

## **1 GENERAL**

### **1.01 RELATED WORK**

- .1 Section 01 35 21 - LEED Requirements
- .2 Section 03 20 00 - Concrete Reinforcement
- .3 Section 03 30 00 - Cast-In-Place Concrete

### **1.02 REFERENCES**

- .1 CSA A23.1-14, Concrete Materials and Methods of Concrete Construction.
- .2 CSA A23.2-14, Methods of Test and Standard Practices for Concrete.
- .3 CSA O86-14 Consolidation, Engineering Design in Wood.
- .4 CSA O121-08(R2013), Douglas Fir Plywood.
- .5 CSA O151-09(R2014), Canadian Softwood Plywood.
- .6 CSA O437 Series-93(R2011) Standards on OSB and Waferboard.
- .7 CSA O153-13, Poplar Plywood.
- .8 CSA S269.1-1975(R2003), Falsework for Construction Purposes.
- .9 CSA-S269.3-M92(R2013), Concrete Formwork.
- .10 ACI 347-04, Guide to Formwork for Concrete, American Concrete Institute.
- .11 Canada Green Building Council (CaGBC):
  - .1 LEED (Leadership in Energy and Environmental Design) Green Building Rating System for New Construction and Major Renovations: LEED Canada-NC - Version 4, 2013.

### **1.03 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with Section 01 74 21.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Seal emptied containers and store safely for disposal.

- .4 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.

#### **1.04 LEED DOCUMENTATION**

- .1 Submit a LEED material submittal form as specified in Section 01 35 21 - LEED Requirements, to identify recycled and/or regional content of materials for inclusion by the Owner/Consultant in a submission for LEED certification.
- .2 Conform to the requirements outlined in Section 01 74 21 - Construction Waste Management.

### **2 PRODUCTS**

#### **2.01 MATERIALS**

- .1 Formwork lumber:
  - .1 Plywood and wood formwork materials to CSA-0121 and CAN/CSA-086, and CSA-0153.
  - .2 For concrete with special architectural features, use formwork materials in accordance to CAN/CSA A23.1.
- .2 Falsework materials: to CSA S269.1.
- .3 Form ties:
  - .1 For concrete not designated "Architectural", use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25mm diameter in concrete surface.
  - .2 For architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.
- .4 Form release agent: 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; having no adverse effect on paint, adhesives, waterproofing, or other treatments which are specified for application to concrete and containing no non-drying ingredients such as mineral oil. Use form release agent with low V.O.C. content.

### **3 EXECUTION**

#### **3.01 ERECTION**

- .1 Verify lines, levels and column centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.

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- .2 Obtain the Departmental Representative's approval for use of earth forms.
  - .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
  - .4 Fabricate and erect falsework in accordance with CSA S269.1.
  - .5 Refer to architectural drawings for concrete members requiring exposed finishes.
  - .6 Do not place shores and mud sills on frozen ground.
  - .7 Provide site drainage to prevent washout of soil supporting mud sills and shores.
  - .8 Fabricate and erect formwork in accordance with CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CAN/CSA- A23.1.
  - .9 Step/lower all building foundations and column footings down as indicated on drawings. Coordinate with plumbing and electrical sub-contractors to step footings down as required to allow all underground plumbing and electrical services to be sleeved through foundation walls or to pass over column pad footings or out of the footing zone of influence. Do not install services under building foundations or in the footing zone of influence.
  - .10 The layout of stepped footings shown on the drawings is schematic only and may not show all locations where stepped footings/lowered footings are required. Review all of the foundations and building services and submit to the Departmental Representative the proposed stepped footings/lowered footings locations and elevations to allow all of the services to be sleeved through the foundation wall and/or provide the required frost cover. Submit the proposed stepped footing/lowered footings locations and elevations prior to commencing any foundation work.
  - .11 Construction Joints:
    - .1 In general incorporate either horizontal or vertical construction joints in accordance with CAN/CSA-A23.1 and to the Departmental Representative's approval. Submit proposed joint locations for review prior to start of formwork erection.
    - .2 Provide construction joints in concrete where work is left off at day's end. Run reinforcement continuous through joints and shear key unless indicated otherwise.
    - .3 Provide proper shear keys and reinforcement at construction joints. In beams, provide inclined shear bars unless

- indicated otherwise.
- .4 Immediately before next pour, clean construction joint and brush with grout of neat cement.
  - .12 Construct forms for architectural concrete, and place ties as indicated and/or as directed. Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.
  - .13 Coat formwork with form release agent before reinforcement, anchors or other accessories are placed, unless soaking with water during hot weather is acceptable. Do not coat plywood forms pre-coated with a chemical release agent.
  - .14 Prior to the concrete pour, review and correct as necessary formwork tolerances and alignment, particularly where soffits of suspended slabs are used as exposed ceilings. See architectural drawings for locations, typically the surfaces are 5-7m in from the exterior edge.
  - .15 Align form joints and make watertight. Keep form joints to minimum.
  - .16 Use 25mm chamfer strips or as indicated on external corners.
  - .17 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
  - .18 Build in anchors, sleeves, and other inserts required to accommodate work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
  - .19 Clean formwork in accordance with CAN/CSA-A23.1, before placing concrete.

