



**MACKENZIE ARENA SLAB AND ENERGY UPGRADES**  
DISTRICT OF MACKENZIE

**ADDENDUM NO. 2**  
FEB 12 2024  
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**ADDENDUM NO. 2**

This Addendum is issued prior to closing of bids to provide revisions, clarifications, and additions to the work.

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1. SPECIFICATION REVISIONS



**MACKENZIE ARENA SLAB AND ENERGY UPGRADES**  
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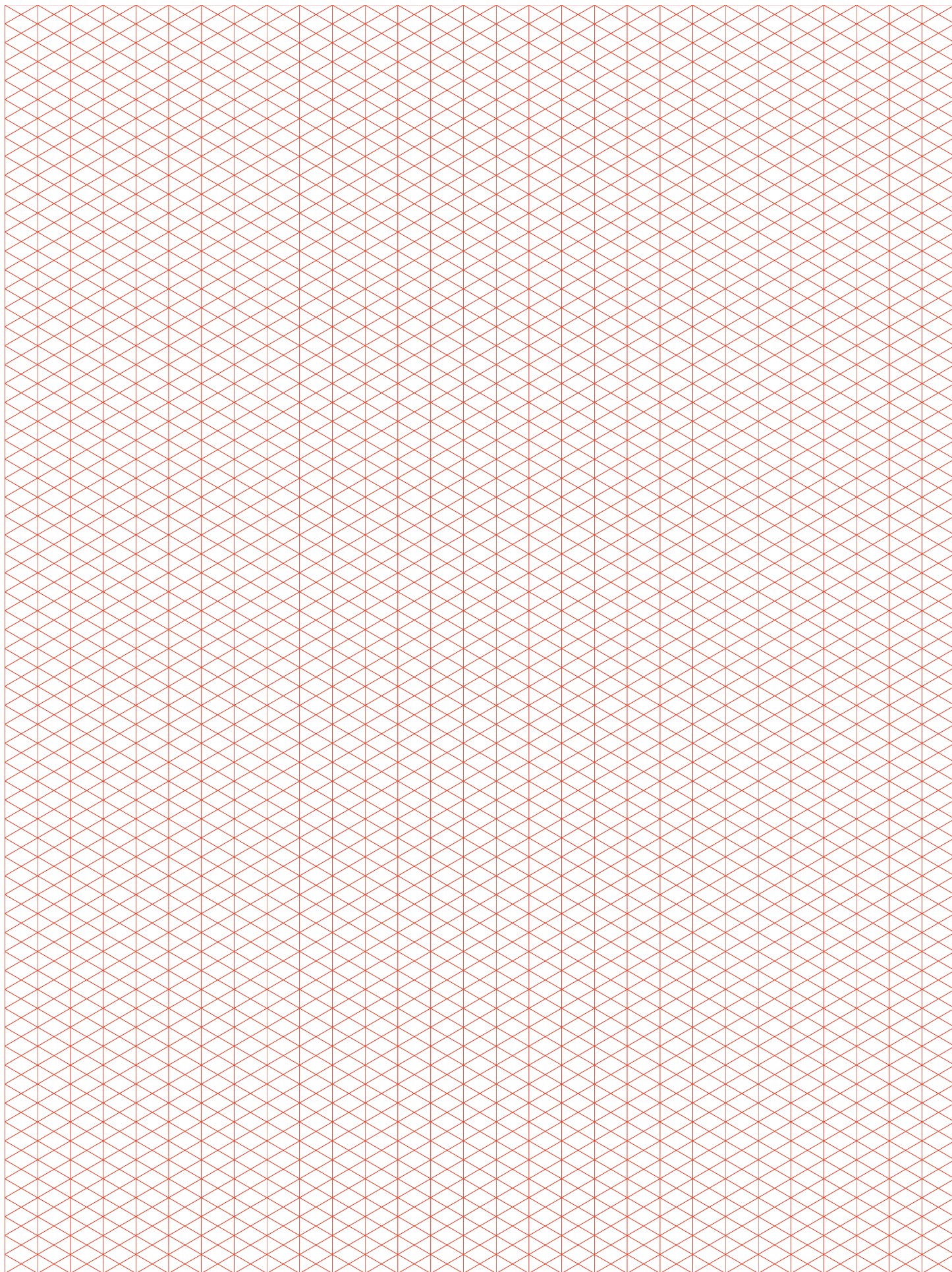
**1. Specification Revisions**

**1.1. Specification 00 21 00 Instructions to Bidders**

Item 1.6.2 Site Visit – Time of site visit will be 1pm.

