A23.2.
- .2 Acceptable Supplementary Cementing Materials (SCM) in concrete include:
  - .1 Fly Ash Type F to CAN.CSA A3000-08.
  - .2 Ground Granulated Blast Furnace Slag Type S to CAN/CSA A3000-08
  - .3 Silica Fume Type SF to CAN/CSA A3000-08.
- .3 Water: to CSA-A23.1/A23.2.
- .4 Aggregates: to CSA-A23.1/A23.2.
- .5 Air entraining admixture: to CSA-A23.1/A23.2. Add air entraining agent to all mixes as indicated.
- .6 Chemical admixtures: to CSA-A23.1/A23.2, clause 6.3. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Concrete shall have a unit weight of 2350 kg/m<sup>3</sup>.
- .8 Concrete retarder: to ASTM C494/C494M-08. Do not allow moisture of any kind

to come in contact with the retarder film.

- .9 Joint Sealant: acceptable products include:
  - .1 For Horizontal Joints: self-leveling sealant.
  - .2 for Vertical Joints: non-sag elastomeric sealant.
- .10 Concrete floor sealer: as per Section 03 35 00 - Concrete Finishing.
- .11 Saw cut joint filler: light reflective, two component, semi-rigid epoxy-only filler with a shore A hardness at 28 days of greater than or equal to 90, per ASTM D22.40.
- .12 Curing compound: to CSA-A23.1/A23.2 white.
  - .1 Curing compound to be compatible with applied finish on concrete.
  - .2 Select low VOC, water-based curing compounds.
- .13 Dovetail anchor slots: minimum 0.6 mm thick galvanized steel with insulation filled slots.
- .14 Pre-molded joint fillers:
  - .1 Bituminous impregnated fiberboard: to ASTM D1751.

## **2.2 MIXES**

- .1 Proportion normal density concrete in accordance with CSA-A23.1/A23.2.
- .2 All concrete shall conform to the following requirements unless noted otherwise herein.
  - .1 Mix 1 for footings, foundation walls, housekeeping pads, and slab on grade.
    - .1 Type GU Portland cement.
    - .2 Minimum compressive strength at 28 days, 25 MPa.
    - .3 Exposure classification: F-2.
    - .4 Nominal size of coarse aggregate 20mm.
    - .5 Slump at time and point of discharge: to CSA-A23.1-04/A23.2-04, not to exceed 80 mm before addition of plasticizer. Add plasticizer as required to achieve workability for ease of concrete placement.
    - .6 Air content: 4 to 7%
    - .7 Chemical admixtures: in accordance with CAN3-A266.4.
    - .8 Super plasticizing admixture shall not be used without prior authorization of Departmental Representative.
    - .9 Supplementary Cementing Materials (SCM):
      - .1 Minimum SCM content: 10%
      - .2 Maximum silica fume content: 5%
      - .3 Maximum total SCM content: 20%
  - .2 Mix 2 for saltwater intake support structures.

- .1 Type GU Portland cement.
- .2 Minimum compressive strength at 28 days, 35 MPa.
- .3 Exposure classification: C-1.
- .4 Nominal size of coarse aggregate 20mm.
- .5 Slump at time and point of discharge: to CSA-A23.1-04/A23.2-04, not to exceed 80mm.
- .6 Air content: 5 to 8%
- .7 Chemical admixtures: in accordance with CAN3-A266.4.
- .8 Supplementary Cementing Materials (SCM):
  - .1 Minimum SCM content: 10%
  - .2 Maximum silica fume content: 5%
  - .3 Maximum total SCM content: 20%
- .3 In sufficient time before placement, the Contractor shall submit the concrete mix designs to the Departmental Representative for approval. No concrete shall be placed before the design is approved.
- .4 Obtain the Departmental Representative's approval before using chemical admixtures other than those specified.
- .5 Provide quality management plan to ensure verification of concrete quality to specified performance.
- .6 Use of Calcium Chloride not permitted.

### **PART 3 – EXECUTION**

#### **3.1 PREPARATION**

- .1 Obtain Departmental Representative's approval before placing concrete. Provide 24 hours notice prior to placing of concrete.
- .2 Pumping of concrete is permitted only after approval of equipment and mix.
- .3 Secure in position reinforcing steel, embedded parts, dowels etc. prior to placing concrete and ensure these are not disturbed during concrete placement.
- .4 Do not place slab on grade concrete until all buried services have been installed, tested, and their locations documented.
- .5 Secure in position anchor bolts and dowels during placement of concrete. Place



anchor bolts with templates.