### **3.02 REMOVAL AND RESHORING**

- .1 Leave formwork in place until the concrete element has achieved at least 70% of the specified 28-day compressive strength for that element. Cast additional concrete test cylinders for the purpose of early testing to verify that 70% of compressive strength has been achieved. Cover the cost of additional cylinders when requesting early form removal.
- .2 Maintain the safety of the structure, both before and after removal of the forms, until concrete has reached its specified 28 day strength.
- .3 Check concrete formwork for alignment and levels prior to the

placing of concrete in the forms. Check the formwork for alignment and levels during and immediately after each concrete pour.

- .4 Provide and maintain during the total duration on site, properly constructed guard rails and toe boards at all slab edges and around all slab openings. Build these in accordance with the Construction Safety Act and to the approval of the Departmental Representative. When the work of this trade is complete, leave all guard rails and toe boards in proper condition as they become the Owner's property.
- .5 Re-use of formwork and falsework subject to requirements of CAN/CSA-A23.1.

**END OF SECTION**

## **1 GENERAL**

### **1.01 RELATED WORK**

- .1 Section 01 35 21 - LEED Requirements
- .2 Section 03 10 00 - Concrete Forming and Accessories
- .3 Section 03 30 00 - Cast-In-Place Concrete

### **1.02 REFERENCES**

- .1 ASTM A767/A767M-09(R2015), Standard Specification for Zinc-coated (Galvanized) Steel Bars for Concrete Reinforcement.
- .2 AASHTO M32-09(R2013), Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- .3 AASHTO M55-09(R2013), Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
- .4 CSA A23.1-00/A23.2-14, Concrete Materials and Methods of Concrete Construction.
- .5 CSA A23.3-14, Design of Concrete Structures.
- .6 CSA G30.18-09(R2014), Billet-Steel Bars for Concrete Reinforcement.
- .7 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .8 CSA W186-M1990(R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .9 Reinforcing Steel Manual of Practice, 4th Edition by the Reinforcing Steel Institute of Canada.
- .10 ACI SP 66, ACI Detailing Manual, 2004.
- .11 Canada Green Building Council (CaGBC):
  - .1 LEED (Leadership in Energy and Environmental Design) Green Building Rating System for New Construction and Major Renovations: LEED Canada-NC - Version 4, 2013.

### **1.03 SOURCE QUALITY CONTROL**

- .1 Upon request, provide the Departmental Representative with certified copy of mill test report of reinforcing steel, showing

physical and chemical analysis, minimum four (4) weeks prior to commencing reinforcing work.

- .2 Upon request inform the Departmental Representative of proposed source of material to be supplied.

#### **1.04 SHOP DRAWINGS**

- .1 Submit shop drawings including placing reinforcement in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate on shop drawing bar bending details, lists, quantities of reinforcement, sizes, spacings, locations of reinforcement and mechanical splices, if approved by the Departmental Representative with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacings and locations of chairs, spacers and hangers. Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada.
- .3 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated. Provide Class B tension lap to CAN/CSA-A23.3 unless otherwise indicated.
- .4 Reinforcement shop drawings must indicate the location of all concrete pour joints in slabs and walls. Obtain the Departmental Representative's approval for location of joints prior to cutting and bending of reinforcement.

#### **1.05 LEED DOCUMENTATION**

- .1 Submit a LEED material submittal form as specified in Section 01 35 21 - LEED Requirements, to identify recycled and/or regional content of materials for inclusion by the Owner/Consultant in a submission for LEED certification.
- .2 Conform to the requirements outlined in Section 01 74 21 - Construction Waste Management.

#### **1.06 SUBSTITUTES**

- .1 Substitute different size bars only if permitted in writing by the Departmental Representative.

### **2 PRODUCTS**

#### **2.01 MATERIALS**

- .1 Reinforcing steel: billet steel, grade 400, deformed bars to

CAN/CSA G30.18, unless indicated otherwise.

- .2 Cold-drawn annealed steel wire ties: to AASHTO M32.
- .3 Welded steel wire fabric: to AASHTO M55. Provide in flat sheets only.
- .4 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1.
- .5 Mechanical splices: subject to approval of the Departmental Representative.
- .6 Plain round bars: to CSA-G40.21.

## **2.02 FABRICATION**

- .1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1, ACI SP-66, and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Obtain the Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of the Departmental Representative, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

## **3 EXECUTION**

### **3.01 FIELD BENDING**

- .1 Examine formwork to confirm it has been completed and adequately braced in place before starting reinforcement placing.
- .2 Do not field bend or field weld reinforcement except where indicated or authorized by the Departmental Representative.
- .3 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .4 Replace bars which develop cracks or splits.

