

## Part 1 - General

### 1.1 RELATED WORK

.1	General Requirements:	Division 01
.2	Excavating, Trenching and Backfilling:	Section 31 23 10
.3	Concrete Reinforcing:	Section 03 20 00
.4	Cast-in-Place Concrete:	Section 03 30 00
.5	Concrete Finishing:	Section 03 35 00
.6	Building Insulation:	Section 07 21 00

### 1.2 REFERENCE STANDARDS

.1	Canadian Standards Association (CSA International).
.1	CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
.2	CSA O121-08, Douglas Fir Plywood.
.3	CSA S269.1-1975 (R2003), Falsework for Construction Purposes.
.4	CAN/CSA-S269.3-M92 (R2008), Concrete Formwork.
.2	American Society for Testing and Materials (ASTM International).
.1	ASTM D1751-04, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
.2	ASTM D2240-05(2010), Standard Test Method for Rubber Property-Durometer Hardness.
.3	ASTM D3575, Foam Test Methods.
.4	ASTM D412-06, Standard Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers – Tension.
.5	ASTM D1621-10, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
.6	ASTM E 1643-11, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
.7	ASTM E1745-11, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
.3	Canadian General Standards Board.
.1	CGSB 19-GP-16M, Sealing Compound, One Component, Polyurethane Base, Chemical Curing.

### **1.3 QUALITY ASSURANCE**

- .1 The Contractor shall be responsible for the structural design of formwork and falsework and its construction, including shoring and bracing, to ensure its stability, and to support safely and resist loads imposed by weight of forms and wet concrete, wind, fluid pressure of concrete, equipment and workers.
- .2 Design of formwork and falsework to be performed by a structural Engineer registered or licensed to practice lawfully in the Province of New Brunswick and who is experienced in design of formwork and falsework.
- .3 The Contractor shall be responsible for the safety of the structure, both before and after removal of the forms, until the concrete has reached the specified 28 day compressive strength.

### **1.4 PRODUCT DELIVERY, STORAGE AND HANDLING**

- .1 Handle and store formwork to prevent damage affecting function or appearance of concrete surfaces exposed to view.

## **Part 2 - General**

### **2.1 MATERIALS**

- .1 Formwork lumber:
  - .1 Plywood and wood formwork materials shall be in accordance with CSA A23.1.
  - .2 Form boards shall be matched pine or spruce, dressed on three sides and in uniform widths.
  - .3 Plywood form panels: Douglas fir, minimum thickness 19 mm, to meet specified requirements of CSA O121, finished one side, fabricated specially for use as concrete form panels, with sealed edges.
- .2 Form release agent: use VOC compliant, biodegradable agent that prevents set of film of concrete in contact with form. To be non-staining, non-grain raising; suitable for type of formwork on which used; having no adverse affect on paint, adhesives, or other treatments which are specified for application to concrete; and containing no non-drying ingredients such as mineral oil.
- .3 Form ties: removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes no larger than 25 mm diameter in concrete surface.
- .4 Chamfers: wood, 45° cut from 20 mm x 20 mm nominal material, or plastic type, unless specified differently on the construction drawings prepared as part of this project.
- .5 Joint tape: non-staining, water impermeable, self-release.

- .6 Structural steel protective coating:
  - .1 Heavy duty asphalt Mastick. Standard of Quality: Bakor 110-14 or approved equivalent.
  
- .7 Premoulded joint fillers:
  - .1 Bituminous impregnated fiberboard: in accordance with ASTM D1751.
  - .2 Polyethylene or urethane: extruded closed cell foam 16 mm and 8 mm diameter.
  - .3 Joint Sealant: polyurethane base, self-leveling, Class A to CGSB 19-GP-16M. Standard of quality: Vulkem 45 by Tremco Incorporated or approved equivalent.
  
- .8 Expanding rubber waterstop: acceptable material: Adeka Ultra Seal Waterstop MC-2010M and P-201 or approved equivalent.
  - .1 Tensile strength: ASTM D412, 0.98 MPa.
  - .2 Elongation: in accordance with ASTM D412, 550%.
  - .3 Hardness: in accordance with ASTM D2240 Duror Type A, 30 hrs.

### **Part 3 - Execution**

#### **3.1 ERECTION**

- .1 Verify lines, levels and column centers before proceeding with formwork and ensure dimensions agree with construction drawings prepared as part of this project.
  
- .2 Construct and remove formwork to produce finished concrete conforming to shape, dimensions, locations and levels shown on the structural drawings within the tolerances required by CSA A23.1.
  
- .3 On completion of formwork and reinforcing steel for each contemplated concrete placement, notify Departmental Representative so that they may review the work in advance of placing of concrete. Do not place concrete in forms until review has been completed.
  
- .4 Construct falsework to CSA S269.1.
  