**1.2. ADD** Structural specification sections as per the enclosed and update section 00 00 01 table of contents.

END OF ADDENDUM NO. 2



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Polar Engineering Specification (Enclosed)

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**Appendix A – Owner-Supplied Record Drawings**

- i. Stuart C Ross Architect – Leisure Service Complex 1999
- ii. Cambrian Facilities Consultants – Pool-Library Complex 1980
- iii. Desmond Parker Architect – Multipurpose Rec Building 1973
- iv. Bruce Carscadden Architect – Ice Arena and Energy Upgrades – 2014
- v. Carscadden Architects – Mackenzie Rec Centre Expansion - 2017

Revised to

February 2024 – Addendum 002

## **1.0 GENERAL**

### **1.1 Documents**

- .1 This section, along with the drawings, forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

### **1.2 Description of Work Included**

- .1 Provide all labour, materials, equipment and services necessary to supply and install concrete, inserts, insulation, polyethylene slip sheet, dowels, sleeves, reinforcement, and chairs in the refrigerated hockey ice slab assembly shown or indicated in all the contract drawings and specifications.
- .2 Coordinate concrete placement fully with other trades.

### **1.3 Related Work Specified Elsewhere**

- .1 Section 03 00 50 – Testing of Concrete and Reinforcement
- .2 Section 03 20 00 – Concrete Reinforcing
- .3 Section 03 30 00 – Cast-in-Place Concrete

### **1.4 Reference Standards**

- .1 Concrete work shall conform to the requirements of the following Standards unless otherwise required by this specification:
  - .1 CSA-A23.1 - Concrete Materials and Methods of Concrete Construction.
  - .2 CSA-A23.2 - Methods of Test for Concrete.
- .2 Where the Standard is referred to in this specification it shall mean the documents specified in this clause, and their referenced Standards.
- .3 A copy of the Standard shall be kept on site by the Contractor for the duration of the work and be made available for reference.
- .4 ASTM E1155M Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.

- .5 ASTM E1486M Standard Test Method for Determining Floor Tolerances Using Waviness, Wheel Path and Levelness Criteria.

## **1.5 Definitions - For This Section**

- .1 "The Owner", "Contractor", "The Consultant", as per the General Conditions and Definitions.
- .2 "Testing Agency" shall mean the testing agency responsible to The Owner
- .3 "Standard" and "Standards" shall mean the reference standards listed under "Reference Standards" in this section.

## **1.6 Testing**

- .1 As per Section 03 00 50 - Testing of Concrete and Reinforcement.
- .2 Arrange for plasticizer to be added on site, with supervision of admixture by manufacturer's representative.
- .3 Refrigerated slab Contractor to provide detailed as-built survey of Floor Flatness and Floor Levelness using digital laser scan of rinks. Results of the survey shall be supplied to the Owner and the Consultant for review.

## **1.7 Qualifications**

- .1 Work shall be performed by a company regularly engaged in the installation of refrigerated slabs and the application of concrete materials. Provide proof that the contractor has successfully completed at least three (3) projects of similar size and complexity in the past five (5) years.
- .2 Foreman or supervisor shall have a minimum of 3000 hours experience and shall have proficiency at all crew positions.
- .3 Refrigerated slab Contractor shall complete all portions of the installation themselves; no installation work shall be subbed out to other Contractors.

## **2.0 PRODUCTS**

### **2.1 Concrete Material**

- .1 All concrete placing shall be in accordance with Section 03 30 00 and as modified herein.

- .2 Concrete for the refrigerated slab shall meet the following general requirements.

Shrinkage potential	less than 300 micro strain
Minimum 28 day strength	25 MPa
Maximum size of coarse aggregate	14 mm
Slump range before plasticizing	40 – 55 mm
Slump range at discharge	150 – 185 mm
Minimum water to cement ratio	0.50
Maximum water to cement ratio	0.55
Air Content	1% to 3%
Cement Type	GUL
Fly ash content	15% to 20% of total cementitious
No In-Situ Carbon Dioxide Mineralization	