- .6 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .7 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .8 Do not place load upon new concrete until authorized by Departmental Representative.
- .9 During concreting operations:
  - .1 Development of cold joints not allowed.
  - .2 Ensure concrete delivery and handling facilities placing with minimum of rehandling, and without damage to existing structure or work.
- .10 Ensure that reinforcement and formwork are thoroughly clean before placing.
- .11 Place concrete in the dry.
- .12 Place footings on undisturbed soil or engineered fill having a minimum bearing capacity of 150 kPa (SLS), 225 kPa (ULS). Geotechnical Engineer shall confirm bearing capacity in writing prior to the placement of concrete.
- .13 All dowels shall be placed before concrete footings are poured.
- .14 All exterior footings shall be founded at least 1.5 m below finished exterior grade.
- .15 Maintain adequate frost protection to all soils under footings and slab on grade for entire duration of work.
- .16 Protect previous work from staining.
- .17 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.

### **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 wall and pilasters, 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.
- .3 Saw cut control joints.
  - .1 Saw cut 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 reinforcements 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.
- .4 Joint fillers.
  - .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative. When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
  - .2 Locate and form isolation, construction, expansion joints as indicated. Install joint filler.
  - .3 Use joint filler to separate slab-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.
- .4 Saw cut 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 saw cut joints prior to occupancy. Clean all dust and debris from the saw cuts and the immediate area. Over fill saw cuts full depth with the specified joint filler. Once the joint filler has hardened sufficiently, cut joint filler flush with slab surface.
- .5 Dampproof membrane.
  - .1 Install dampproof membrane under concrete slab-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 Anchor bolts.
  - .1 Install anchor bolts, as detailed on the structural drawings, complete with

- nuts, washers and bolts.
- .2 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.
- .7 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.
- .8 Concrete shall not be placed on or against any surface (including rebar) that is at a temperature below 5°C.
- .9 Concrete at time of deposit shall be between 10°C and 30°C.
- .10 Pour concrete continuously between predetermined construction and control joints.
- .11 Construction Joints shall not be permitted in walls without prior written approval of Departmental Representative. Should construction joints be permitted, locate construction joints as to least impair the strength of the structure. Construction joints shall be keyed and 15M dowels x 1070 long at 600 on centres shall be added. Reinforcing shall not be interrupted. Seal all shrinkage cracks with an approved epoxy injection technique minimum 28 days after curing.
- .12 Carry out winter concreting in strict accordance with. CSA-A23.1/A23.2.

### **3.3 FIELD QUALITY CONTROL**

- .1 Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory designated by the Departmental Representative in accordance with CSA-A23.1/A23.2. The cost of the inspection and testing to be borne by Departmental Representative.
- .2 For compressive strength testing of concrete a minimum of 3 cylinders and 2 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 40 cubic meter or fraction thereof for footings and foundation walls.
  - .5 Additional test specimen shall be taken whenever requested by the Departmental Representative to verify the concrete quality.
- .3 Non-destructive Methods for Testing Concrete shall be in accordance with CSA-A23.1/A23.2.
- .4 Minimum 4 weeks prior to starting concrete work, submit proposed quality control procedures for Departmental Representative's approval.
  - .1 Uniform finishes.

- .2 Cold weather concreting.
- .3 Hot weather protection.
- .4 Curing.
- .5 Concrete finishing for slab-on-grade.

### **3.4 CONCRETE COVER OVER REINFORCEMENT**

- .1 Ensure reinforcement steel is placed to specified tolerances.
- .2 Concrete cover around reinforcing steel shall be as follows unless noted on drawings:
  - .1 Surfaces placed against soil 75 mm.
  - .2 Pilasters (to vertical bars) 50 mm.
  - .3 Walls and grade beams 40 mm.
  - .4 Suspended slab: top = 20 mm. Bottom = 25 mm.
  - .5 Slab on grade, top = 75 mm. Bottom = 40 mm.
- .3 The preceding clear covers to be maintained within 5 mm.
- .4 Provide continuous supervision during the placement of concrete to ensure that the reinforcing steel is maintained in its correct position.

### **3.5 FINISHING**

- .1 Finish concrete in accordance with CSA-A23.1/A23.2.
- .2 Finish concrete in accordance with Section 03 35 00 - Concrete Finishing, concrete finishing to tolerances specified therein.