- .5 Construct concrete formwork and provide sufficient ties and bracing to safely resist concrete pressures and other construction loadings without excessive bulging, distortion or displacement.
  
- .6 Construction of formwork shall permit easy dismantling and stripping in order to avoid damage to concrete during formwork removal.
  
- .7 Obtain Departmental Representative's approval before framing openings in concrete unless shown on structural drawings prepared as part of this project.

- .8 Hand-trim bottom and remove loose earth or lean concrete before placing concrete. All footings shall be founded on a layer of gravel on top of bedrock, native compact to dense silty sand with gravel, or compacted structural engineered fill with an allowable bearing capacity of 150 kPa as per Division 31. Lean concrete shall be used as required. Earth forms on sides will not be permitted, i.e. formwork shall extend full depth of all footings.
- .9 Install wood stringers for suspension of reinforcement in place where chairs are not utilized.
- .10 Align form joints and make watertight. Keep form joints to minimum.
- .11 Locate vertical wall control joints mid-distance between columns unless noted otherwise on the drawings. The maximum distance between joints shall be 10 m. Use 25 mm V-joint on exposed faces unless noted otherwise.
- .12 Concrete shall not be poured continuous through retaining wall control joints.
- .13 Use 20 mm chamfer strips on external corners of beams, columns and walls exposed to view, unless noted otherwise. Coordinate with Architectural drawings.
- .14 Construction joints:
  - .1 In general, incorporate either horizontal or vertical construction joints in accordance with CSA A23.1.
  - .2 Provide construction joints in concrete where work is left off at day's end. Run reinforcement continuous through joint.
  - .3 Provide proper key, reinforcement and V-joint on exposed faces.
  - .4 In beams, provide inclined shear bars as required.
  - .5 Immediately before next pour, clean construction joint and brush with grout of neat cement.
  - .6 Do not place wall or slab construction joints in water retaining structures.
- .15 Form chases, slots, openings, drips, recesses, expansion and control joints as detailed.
- .16 Coat formwork with form release agent before reinforcement, anchors or other accessories are placed. Do not coat plywood forms precoated with a chemical release agent.
- .17 Set all required bolts, anchor rods, inserts, angles, plates, decking and other embedded items. Anchor securely to formwork before placing concrete.
- .18 Leave formwork in place for following minimum periods of time after placing concrete:
  - .1 Forty eight hours for footings and trenches.
  - .2 Seventy Two hours for walls, columns, and piers.

- .19 Take care in removing plywood forms. Use wood wedges and gradual force to pry the formwork loose from the concrete. Do not beat, jar or shake the formwork or pry with metal bars. Leave plywood forms in place as long as possible and until other adjacent formwork is stripped to permit maximum shrinkage away from concrete and to protect concrete surfaces. Take particular care to prevent damage to external corners and top edges of walls.
- .20 Re-use of formwork and falsework:
  - .1 Re-use of formwork and falsework subject to requirements of CSA A23.1, CAN/CSA S269.1 and CAN/CSA S269.3.
  - .2 Re-use forms that can be repaired to original condition only. Remove nails, clean and repair surfaces and reapply specified form coating.
  - .3 Re-use forms for exposed concrete surfaces only if their surfaces are not marred in any manner, they are cleaned and retreated and their tie holes may be utilized to maintain pattern of layout.

### **3.2 STRUCTURAL STEEL PROTECTIVE COATING**

- .1 Apply 3 mm thick layer of protective coating to the base of all structural steel columns which extend below top of concrete slabs on grade.
- .2 Apply 3 mm protective coating to the side and top of base plates as well as to anchor rods and columns from underside of base plate elevation to 25 mm below top of concrete.

### **3.3 JOINT FILLERS**

- .1 Locate and form isolation joint as indicated. Install joint filler to manufacturer's instructions.
- .2 Unless otherwise indicated, use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces. Extend joint filler from bottom of slab to within 24 mm of finished slab surface.
- .3 Install 16 mm foam filler to separate joint filler and sealer.
- .4 Fill remaining 8 mm with joint sealer to manufacturer's instructions.
- .5 Locate saw cut control joints in slabs as indicated and detailed.
- .6 Install 8 mm foam filler 8 mm below finished slab surface and fill saw cut with joint sealer to manufacturer's instructions.
  - .1 Attach the joint filler to securely to the existing concrete, coping and form with tape or mechanical fasteners prior to placing the concrete slab.
  - .2 Ensure that the joint filler is level with the desired slab surface.
  - .3 After the slab is cast, remove the pre-scored strip and apply joint sealant

**3.4 WATERSTOPS**

- .1 Expanding rubber waterstop: Comply with manufacturer's printed instructions for field installation.
- .2 Sidelap 50 mm minimum when connecting straps end to end.