### **3.02 PLACING REINFORCEMENT**

- .1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CAN/CSA-A23.1 and as follows:
  - .1 Clean all reinforcing of millscale, oil grease, or other

- deleterious material before and after placing reinforcement.
- .2 Secure reinforcing steel rigidly in position with annealed wire or use approved clips to intersections supported on reinforcing chairs.
  - .3 Do not allow the position of the bars to alter during concreting and maintain correct cover as noted on the drawings at all times.
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- .2 Use plain round bars as slip dowels in concrete. Paint portion of dowel intended to move within hardened concrete with one coat of lead or asphalt paint. When paint is dry, apply a thick even film of mineral lubricating grease.
  - .3 Prior to placing concrete, obtain the Departmental Representative's approval of reinforcing material and placement. Provide the Departmental Representative 48 hours' notice to when reinforcing material will be installed and ready for observation.
  - .4 Maintain cover to reinforcement during concrete pour.

**END OF SECTION**

## **1 GENERAL**

### **1.01 RELATED WORK**

- .1 Section 01 35 21 - LEED Requirements
- .2 Section 03 10 00 - Concrete Forming and Accessories
- .3 Section 03 20 00 - Concrete Reinforcing

### **1.02 REFERENCES**

- .1 ASTM C109/C109M-16A, Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2 in. or 50 mm Cube Specimens).
- .2 ASTM C260-10A(R2016), Specification for Air-Entraining Admixtures for Concrete.
- .3 ASTM C309-2011, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- .4 ASTM C494/C494M-16, Specification for Chemical Admixtures for Concrete.
- .5 ASTM C827-16, Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
- .6 ASTM C939-16A, Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
- .7 ASTM D624-00(R2012), Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
- .8 ASTM D1653-2013, Test Methods for Water Vapour Transmission of Organic Coating Films.
- .9 ASTM D1751-04(R2013), Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
- .10 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .11 CAN/ULC S701-2011, Standard for Thermal Insulation, Polystyrene, Rounds and Pipe Covering.
- .12 CSA A23.1-14, Concrete Materials and Methods of Concrete Construction.

- .13 CSA A23.2-14, Methods of Test for Concrete.
- .14 CSA A3000-13, Consolidation - Cementitious Materials Compendium.
- .15 Canada Green Building Council (CaGBC):
  - .1 LEED (Leadership in Energy and Environmental Design) Green Building Rating System for New Construction and Major Renovations: LEED Canada-NC - Version 4, 2013.

### 1.03 SAMPLES

- .1 At least four (4) weeks prior to commencing Work, inform the Departmental Representative of proposed source of aggregates and provide access for sampling.

### 1.04 CERTIFICATES

- .1 Minimum four (4) weeks prior to starting concrete work submit to the Departmental Representative manufacturer's test data and certification by qualified independent inspection and testing laboratory that the following materials will meet specified requirements:
  - .1 Portland cement.
  - .2 Supplementary cementing materials.
    - .1 For fly ash, provide details of supply, supplier's quality control program, test data for at least three (3) samples from the previous month's supply and details of proposed quality control tests to be made between shipment to concrete supplier and use in the concrete.
  - .3 Grout.
  - .4 Admixtures.
  - .5 Aggregates.
  - .6 Water.
  - .7 Joint filler.
  - .8 Waterstops.
- .2 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA- A23.1 and that mix design is adjusted to prevent alkali aggregate reactivity problems.
- .3 Provide certification that mix proportions selected will produce concrete of specified quality and yield and that strength will comply with CSA-A23.1 and that mix design is adjusted to prevent alkali aggregate reactivity problems.
- .4 Provide written confirmation from concrete supplier the percent replacement of Portland cement for fly ash/supplementary cementing materials for all concrete mix designs.

### **1.05 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate and recycle waste materials in accordance with applicable local provincial and national regulations.
- .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 Seal emptied containers and store safely for disposal away from children.
- .6 Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, noncombustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.
- .7 Choose least harmful, appropriate cleaning method which will perform adequately.

### **1.06 LEED DOCUMENTATION**

- .1 Submit a LEED material submittal form as specified in Section 01 35 21 - LEED Requirements, to identify recycled and/or regional content of materials for inclusion by the Departmental Representative in a submission for LEED certification.
- .2 Provide a letter from the concrete supplier identifying the regional content, the total concrete cost, and the contribution to the LEED Recycled Content credit calculated in accordance with the CaGBC's "LEED-Canada NC - MRc4 Portland Cement Reduction Calculator.
- .3 Provide product data sheet or MSDS sheets indicating the VOC content of interior site-applied adhesives, sealants, paints and/or coatings. Refer to emission limits stated in Section 01 35 21 - LEED Requirements.
- .4 Conform to the requirements outlined in Section 01 74 21 - Construction Waste Management.

### **1.07 LEED REQUIREMENTS**

- .1 For all site-applied interior adhesives, sealants, paints and coating products, conform to the VOC requirements of Section 01

35 21 - LEED Requirements.

- .2 Conform to the requirements outlined in Section 01 74 21 - Construction Waste Management.