### **3.6 CURING**

- .1 Cure concrete in accordance with CSA-A23.1/A23.2.
- .2 Ensure that freshly placed concrete is protected from freezing, dehydration, mechanical shock and contact with injurious substances.
- .3 Use curing compounds compatible with applied finish on concrete.
- .4 The concrete shall be protected from premature drying and extremes of temperature, and shall be cured at a temperature of at least 10°C for a minimum period of 3 days.
- .5 Concrete slab-on-grade shall undergo a five (5) day water cure. Water cure shall be done in accordance with CSA-A23.1/A23.2 and shall be done by:

- .1 Non-staining absorptive mat or fabric kept continuously wet.
- .2 Additionally, curing mats shall be thoroughly wet when applied and kept continuously wet in intimate contact with the concrete surface for the duration of the moist curing period. Mats shall be long enough to cover the entire width and edges of the concrete and lapped at joint to prevent drying between adjacent sheets. Mats shall be applied to concrete immediately after disappearance of surface water sheen after the final finishing pass.
- .3 End laps shall be at least 75 mm (3") and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- .4 Remove curing cover and allow concrete to air dry for at least twelve (12) hours prior to applying liquid densifier/ sealer.
- .6 Foot traffic shall be kept off curing concrete for 1 day.
- .7 Vehicles shall be kept off concrete for 7 days.
- .8 Do not use curing compounds that would have a detrimental effect on bonding, adhesion, curing, appearance, or similar qualities of materials applied to concrete surfaces. Use only moisture curing for surfaces where finishes are incompatible with curing compound.
- .9 Apply floor sealer as per Section 03 35 00 - Concrete Finishing.

### **3.7 DEFECTIVE WORK**

- .1 Repairs and classification of unacceptable concrete to be in accordance with CSA-A23.1/A23.2.
- .2 Remove defective concrete and embedded debris and repair as directed by Departmental Representative.
- .3 Excessive honeycomb or embedded debris in any concrete is not acceptable.
- .4 Remove to bare concrete curing compounds detrimental to application of specified finishes.
- .5 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.
- .6 Repair all shrinkage cracks in the completed slabs-on-grade employing a suitable

epoxy injection technique acceptable to Departmental Representative to completely seal all such cracks.

### **3.8 TOLERANCES**

- .1 Concrete tolerance in accordance with CSA-A23.1/A23.2.
- .2 Concrete floor tolerances as per Section 03 35 00 - Concrete Finishing.

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## **PART 1 – GENERAL**

### **1.1 RELATED SECTIONS**

- .1 Section 03 30 00 - Cast-in-Place Concrete.
- .2 Section 03 20 00 - Concrete Reinforcing.
- .3 Section 03 10 00 - Concrete Forming and Accessories.

### **1.2 REFERENCES**

- .1 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors.
- .2 Canadian Standards Association (CSA)
  - .1 CSA-A23.1-04/A23.2-04, Concrete Materials and Methods of Concrete Construction.

### **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 PRODUCT DATA**

- .1 Submit product data in accordance with Section 01 33 00 Submittal Procedures.
- .2 Submit WHMIS MSDS - Material Safety Data Sheets - Hazardous Materials. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for concrete floor treatment materials. Indicate VOC content.
- .3 Include application instructions for concrete floor treatments.

### **1.5 ENVIRONMENTAL REQUIREMENTS**

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- .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.
  - .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 enclosed spaces in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.
    - .2 Provide continuous ventilation during and after coating application.

## **PART 2 – PRODUCTS**

### **2.1 SEALING COMPOUNDS**

- .1 Liquid densifier/sealer: high performance, deeply penetrating concrete densifier; odourless, colourless VOC compliant, non-yellowing silicate based solution designed to harden, dustproof and protect concrete floors subjected to heavy vehicular traffic and resist black rubber tire marks on concrete surfaces. The compound must contain a minimum solids content of 20%, of which 50% is silicate. Sealer to be supplied by an ISO 9001-2000 registered manufacturer.
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## **2.2 CURING COMPOUNDS**

- .1 Curing Compounds: to Section 03 30 00 – Cast-In-Place Concrete.

## **PART 3 – EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 EXECUTION**

- .1 Finish concrete in accordance with CSA A23.1/A23.2.
- .2 Use procedures acceptable to Departmental Representative to remove excess bleed water. Ensure surface is not damaged.
- .3 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise noted.
- .4 Saw cut crack control joints for slab-on-grade conform to CSA-A23.1/A23.2, 24 hour maximum after placing concrete.

### **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 to areas as specified in finish schedule.
  - .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 m<sup>2</sup>/L (200-300ft<sup>2</sup>/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-
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applied at no cost to the Owner.

- .6 Strictly follow manufacturer's application instructions.
- .7 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.
- .8 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 squeegee onto the floor area that is to be treated next.
- .9 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.
- .10 At completion, floor must be squeegee dry. If necessary, dry mops shall be used to dry up excess water.

### **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.
  - .3 Finish concrete slab on grade to a tight consistent steel trowel appearance without burnishing the surface. Finish in accordance with Class A Finish Classification per CSA A23.1/A23.2.
  - .4 Do not overwork Slab surfaces.
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