**END OF SECTION**

## **Part 1 - General**

### **1.1 RELATED WORK**

- |    |                                   |                  |
|----|-----------------------------------|------------------|
| .1 | General Requirements:             | Division 01      |
| .2 | Concrete Forming and Accessories: | Section 03 10 00 |
| .3 | Concrete Reinforcing:             | Section 03 20 00 |
| .4 | Concrete Finishing:               | Section 03 35 00 |

### **1.2 REFERENCE STANDARDS**

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|----|--|
| .1 | American Society for Testing and Materials (ASTM International).   |
| .1 | ASTM A82-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.   |
| .2 | ASTM A185-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.                                   |
| .2 | Canadian Standards Association (CSA International).  |
| .1 | CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete. |
| .2 | CSA A23.3-04 (R2010), Design of Concrete Structures.   |
| .3 | CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement.   |
| .4 | CSA W186-M1990 (R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.   |
| .3 | Reinforcing Steel Institute of Canada (RSIC).  |
| .1 | Reinforcing Steel Manual of Standard Practice, 2004.   |

### **1.3 SUBMITTALS**

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|----|---|
| .1 | Provide Departmental Representative with certified copy of mill test report of steel supplied, showing physical and chemical analysis prior to commencing reinforcing work. |
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### **1.4 TEST REPORTS**

- |    |   |
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| .1 | Provide Departmental Representative with certified copy of mill test report of steel supplied, showing physical and chemical analysis prior to commencing reinforcing work. |
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### **1.5 SHOP DRAWINGS**

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|----|---|
| .1 | Submit shop drawings in accordance with Division 1.   |
| .2 | Clearly indicate bar sizes, spacings, location and quantities of reinforcement, mesh, chairs, spacers and hangers with identifying code marks to permit correct placement without reference to structural drawings; to CSA A23.3, to Reinforcing Steel Manual of Standard Practice. |
| .3 | Detail placement of reinforcing where special conditions occur.   |

- .4 Use minimum lap lengths indicated on the structural drawings prepared as part of this project.
- .5 Each shop drawing shall bear the stamp and signature of a qualified professional Engineer registered or licensed to practice in the Province of New Brunswick.
- .6 All shop drawings and material lists are to contain a blank area measuring 70 mm high by 100 mm long located near the bottom right hand corner of the drawing or page. This area is to be reserved for the Engineer's review stamp.

## **1.6 SUBSTITUTES**

- .1 Substitutions of different size bars are permitted only upon written approval of Departmental Representative.

## **Part 2 - Products**

### **2.1 MATERIALS**

- .1 Reinforcing bars: billet steel, grade 400 deformed bars in accordance with CAN/CSA-G30.18 unless indicated otherwise.
- .2 Weldable reinforcing steel to CAN/CSA-G30.18, Grade 400W.
- .3 Welded steel wire fabric: to ASTM A185. Provide in flat sheets only.
- .4 Chairs, bolsters, bar supports, spacers: adequate for strength and support of reinforcing construction conditions.
- .5 Tie Wires: Cold-drawn annealed steel wire ties in accordance with ASTM A82.
- .6 Architectural concrete surfaces: special chairs, bolsters, bar supports and spacers to be plastic coated, stainless steel or as indicated. All concrete surfaces exposed to view are architectural concrete surfaces.
- .7 Mechanical splices subject to approval of the Departmental Representative.
- .8 Dowel Bar Splicers: Threaded splicing system, Grade 400 reinforcing steel. Standard of Quality: Threaded splicing system by Dayton/Richmond.

### **2.2 FABRICATION**

- .1 Fabricate reinforcing to CSA A23.1.
- .2 Fabrication tolerances for reinforcing steel in accordance with Reinforcing Steel Manual of Standard Practice.
- .3 Obtain Departmental Representative's approval for locations of reinforcement splices.

- .4 Fabricate reinforcing steel within following tolerances:
  - .1 Sheared length: plus or minus 25 mm.
  - .2 Depth of truss bar: plus 0, minus 12 mm.
  - .3 Stirrups, ties and spirals: plus or minus 12 mm.
  - .4 Other bends: plus or minus 25 mm.
- .5 Ship bundles of bar reinforcement, clearly identified in accordance with bar list.