## 2 PRODUCTS

### 2.01 MATERIALS

- .1 Portland cement and supplementary cementing materials: to CAN/CSA-A3000.
- .2 Water: to CSA-A23.1.
- .3 Aggregates: to CSA-A23.1. Coarse aggregates to be normal density.
- .4 Air entraining admixture: to ASTM C260.
- .5 Chemical admixtures: to ASTM C494. Have the Departmental Representative approve accelerating or set retarding admixtures during cold and hot weather placing.
- .6 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents.
  - .1 Compressive strength: 50 MPa at 28 days.
  - .2 Consistency:
    - .1 Fluid: to ASTM C827. Time of efflux through flow cone (ASTM C939), under 30 s.
    - .2 Flowable: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portion) 125 to 145%.
    - .3 Plastic: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portions) 100 to 125%.
    - .4 Dry pack to manufacturer's requirements.
- .7 Pre moulded joint fillers:
  - .1 Bituminous impregnated fibre board: to ASTM D1751.
- .8 Curing compounds: to CSA-A23.1 and to ASTM C309, Type 1-D with fugitive dye, except for exposed concrete. Do not use curing compound in areas where floor hardener, applied finish or finishing floor adhesive is to be applied.
- .9 Rigid board under-slab and foundation wall perimeter insulation to CAN/ULC S701 and as specified in Section 07 21 13 - Board Insulation. See architectural drawings for locations and requirements.
- .10 Waterstops: Expanding bentonite concrete waterstops, 25mm x 19mm.

## 2.02 CONCRETE MIXES

- .1 Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1 to give following properties for concrete in all building foundations and perimeter walls:
  - .1 Cement: Type GU.
  - .2 Minimum compressive strength at 28 days: 25 MPa.
  - .3 Class of exposure: F-2.
  - .4 Nominal size of coarse aggregate: 20 mm.
  - .5 Slump at time and point of discharge: 80 mm  $\pm$ 30 mm.
  - .6 Air content: 4 to 7%.
  - .7 Chemical admixtures: type as approved, and in accordance with ASTM C494.
  
- .2 Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1 to give following properties for concrete in mud slabs:
  - .1 Cement: Type GU.
  - .2 Minimum compressive strength at 28 days: 20 MPa.
  - .3 Class of exposure: N.
  - .4 Nominal size of coarse aggregate: 20 mm.
  - .5 Slump at time and point of discharge: 80 mm  $\pm$ 30 mm.
  - .6 Air content: N/A
  - .7 Chemical admixtures: type as approved, and in accordance with ASTM C494.
  
- .3 Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1 to give following properties for concrete slab on grade and housekeeping pads not specified as being polished:
  - .1 Cement: Type GU.
  - .2 Minimum compressive strength at 28 days: 25 MPa.
  - .3 Class of exposure: N.
  - .4 Nominal size of coarse aggregate: 20 mm.
  - .5 Slump at time and point of discharge: 75 mm maximum.
  - .6 Chemical admixtures: type as approved and in accordance with ASTM C494.
  - .7 Use of super plasticizer is permitted to ease placement of concrete. 75 mm maximum slump measured prior to the addition of super plasticizer.
  
- .4 Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1 to give following properties for polished concrete slabs on grade:
  - .1 Cement: Type GU.
  - .2 No flyash or other supplementary cementitious materials permitted
  - .3 Minimum compressive strength at 28 days: 35 MPa.
  - .4 Class of exposure: N.
  - .5 Nominal size of coarse aggregate: 13 mm.
  - .6 Slump at time and point of discharge: 75 mm maximum.

- .7 Chemical admixtures: type as approved and in accordance with ASTM C494.
- .8 Colour of liquid colourant: Black.

### **3 EXECUTION**

#### **3.01 EXAMINATION**

- .1 Confirm founding material on which footings and other concrete work are to be placed are free from water. Place concrete only on frost-free ground. Remove previously frozen bearing surfaces.
- .2 Confirm geotechnical conditions existing on site are capable of supporting bearing capacity requirements assumed in structural design.
- .3 All foundation bearing surfaces will be inspected and approved by the Departmental Representative's geotechnical engineer prior to placing concrete.
- .4 Place all structural fill as directed by the Geotechnical engineer and in the presence of the geotechnical engineer or one of their qualified representatives.
- .5 If deemed necessary by Geotechnical engineer, place a mud slab in the bottom of footing excavations to prevent softening of the in-situ foundation soils.
- .6 Do not place plumbing and electrical conduit under building foundations. Coordinate with mechanical and electrical sub-contractor and step/lower all foundations to have all services either sleeve through foundation walls, or run above column pad footings. Do not place any plumbing or conduit under foundations unless written consent is received from the Departmental Representative.

#### **3.02 WORKMANSHIP**

- .1 Obtain the Departmental Representative's approval before placing concrete. Provide 48 hours' notice prior to placing of concrete.
- .2 Pumping of concrete is permitted only after approval of equipment and mix.
- .3 Do not disturb reinforcement and inserts during concrete placement.
- .4 Prior to placing of concrete, obtain the Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.