### **Part 3 - Execution**

#### **3.1 FIELD BENDING**

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

#### **3.2 PLACING REINFORCEMENT**

- .1 Place reinforcing steel in accordance with CSA A23.1 and as indicated on reviewed shop drawings.
- .2 Place, support and space reinforcing in alignment to position indicated and as follows:
  - .1 Concrete surfaces exposed to view: consider as architectural concrete and use non-staining supports and spacers.
  - .2 Walls: provide spacers each face at 1200 mm maximum centres. Provide 10M spreader bars between mats and in line with concrete spacers.
  - .3 Pilasters and columns: laterally support along height. Place and support in pairs on opposite faces.
  - .4 Slabs on grade: support all reinforcement on chairs to accurately maintain position and concrete cover over reinforcement.
  - .5 Slabs on metal deck: support all reinforcement on chairs to accurately maintain position and concrete cover over reinforcement.
- .3 Do not cut reinforcement, either before or after concrete is placed, to permit incorporation of other work.
- .4 Do not relocate bars without approval from Departmental Representative.
- .5 Remove and replace reinforcement which is visibly damaged or cracked.
- .6 Clean reinforcing before placing concrete.
- .7 Obtain Departmental Representative's approval of reinforcing steel and placing before placing concrete.

- .8 Obtain Departmental Representative's approval before welding reinforcing bars. Weld in accordance with CSA W186.
- .9 Place column and foundation wall footing reinforcing steel only after bearing surface has been inspected and approved by the Geotechnical Consultant.
- .10 All footing reinforcing shall continue through column footings and shall continue to the ends of the footing where footings change direction or stop,
- .11 All wall reinforcing shall continue through pier reinforcing.
- .12 All column reinforcing ties shall have 135 degree hooks, alternate hooks.
- .13 Reinforce slabs on grade as detailed on the drawings.
- .14 Reinforce slabs on metal deck as detailed on the drawings.
- .15 Coordinate slab reinforcement placement within floor radiant heat tubing.
- .16 Adjust reinforcement immediately before concrete is placed to ensure that bars are in correct position and are securely tied to maintain position.
- .17 Ensure that reinforcing steel foreman is present at all times concrete is placed to ensure that reinforcing remains in place as tied, and to take necessary remedial action.

### **3.3 ON-SITE STORAGE AND HANDLING**

- .1 Reinforcing steel shall be handled and stored in such a manner to in such a manner to keep it free of dirt, mud and water.
- .2 Reinforcing steel shall be off loaded from the truck directly onto purpose made storage racks.
- .3 Any reinforcing steel which is dirty, muddy and/or rusty shall be cleaned with wire brushes and/or shot blasted to the satisfaction of the Departmental Representative.

**END OF SECTION**

## **Part 1 - General**

### **1.1 RELATED WORK**

.1	General Requirements:	Division 01
.2	Excavating, Trenching and Backfilling:	Section 31 23 10
.3	Concrete Walks, Curbs and Gutters:	Section 32 16 15
.4	Concrete Forming and Accessories:	Section 03 10 00
.5	Concrete Reinforcing:	Section 03 20 00
.6	Concrete Finishing:	Section 03 35 00
.7	Building Insulation:	Section 07 21 00

### **1.2 REFERENCE STANDARDS**

.1	Canadian Standards Association (CSA International).
.1	CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
.2	CAN/CSA A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005.
.3	CSA W59-03 (R2008), Welded Steel Construction (Metal Arc Welding).
.4	CSA G40.20-04/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel.
.5	CSA S16-09, Design of Steel Structures.
.2	American Society for Testing and Materials (ASTM International).
.1	ASTM C260-10a Standard Specification for Air-Entraining Admixtures for Concrete.
.2	ASTM C494/C494M-11, Standard Specification for Chemical Admixtures for Concrete.

### **1.3 SUBMITTALS**

.1	Submit mixture proportions in accordance with CSA A23.1 and Clause 2.2 of this specification for review by Departmental Representative at least 72 hours prior to commencing cast-in-place concrete work. No concrete shall be placed prior to written review of the concrete mixes.
.2	Provide certification that plant, equipment, and all materials to be used in concrete comply with the requirements of CSA A23.1.
.3	Provide certification that mix proportions selected will produce concrete of specified quality and yield and that strength will comply with CSA A23.1.
.4	At least 4 weeks prior to commencing cast-in-place concrete work, Contractor shall inform Departmental Representative of proposed source of aggregates and SCMs, and provide access for sampling.

- .5 Provide certification that mixture proportions include preventative measures to mitigate potential expansions due to alkali aggregate reactivity in accordance with CSA A23.2.
- .6 Provide proof that the ready mixed concrete producer has a current membership with Atlantic Concrete Association as well as a current Certificate of Conformance for Concrete Production Facilities, issued by ACA.
- .7 Submit a plan for curing to the Departmental Representative for review and approval together with other tender documents. The curing plan shall be prepared in strict accordance with the requirements of CSA A23.1 including without limitation:
  - .1 Method of protecting the concrete from evaporation of surface moisture from the fresh concrete.
  - .2 Type of curing material to be used.
  - .3 How the surface will be kept moist and the quality control requirements for keeping the surface moist.
  - .4 Time of initiation and duration of curing.
  - .5 Provisions to address potential problems such as high winds, and hot and cold weather.
  - .6 Limitations of access, if any, to the surfaces being cured.