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- .5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
  - .6 Do not place load upon new concrete until authorized by the Departmental Representative.
  - .7 Place concrete protective cover to reinforcement as noted on the drawings.
  - .8 Support bars in slabs on grade on plastic coated steel chairs to maintain exact cover requirements.
  - .9 In cold weather protect concrete work to CSA-A23.1 and following:
    - .1 Cold weather is defined as a period when the mean air temperature drops below 5°C for more than three successive days.
    - .2 When air temperature is above 0°C and is forecast to remain so for 48 hours after placing, insulated tarps are acceptable protection provided concrete temperatures are monitored and comply with temperature limits specified in the following paragraph.
    - .3 For all other cold weather conditions protect concrete with a windproof enclosure of canvas or other material to allow free circulation of inside air around fresh concrete. At no point let walls of enclosure touch formwork and provide sufficient space for removal of formwork and for finishing. Supply approved heating equipment capable of keeping inside air at sufficiently curing temperatures:
      - .1 For an initial three days, at a temperature of not less than 15°C.
      - .2 Maintain concrete at temperatures of not less than 10°C for a total period of seven days plus the initial three (3) days specified above.
      - .3 At no time shall concrete temperatures exceed 30°C at surfaces.
      - .4 Reduce enclosure air temperature at a rate not exceeding 10°C per day until outside air temperature has been reached.
      - .5 Take temperature readings both of air and of concrete surfaces at several points within area protected at start and at end of working day. Maintain complete records of temperature readings.
    - .4 Verify concrete has cured without suffering damage. When enclosure is provided, avoid rapid drying of the concrete.
  - .10 Monitor concrete temperature and moisture evaporation rates and provide appropriate hot weather protection as defined in clause 21 of CSA-A23.1. Maintain records of all measurements during hot weather periods for review by the Departmental Representative.

### 3.03 CONSTRUCTION

- .1 Do cast-in-place concrete work in accordance with CSA-A23.1.
- .2 Where approved by the Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100mm x 100mm not indicated, must be approved by the Departmental Representative.
- .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from the Departmental Representative before placing concrete.
- .4 Coordinate locations and sizes of sleeves and openings required in concrete elements with architectural, civil, mechanical and electrical drawings and sub-contractors.
- .5 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .6 Anchor bolts:
  - .1 Place anchor bolts to templates under supervision of trade supplying anchors prior to placing concrete.
  - .2 Protect anchor bolt holes from water accumulations.
- .7 Core-drilling/cutting of holes in any concrete element is not permitted without written consent from the Departmental Representative. Submit all proposed core-drilling/cutting to the Departmental Representative for review prior to execution of work. Request for core-drilling/cutting must have 72 hours' notice to allow the Departmental Representative time to review proposed locations.

### 3.04 PLACING CONCRETE

- .1 Place concrete as specified in CSA-A23.1.
- .2 Inform the Departmental Representative at least 48 hours before each concrete placing operation.
- .3 Do not place concrete when it is raining or likely to rain. If rain begins after concrete is placed, protect with waterproof covers until set.
- .4 Do not permit vertical free fall of concrete mix to exceed 1.5m.
- .5 For exposed concrete, take special precautions when placing to prevent segregation of concrete, and to avoid cold joints, honeycombing or voids. Do not allow vibrator to touch formwork.

- .6 Use form vibrators only when sections are too narrow for internal type. Employ a sufficient number of vibrators to provide complete consolidation of concrete throughout entire volume of each layer. Have available at least one extra vibrator on hand for emergency.
- .7 Do not use vibrators for interior and exterior concrete slabs on fill.
- .8 Use only tools and handling equipment that are clear of rust or other harmful and foreign material to avoid efflorescence and staining of slabs or hardened concrete.
- .9 Use concrete pumps to place concrete only with approval of methods, equipment and mix design.
- .10 Provide continuous supervision during placement of concrete including concrete grout to ensure reinforcing steel is maintained in correct position.

### **3.05 PLACING GROUT**

- .1 Grout where indicated using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.

### **3.06 SAW CUTTING**

- .1 Commence sawing as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and before all controlled shrinkage cracking occurs. See Section 20.2.1 of CSA-A23.1.

### **3.07 SURFACE TOLERANCE**

- .1 Completed elevation of the top surface of all slabs to be within the surface tolerances specified in CSA A23.1, Table 15 for moderately flat, class C (interior slab- on-grade) and conventional smooth, class A (for floating floors).
- .2 Elevation Survey of completed floor finishes is to be in accordance with the straight edge method defined in CSA A23.1, clause 22.1.2.

### **3.08 REPAIRS**

- .1 In the event that the post- finishing survey shows that the slab surface does not meet the specified tolerances, take corrective action within five (5) working days, or as directed by the Departmental Representative.
- .2 Submit proposed corrective action in writing, with complete

details of methods, tools, and materials for the Departmental Representative's approval. Upon acceptance of the proposed method, prepare a test area, and upon acceptance, will be the standard for the remainder of the repairs.

- .3 Grind down high points to a smooth surface conforming to the specifications and with a surface finish equal to the remainder of the slab. If cutting or chipping by hammer is required at high areas, then cut the area low with square saw cut edges and patch as noted below.
- .4 Fill low areas by patching with a bonded topping. Chip and saw cut square the edges of patch areas a minimum of 6mm deep. Alternatively, the Departmental Representative may approve feather edging if epoxy type topping is used and a properly bonded smooth finish can be removed before placing patch material. Finish patches to a smooth surface equal to the finish on the remainder of the slab, and cured adequately. Do all patching procedures in strict accordance with the manufacturer's directions and to the approval of the Departmental Representative.

### **3.09 FINISHING**

- .1 Finish concrete in accordance with CSA-A23.1.
- .2 Use smooth form finish for all concrete surfaces. Use form facing material that will produce a smooth, hard, uniform texture on the concrete. Do not use material with raised grain, torn surfaces, worn edges, patches, dents or other defects that will impair the texture of the concrete surface. Patch the holes and defects. Completely remove fins.
- .3 Use smooth steel trowel finish for concrete slabs on grade, suspended slabs on metal deck, and floating floors in mechanical and electrical rooms.
- .4 Remove tie cones and patch with latex modified concrete finish. Mix to be in strict accordance with manufacturer's instructions.
- .5 Use rubbed finish for all interior concrete exposed to view. Patch tie holes and defects. Remove fins exceeding 6mm in height.
- .6 Rub exposed sharp edges of concrete with carborundum to produce 3mm radius edges unless otherwise indicated.
- .7 Apply curing compounds to concrete surfaces as required. Confirm in writing the compatibility of curing compound with the applied finish on each concrete surface.

- .8 Slab and Floor Finish Classifications:
  - .1 Concrete slab-on-grade are to have a moderately flat finish as defined in CAN/CSA A23.1, table 22, class C.
- .9 Elevation survey:
  - .1 Carry out an elevation survey on finished slab-on- grade and floating floor surfaces in accordance with the measurement procedures outlined in CAN/CSA A23.1, clause 22.1.2.
- .10 Tolerances:
  - .1 Surface tolerances are to be within the specified limits of CAN/CSA A23.1, table 15.
  - .2 Tolerances are to be in accordance with CAN/CSA A23.1 unless noted otherwise.

### **3.10 BOARD INSULATION**

- .1 Examination:
  - .1 Examine substrates and immediately inform the Departmental Representative in writing of defects.
  - .2 Prior to commencement of work, ensure substrates are firm, straight, smooth, dry, free of snow, ice, frost and clean of dust and debris.
- .2 Workmanship and Application: as specified in Section 07 21 13 - Board Insulation.

### **3.11 JOINT FILLERS**

- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by the 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 and control joints as indicated. Install joint filler.
- .3 Use 6mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 13mm of finished slab surface unless indicated otherwise.

### **3.12 SLAB-ON-GRADE JOINTS**

- .1 Provide construction joint between adjacent concrete pours.
- .2 Provide an isolation joint where the slab-on-grade abuts a vertical element.
- .3 Provide saw cut control joints as indicated on the structural

drawings except at those locations where construction joints or isolation joints are provided.

### **3.13 WATERSTOPS**

- .1 Use only straight heat sealed butt joints in field. Use factory welded corners and intersections unless otherwise approved by the Departmental Representative.

### **3.14 FIELD QUALITY CONTROL**

- .1 Inspection and testing of concrete and concrete materials will be carried out by the Departmental Representative or a Testing Laboratory designated by the Departmental Representative in accordance with CSA-A23.1.
- .2 Pay for costs of tests.
- .3 Provide a minimum of three (3) test cylinders, as follows:
  - .1 Each day's pour.
  - .2 Each change of supplier.
  - .3 Each 50 m<sup>3</sup> or fraction thereof.
  - .4 Additional test at the request of the Departmental Representative.
  - .5 If Contractor wants to strip formwork early, request additional cylinders to be cast and pay for additional cylinders and testing of the additional cylinders.
- .4 The Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .5 Conduct non-destructive Methods for Testing Concrete in accordance with CSA-A23.2.
- .6 Inspection or testing by the Departmental Representative will not augment or replace Contractor quality control nor relieve them of their contractual responsibility.

**END OF SECTION**

## **1 GENERAL**

### **1.01 RELATED REQUIREMENTS**

- .1 Section 03 30 00 - Cast-in-Place Concrete.

### **1.02 REFERENCES**

- .1 ASTM International (ASTM)
  - .1 ASTM C1315-11, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
  - .2 ASTM D1751-04(2013)e1, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
  - .3 ASTM D1752-04a(2013), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
  - .4 ASTM F2659-10(2015), Standard Guide for Preliminary Evaluation of Comparative Moisture Condition of Concrete, Gypsum Cement and Other Floor Slabs and Screeds Using a Non-Destructive Electronic Moisture Meter.
- .2 Canada Green Building Council (CaGBC)
  - .1 LEED® Canada 2009 Rating System, LEED® Canada for New Construction and Major Renovations.
- .3 CSA Group (CSA)
  - .1 CAN/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).
- .4 South Coast Air Quality Management District (SCAQMD), California State
  - .1 SCAQMD Rule 1168-A2011, Adhesives and Sealants Applications.