#### **1.4 AS-BUILT DRAWINGS**

- .1 Maintain "As Built" conditions on record drawings for all concrete work as specified in Division 1.

### **Part 2 - Products**

#### **2.1 MATERIALS**

- .1 Cement: Type GU in accordance with CSA A3001.
- .2 Supplementary cementing materials: in accordance with CSA A3001.
- .3 Water: in accordance with CSA A23.1.
- .4 Fine aggregate: FA1 as per (Table 10 of) CSA A23.1.
- .5 Coarse aggregate: 20 to 5 mm maximum nominal size as per (Table 11) CSA A23.1.
- .6 Air entraining admixture: in accordance with ASTM C260.
- .7 Chemical admixtures: in accordance with) ASTM C494/C494M.
- .8 Non-shrink grout at column bases: premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, of fluid consistency, having minimum 28 day compressive strength of 50 MPa.

- .9 Self-leveling grout at interior freezer and cooler bases: non-shrink, hydraulic cement based mineral aggregate grout with an extended working time, having minimum 28 day compressive strength of 50 MPa. Standard of quality: BASF Masterflow 928.
- .10 Self-leveling grout at exterior freezer and cooler bases: non-shrink, non-ferrous, mineral aggregate-based precision grout, having minimum 28 day compressive strength of 50 MPa. Standard of quality: WR Meadows Sealtight 588-10K.
- .11 Chemical adhesive anchor system: Hilti HIT HY200, Epcon Acrylic 7 or approved equal.
- .12 Anchor rods: in accordance with CAN/CSA-G40.21, Grade 300W.
- .13 Welding materials: in accordance with CSA W59.
- .14 Welding electrodes: E49XX.
- .15 Steel sections and plates: angles, plates, etc., to be set in or anchored to concrete in accordance with CAN/CSA-G40.21, 300W.
- .16 Shop paint primer: in accordance with CISC/CPMA 1.73a.
- .17 Shear connector studs: End welded headed (H studs) in accordance with CSA S16. Studs to be of size shown on the drawings with a minimum  $F_u = 415$  MPa.

## **2.2 CONCRETE MIXTURES**

- .1 Proportion normal density concrete in accordance with Alternative 1 (Performance) of CSA A23.1, Table 5, for the following elements and applications:
  - Perimeter piers and foundation walls:
    - .1 Class F-2 exposure
    - .2 Compressive strength at 28 days: 25 MPa
    - .3 Total air content: 4 - 7%
    - .4 Slump at point of discharge into the work: 80 mm
  - Footings and interior piers, foundation walls, piers, slabs on grade, slabs on metal deck, structural slabs, cooler and freezer slabs and concrete beams:
    - .1 Class N exposure
    - .2 Compressive strength at 28 days: 25 MPa on the drawings
    - .3 Total air content: less than 3 percent
    - .4 Slump at point of discharge into the work: 80 mm
  - Exterior slabs, pads, stairs, ramps, walkways, etc:
    - .1 Class C-1 exposure
    - .2 Compressive strength at 28 days: 35 MPa
    - .3 Total air content: 5 - 8%
    - .4 Slump at point of discharge into the work: 80 mm

Mud slabs and lean concrete:

- .1 Class N exposure
- .2 Compressive strength at 28 days: 15 MPa
- .3 Total air content: less than 3%
- .4 Slump at point of discharge into the work: 80 mm

- .2 The use of supplementary cementing materials is not permitted in slabs on grade, slabs on metal deck and suspended slabs.

### **2.3 ADMIXTURES**

- .1 Use of admixtures subject to review by Departmental Representative.
- .2 Use only compatible admixtures.
- .3 Use of free calcium chloride and chloride bearing admixtures is not permitted.
- .4 If required, add a water reducing admixture to concrete in accordance with manufacturer's specifications. Incorporate admixture as a liquid by automatic mechanical dispenser. Reduce mix water, thereby, but do not change cement content from that required in plain mix design. Take admixtures into account when designing mix, and ensure that they are compatible with each other and with concrete accessories.
- .5 For the concrete walls, the use of a superplasticizer may be required to increase the slump to 150 mm minimum for workability while maintaining design mix strength and water/cement ratio specified. Follow the manufacturer's recommendations.

## **Part 3 - EXECUTION**

### **3.1 WORKMANSHIP**

- .1 All cast-in-place concrete work shall be in accordance with CSA A23.1 and CSA A23.2 except where specified otherwise.
- .2 Hard copies of CSA A23.1 and CSA A23.2 shall be on site at all times.
- .3 Obtain Departmental Representative's approval before placing concrete. Provide 24 hours of notice to Departmental Representative prior to placing of concrete.
- .4 All concrete shall be consolidated using high frequency vibrators.
- .5 Ensure reinforcement and inserts are not disturbed during concrete placement and consolidation.
- .6 Preparations prior to placing of concrete shall include:
  - .1 Formwork completed and secured.
  - .2 Ice and free standing water removed.
  - .3 Reinforcement secured in place.
  - .4 All anchor rods and other embedded items accurately located and held in position.