### 1.03 ACTION AND INFORMATION SUBMITTALS

- .1 Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
  - .1 Provide manufacturer's printed product literature and data sheets for concrete finishes and include product characteristics, performance criteria, physical size, finish and limitations.
    - .1 Provide two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements. WHMIS MSDS acceptable to Labour Canada and Health and Welfare Canada for concrete floor treatment materials. Indicate VOC content in g/L.
    - .2 Include application instructions for concrete floor treatment.
- .3 LEED® Submittals:
  - .1 Submit LEED submittal forms for Credits MR 4.2 - Low Emitting Materials, Paints and Coatings in accordance with Section 01 35 21 - LEED® Requirements. Indicate the following:
    - .1 Submit LEED® submittal forms verifying products contain less than the allowable VOC content limits in accordance with SCAQMD Rule #1113.

### 1.04 ENVIRONMENTAL REQUIREMENTS

- .1 Temporary lighting:
  - .1 Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 sq m of floor being treated.
- .2 Electrical power:
  - .1 Provide sufficient electrical power to operate equipment normally used during construction.
- .3 Work area:
  - .1 Make work area water tight protected against rain and detrimental weather conditions.

- .4 Temperature:
  - .1 Maintain ambient temperature of not less than 10 degrees 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 before proceeding with any flooring applications.
- .6 Safety:
  - .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
- .7 Ventilation:
  - .1 Ventilate area of work by use of approved portable supply and exhaust fans as required to prevent humidity damage to other parts of the Work.
  - .2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.
  - .3 Provide continuous ventilation during and after coating application.

#### **1.05 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
  - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

## **2 PRODUCTS**

### **2.01 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.

- .3 Concrete slab finish: CSA A23.1 Class C Slab Finishing.
- .4 Grinding and polishing of exposed aggregate concrete floor shall be performed by a company and personnel experienced and skilled in grinding and polishing concrete floors for interior finish work. Provide proof of experience and letters of reference upon request to Departmental Representative.

## **2.02 SEALING COMPOUNDS**

- .1 Surface sealer: to CAN/CGSB 25.20, Type 2 water-based, clear, commercial grade sealer.
  - .1 Surface sealers manufactured or formulated with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, hexavalent chromium and their compounds are not acceptable.
  - .2 Surface sealer shall be compatible with the hardener and shall be manufactured by hardener manufacturer.
  - .3 Surface sealer shall have less than 100g/l of VOC in accordance with SCAQMD Rule #1113.

## **2.03 HARDENERS**

- .1 Liquid Chemical Sealer and Hardener, Type: 1 Sodium silicate, permanent penetrating sealer and hardener, having the following minimum properties:
  - .1 Liquid applied, water based, chemically reactive.
  - .2 Non-toxic, non-flammable, and anti-dusting have low or no VOC.
  - .3 Colour: colourless.
  - .4 Compressive strength, to ASTM C39: 38% or greater increase at 28 days compared to untreated samples.
  - .5 Impact Resistance, to ASTM C805: 13% or greater increase in impact resistance compared to untreated samples.
  - .6 Coefficient of Friction, to ASTM C1028: Dry: 0.86 or better; Wet: 0.69 or better.
  - .7 Abrasion Resistance, to ASTM C779: at least 32% increase in 30 minutes compared to untreated samples.

## **2.04 CURING COMPOUNDS**

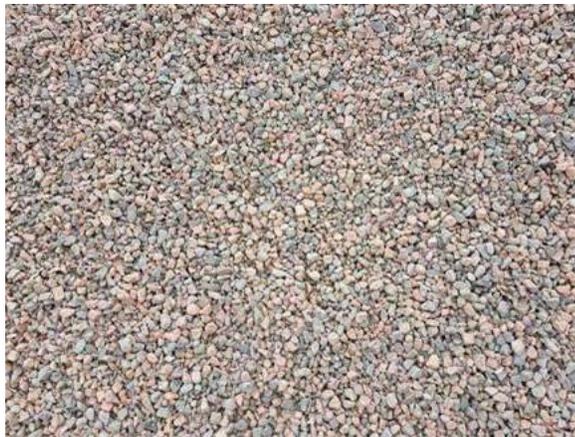
- .1 Select low-VOC, water-based, organic-solvent free curing compounds.

## 2.05 MIXES

- .1 Mixing ratios in accordance with manufacturer's written instructions.

## 2.06 ACCESSORIES

- .1 Cement, grey cement, colouring material, aggregates, water admixture: to CSA A23.4 and CSA A23.1. Supplementary cementing materials: to CSA A3000. Use same brands and source of cement and aggregate for entire project to ensure uniformity of colouration and other mix characteristics.
- .2 Exposed Aggregate Floor: Locally-available aggregate, reddish blend, to match sample provided by Departmental Representative; likeness as depicted below:



- .2 Joint Filler Strips:
  - .1 Floor Isolation Joints: to ASTM D1751, bituminous impregnated fibreboard, or to ASTM D1752, cork or self-expanding cork, 13 mm thick minimum.
  - .2 Edge Joint Filler: ASTM D1751, bituminous impregnated fibreboard, 13 mm thick minimum.
- .3 Control Joints, to Section 07 92 00 - Joint Sealants, Control joint sealant: two-component, epoxy-urethane, self-levelling, load-bearing sealant for saw cut or preformed control joints.

### **3 EXECUTION**

#### **3.01 GENERAL**

- .1 Comply with the requirements of Section 03 30 00 - Cast-in-Place Concrete.

#### **3.02 EXAMINATION**

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

#### **3.03 FINISHING FORMED SURFACES**

- .1 Unspecified Finish: Provide following finishes as applicable when finish of formed surfaces is not specifically indicated:
- .2 Unexposed Surfaces:
  - .1 Rough form finish for concrete not exposed to view.
  - .2 Smooth form finish for concrete to receive membrane waterproofing.
- .3 Exposed Surfaces:
  - .1 Smooth form finish for concrete surfaces exposed to view.
- .4 Rough Form Finish: Leave surfaces with texture imparted by forms; patch tie holes and defects; remove fins longer than 6 mm high.
- .5 Smooth Form Finish: Coordinate as necessary to secure form construction using smooth, hard, uniform surfaces with number of seams kept to a minimum, uniformly spaced in an orderly pattern; patch tie holes and defects; completely remove fins.

#### **3.04 FINISHING SLABS**

- .1 Finish floors and slabs in accordance with CSA A23.1 recommendations for screeding, re-straightening, and finishing operations for concrete surfaces; do not wet concrete surfaces.
- .2 Float (Initial) Finishing:
  - .1 Consolidate surface with power driven floats or by hand floating if area is small or inaccessible to power driven floats.

- .2 Re-straighten, cut down high spots, and fill low spots.
  - .3 Repeat float passes and re straightening until surface is left with a uniform, smooth, granular texture.
  - .4 Apply float finishing to surfaces receiving trowel finishing.
- .3 Trowel (Final) Finishing:
- .1 Commence trowel finishing after all bleed water has disappeared and when the concrete has stiffened sufficiently to prevent the working of excess mortar to the surface.
  - .2 Apply first trowelling and consolidate concrete by hand or power driven trowel after applying float finishing; continue trowelling passes and re-straighten until surface is free of trowel marks and uniform in texture and appearance; repair or smooth any surface defects that would telegraph through applied coatings or floor covering.
  - .3 Apply a trowel finishing to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film finish coating system.
  - .4 Finish surfaces to the tolerances required for CSA A23.1 Class C Slab Finish.
- .4 Curing:
- .1 cure to Section 03 30 00 - Cast-in-Place Concrete requirements.

### **3.05 EXPOSED AGGERATE FLOOR**

- .1 Colour: reddish tint achieved by using reddish coloured blend of locally available aggregate.
- .2 Grind floors to achieve Concrete Polishing Association of America (CPAA) Class D aggregate exposure (Large aggregate with little or no fine aggregate exposure); approximate depth of grinding to achieve Class D finish: about 6 mm..
- .3 Horizontal surfaces shall be flat:  $\pm 3$  mm over 3050 mm, and finished to bring aggregate to surface; coordinate with other trades as required to ensure tolerances are achieved.
- .4 Clean fully cured concrete floor by washing with water and remove any grit that could gouge the concrete during grinding processes.

- .5 At surfaces to be polished, fill any surface flaws or bugholes with patching slurry with cured colour to match adjacent concrete.
- .6 Begin polishing using #50-grit pad. Treat all surfaces, including edges. Supply constant stream of water during all grinding procedures.
- .7 Follow #50-grit polishing with #100-grit pad and polish all surfaces again.
- .8 Repeat procedure using successively finer grit pads until finishing using a #400 grit pad; required finish is 'Level 2 Class D' (honed with coarse aggregate visible) per Concrete Polishing Association of America (CPAA) criteria.
- .9 Use hand-held diamond blocks or pads to polish any areas that cannot be reached by electric polisher. Use pads to round edges of counters: 3 mm radiused edges.
- .10 Clean surfaces and apply epoxy sealer to exposed concrete surfaces taking measures to protect adjacent surfaces from splashes and damage.
- .11 Apply epoxy sealer, to Section 09 91 00 - Painting.
- .12 Finished appearance to approximate the following illustration:



### **3.06 LIQUID APPLIED FLOOR HARDENER**

- .1 Apply liquid floor hardener in accordance with manufacturer's written instructions after initial floating.
- .2 Cure concrete in accordance with manufacturer's recommended instructions.

### **3.07 LIQUID APPLIED FLOOR SEALER AND JOINT SEALANTS**

- .1 Seal horizontal control joints, and joints at junction of floor with vertical surfaces, with Control Joint Filler.
- .2 Apply concrete floor sealer in accordance with sealer manufacturer's printed instructions and technical datasheets.
- .3 Mask as required. Clean overspray. Clean sealant from adjacent surfaces.

### **3.08 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal and Section 01 35 21 - LEED Requirements.

### **3.089 PROTECTION**

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

**END OF SECTION**