- .7 Maintain accurate records of all concrete placed to indicate date, location of placement, quantity placed, concrete temperature and test specimens cast. Keep these records at site until project is complete.
- .8 Prior to placing, submit to the Departmental Representative for review the proposed method of curing and protection of concrete during placing and curing in adverse weather conditions.

### **3.2 INSERTS**

- .1 Embedded structural steel angles, plates and anchor rods shall be supplied by Subcontractor responsible for structural steel under Section 05 12 23 to the site and installed by the Subcontractor responsible for cast-in-place concrete, unless noted otherwise on the construction drawings prepared as part of this project.
- .2 All anchor rods and embedded metal shall be carefully set to conform to the dimensions shown on the drawings and shall be rigidly held in place during placing of the concrete.
- .3 Unless openings are indicated on the structural drawings prepared as part of this project, openings in suspended structural slabs, beams or columns for architectural, mechanical, electrical, or food services requirements must be sleeved before concrete is placed.
- .4 No sleeves, ducts, pipes or other openings shall pass through beams or columns except where expressly detailed on the drawings or approved by the Departmental Representative.
- .5 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of all modifications from Departmental Representative before placing of concrete. See architectural, mechanical, food services and electrical drawings for additional inserts to be installed in this section.
- .6 Check locations and sizes of sleeves, openings, etc., shown on structural drawings with Departmental Representative prior to placing concrete. Sleeves, openings, etc., greater than 100 mm square or a series of continuous small openings with a linear length greater than 100 mm not indicated on structural drawings must be approved by the Departmental Representative.
- .7 Contractor to coordinate and review placement of architectural, mechanical and electrical inserts, sleeves, ties, anchor rods, pipe hangers, etc. as required by other trades before concrete is placed.
- .8 No core drilling of concrete is allowed unless approved by the Departmental Representative.

### **3.3 HOUSEKEEPING PADS, CURBS**

- .1 Accurately place all required concrete bases, curbs and housekeeping pads as shown for architectural, mechanical, food services and electrical equipment, including reinforcing steel indicated on drawings.
- .2 Build in anchor rods as required.

- .3 Finish slabs to match adjacent surfaces.
- .4 Refer to mechanical, food services, electrical and architectural drawings for size, locations and number of pads.

### **3.4 GROUTING**

- .1 Grout underside of steel columns and beam bearing plates with a minimum 40 mm thickness of non-shrink grout mixed in accordance with to the manufacturer's instructions to ensure a smooth level surface at the elevation indicated and having full contact with the underside of the bearing plate.
- .2 Grout underside of freezer and cooler bases with 20 mm non-shrink self-leveling grout mixed in accordance with to the manufacturer's instructions to ensure a smooth level surface at the elevation indicated.
- .3 Grout shall be capable of being mixed at a fluid consistency; dry pack placement of the grout is not permitted.
- .4 Provide 24 hours notice to Departmental Representative prior to grouting.

### **3.5 INSTALLATION OF REINFORCING STEEL/ANCHOR RODS USING ADHESIVE ANCHOR SYSTEM**

- .1 Install reinforcing steel/anchor rods using adhesive anchor system in concrete at locations noted or shown noted or shown on the drawings and/or as required to complete the work. Installation shall be in strict accordance with the manufacturer's written instructions.

### **3.6 FINISHING**

- .1 Finish exposed concrete to CSA A23.1.
- .2 Unless specified elsewhere, interior slabs on grade shall receive sufficient passes with a trowel to obtain a dense hard smooth surface free of trowel marks.
- .3 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise detailed or specified elsewhere.
- .4 All concrete exposed to view requires a smooth form finish.

### **3.7 CURING**

- .1 Curing of all elements cast under this section shall begin immediately following placing and finishing following the requirements (of Table 2 and Table 20) of CSA Standard A23.1.
- .2 Contractor shall obtain the approval of the Departmental Representative for proposed means of monitoring concrete curing conditions. Contractor shall be responsible for confirming completion of curing.
- .3 Concrete for exposure Classes C-2 shall receive an additional curing period as defined by Table 20 of CSA A23.1.

### **3.8 COLD WEATHER REQUIREMENTS**

- .1 As a minimum, the requirements of Clause 7.4.1.5 of CSA A23.1 shall be followed for cold weather protection.
- .2 All materials and equipment needed for the protection and curing of the concrete in cold weather, as defined by CSA A23.1, shall be available on site before the concrete placement begins.
- .3 Cold weather protection and curing shall be applied in order to maintain the concrete temperature at or above 10°C for the time of the curing periods specified in Table 20 of CSA A23.1. Measures shall be taken to prevent subsequent frost penetration to the footing level.
- .4 When placing suspended slabs when the air temperature is at or below 4°C, enclose working area and supply moist heat under the slabs. Supply moist heat over the slabs as required to ensure all surfaces are above 5°C prior to placing and as required for finishing the concrete. Maintain and reduce temperatures as per code requirements. Refer to Section 03 10 00 for required concrete strengths prior to form removal.

### **3.9 HOT WEATHER CURING**

- .1 Hot weather curing and protection shall conform to the requirements of Clause 7.4.1.4 of CSA A23.1.
- .2 When the air temperature is at or above 25°C, the basic curing period (3 days) shall be accomplished by water spray, or saturated absorptive fabric rather than by curing compounds, in order to achieve cooling by evaporation. Apply curing compound immediately following the basic curing period.

### **3.10 DEFECTIVE CONCRETE**

- .1 All honeycombed concrete shall be removed to sound concrete and the areas patched in a manner acceptable to the Departmental Representative.
- .2 All imperfections greater than 30 mm deep shall be removed to sound concrete and the areas patched in a manner acceptable to the Departmental Representative.
- .3 Embedded debris shall be removed to sound concrete and the areas patched in a manner acceptable to the Departmental Representative.
- .4 At the Departmental Representative's discretion, exposed architectural concrete surfaces shall be demolished and reconstructed if there is defective concrete. See architectural drawings, prepared as part of this project for concrete surfaces exposed to view.

### **3.11 PATCHING**

- .1 Patch imperfections within 24 hours of stripping of forms. Patch imperfections less than 30 mm deep as follows:
  - .1 Chip down edges perpendicular to surface to Departmental Representative's approval.
  - .2 Wet area and brush on 1:1 cement-sand grout.
  - .3 Patch with 1:2 cement-sand mortar with 10% hydrated lime.
- .2 Patch existing concrete surfaces where damaged by cutting or drilling.
- .3 Patch all form tie holes.
- .4 Do not patch cone tie holes at exposed architectural concrete.

### **3.12 INSPECTION AND TESTING**

- .1 Inspection, sampling, testing and reporting of concrete and concrete materials will be carried out by a testing laboratory approved by the Departmental Representative as specified in Division 1. All test methods shall be in accordance with CSA A23.2.
- .2 Testing laboratory will cast three test specimens from each 75 m<sup>3</sup> of concrete placed, for every placement or when required by the Departmental Representative. Cylindrical specimens shall be tested in compression at 7 and 28 days (2 specimens) unless directed otherwise by the Departmental Representative.
- .3 Testing laboratory will make at least one slump test and one air content test for each set of test specimens cast.
- .4 Alkali-aggregate reaction tests are to be performed or certification reports supplied verifying the quality of the aggregates to be used.
- .5 Copies of all test reports to be submitted to the General Contractor, Ready Mixed Concrete Producer, and the Departmental Representative.
- .6 Cost of all testing to be borne by the Owner as specified in Division 1.
- .7 CSA A23.1 shall form the basis for acceptance, strengthening or replacement of concrete not meeting specified quality.
- .8 Cooperate with and assist the testing company by providing access to all parts of the work as required.

**END OF SECTION**

**Part 1 - General**

**1.1 RELATED WORK**

- .1 General Requirements: Division 1
- .2 Concrete Reinforcing: Section 03 20 00
- .3 Cast-in-Place Concrete: Section 03 30 00
- .4 Joint Sealing: Section 07 92 00

**1.2 REFERENCE STANDARDS**

- .1 Canadian Standards Association (CSA International).
  - .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .2 American Society for Testing and Materials (ASTM International).
  - .1 ASTM C109-11b, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
  - .2 ASTM C309-11, Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete.

**Part 2 - Products**

**2.1 MATERIALS**

- .1 Concrete materials and reinforcement: in accordance with Sections 03 20 00 and 03 30 00.
- .2 Concrete curing compound to be high solids, water based curing and sealing compound to ASTM C309-03. Concrete curing compound shall be compatible with asphalt based adhesives. Acceptable products: Vocomp 20 by W.R. Meadows, KURE-N-SEAL WB by BASF, Masterkure 200W by BASF. Unless specified elsewhere herein, apply curing compound to manufacturer's written instructions.
- .3 Non-Metallic Floor Hardener: premixed coloured abrasion resistant hardener.
  - .1 Hardness: 6.5 Moh's Scale. Particle shape: rough, angular. Compressive strength 70 MPa at 28 days (ASTM C-109-80). Acceptable manufacturers: Sternson Ltd., Master Builders Co. Ltd. Acceptable materials: Colorplete and Colorcron or an approved equivalent.
- .4 Additives, admixtures, hardeners, curing compounds and sealers are to be compatible.

### **Part 3 - Execution**

#### **3.1 WORKMANSHIP**

- .1 All work shall be in accordance with CSA A23.1 except where specified otherwise.
- .2 Steel trowel concrete slabs to be left exposed or to receive carpeting, resilient flooring and applied floor finishes.
- .3 Concrete slabs to receive toppings, quarry tile, ceramic tile, terrazzo, to be screeded off to true lines and levels shown and left ready to receive finish. Depress slabs to accommodate finish.
- .4 Slope portions of slabs as indicated on the drawings.
- .5 Ensure formwork and embedded metal parts are not disturbed or displaced during the finishing operation.

#### **3.2 PLAIN FLOOR FINISHES**

- .1 Consolidate concrete by vibrating to force coarse aggregate into concrete mix and then screed.
- .2 Float surface with wood or metal floats or with power finishing machine and bring surface to true grade.
- .3 Steel trowel to smooth and even surface in accordance with CSA A23.1, Table 22, Class A.
- .4 After Item 3.2.3 of this Section, follow with second steel trowelling to produce smooth burnished surface to within 8 mm tolerance when measured in any direction using a 3 m straight edge.
- .5 Sprinkling of dry cement or dry cement and sand mixture over concrete surfaces is not acceptable.
- .6 Saw cut control joints in slabs-on-grade within 12 hours after finishing. Use 5 mm thick blade, cutting to 1/3 of slab thickness or as shown on drawings. Control joints to be located as shown on the drawings. Fill joints with sealant. Saw cut crack control joints to CSA A23.1.
- .7 All concrete slabs shall be cured as follows:  
  
Method 1 – If air temperature is between 5°C and 26°C, apply curing compound in strict accordance with manufacturer's instructions at the rate of 7 square meters per litre.

Method 2 – If air temperature is 27°C or above, cure the slab by continuous wet curing for a minimum of 5 days. Cover slab with a burlap or non-woven geotextile fabric immediately after finishing of concrete. Water shall not be allowed to drip, flow, or puddle on the concrete slab. Equipment and materials necessary for water curing shall be on site and ready for use prior to concrete placement. Following the 5 days of wet curing and immediately after surface water is removed, apply curing compound in strict accordance with manufacturer's instructions at the rate of 7 m<sup>2</sup> per litre.

(Note: Method 2 may be used in place of Method 1)

- .8 After curing and when concrete is dry, seal all slab floor joints at junction with vertical surfaces with joint sealant.

### **3.3 HARDENED FLOOR FINISH**

- .1 Refer to Finish Schedule for floors which are to receive hardener.
- .2 A trained service technician from the manufacturers of the concrete floor hardeners shall be on site during the initial period of installation of hardened concrete floors.
- .3 Finish concrete floors as per Clause 3.2.
- .4 Apply floor hardener at a rate of 5 kg/m<sup>2</sup> in accordance with manufacturer's written instructions.
- .5 Apply first shake of aggregate (3 kg/m<sup>2</sup>) after floating.
- .6 Float first shake and apply second shake at right angles to first.
- .7 Float second shake to produce medium textured non-slip finish.
- .8 Apply additional floating to produce medium textured non-slip finish.
- .9 On interior slabs, flat steel trowel to produce a fine textured non-slip finish and burnish trowel to within 1 mm tolerance when measured in any direction using 1 m straight edge.
- .10 Steel trowel to smooth and even surface in accordance with CSA A23.1, Class A.
- .11 Saw cut control joints as specified.
- .12 All concrete slabs with hardener shall be cured as per Item 3.2.8 at this Section.
- .13 Apply curing compound in accordance with manufacturer's recommendations at the rate of 7 m<sup>2</sup>/l.

### **3.4 EXTERIOR SLABS, PADS, WALKWAYS, STAIRS, ETC**

- .1 Float and trowel concrete walkways as per Clause 3.2.
- .2 Immediately after floating, give surface a light broom finish to produce regular corrugations not exceeding 1 mm deep, by drawing broom in direction normal to center line. For area west of Line 4 receiving epoxy floor finish, provide smooth finish as per Section 3.2.
- .3 Provide edging as indicated with 10 mm radius edging tool.
- .4 All exterior slabs, stairs, steps, etc., shall be protected with two applications of commercial-grade boiled linseed oil mixed with varsol. The first application shall be a mixture of equal parts of oil and varsol applied on a dry surface at a rate of 10 m<sup>2</sup> per litre. The second application shall be from one half to full strength oil applied at a rate of 15 m<sup>2</sup> per litre after the first treatment has been absorbed.
- .5 All exterior concrete to be cured by continuous wet curing for a minimum of 7 days.

**END OF SECTION**