## 2.2 Reinforcing Materials

- .1 Reinforcing conforming to CAN/CSA-G30.18, 400MPa yield strength; deformed billet steel bars uncoated finish.
- .2 Welded wire mesh: plain type conforming to ASTM A185/A185M in flat sheets uncoated finish.
- .3 Chairs for reinforcing materials in the refrigerated slab shall be sufficient in number and strength to support the reinforcing steel independent of and clear of the refrigeration piping under construction loads. Chairs and other reinforcing steel supports shall be equipped with or placed on enlarged bases as required to prevent indentation of the insulation under construction loads.
- .4 Chairs: "M" style rink chairs, 600mm on center along the length of each row of pipe. Chairs designed and supplied by Contractor. Provide chairs for reinforcing materials in the refrigerated slab, sufficient in number and of sufficient strength to support the reinforcing steel independent of and clear of the refrigerating piping under construction loads. Equip chairs and other reinforcing steel supports with or placed on enlarged bases as required to prevent indentation of the insulation under construction loads.
- .5 All bar and mesh reinforcement ties shall be reinforcement tie loops, no wire ties allowed. Reinforcement tie loops shall be turned down away from piping.



## **2.3 Formwork Materials**

- .1 Forms must be capable of the degree of adjustment necessary to achieve the construction tolerances specified herein.

## **3.0 EXECUTION**

### **3.1 Examination**

- .1 Report unsatisfactory conditions to the General Contractor and Consultant in writing. Commencement of work implies acceptance of the existing conditions.

### **3.2 Excavation, Final Grading and Compaction**

- .1 All excavation, fill and compaction is carried out under the direction of the Consultant and a Geotechnical Engineer registered in the province of British Columbia.

### **3.3 Installation/Sand, Piping and Insulation**

- .1 All installation for sand, heating pipes, and insulation layer shall be carried out under the direction of the Consultant.

### **3.4 Installation/Slip Sheet**

- .1 Install 1 layer of polyethylene sheet, with 200mm lapped joints to provide a slip sheet between the concrete and the top of the insulation.
- .2 Extend slip sheet up past top of the adjacent slab, after curing has been completed. Cut off slip sheet to top of insulation.
- .3 Protect the top surface of the slip sheet at all times from damage due to work traffic and other causes. Use an approved protection board if necessary. Repair damage to slip sheet as needed.
- .4 Maintain insulation and slip sheet surfaces clean and free on contained at all times.
- .5 Slip sheet must be sealed at laps.
- .6 Ensure rink slip sheet is not bonded to the insulation.

### **3.5 Formwork**

- .1 Erect and adjust formwork for the refrigerated slab to confirm to the tolerances specified herein.

### **3.6 Installation of Reinforcement and Refrigeration Piping**

- .1 Review reinforcing mesh details with Consultant to confirm the pattern required.
- .2 Install pipe chairs and screed chairs (if used), in position on top of insulation.
- .3 Lay bottom longitudinal reinforcing bars over entire floor area onto pipe chairs; install transverse bars to top of longitudinal bars. Tie reinforcement layers together and to the pipe chairs with wire ties at 600mm on centre each way. Turn down loop ties and away from piping and remove burrs from reinforcing where required to protect plastic piping from damage. Deflect reinforcing bars at trench ends as required to permit deflection of the plastic pipes in trench. Ensure rows of pipe chairs are properly aligned so pipe runs are straight.
- .4 Allow Refrigeration Subcontractor access to install pipe chairs and plastic piping, to make connections, and to apply pressure test to system.
- .5 Lay two layers of wire mesh over entire floor area in lap patterns as detailed on the drawings and reviewed shop drawings. Install longitudinal wires on mesh sheets to the bottom side of the sheet in one row and to the top side in the adjacent row. Overlap all sheets minimum 200mm along each side. Install pre-cut splice section of mesh at butted ends of long sheets on mesh.

- .6 Tie top layer of mesh to pipe chairs with loop ties at 600mm on centre. Turn down ends of wires and away from pipes and remove burrs from mesh reinforcing where required to protect piping from damage. Bend ends of mesh wires away from plastic pipes in necessary. Tie bottom layer of reinforcing mesh to top layer at 600mm on centre along mid-span of reinforcing so that both layers act together to resist deflection due to foot traffic during concrete pour. Tighten these ties just snug enough to maintain an equal spacing between the two layers of reinforcing at all points. Ensure the corners of all mesh sheets are tied.
- .7 Use extreme caution during these operations and in placing concrete to ensure plastic piping is not damaged or displaced.
- .8 The Contractor is responsible for placing and maintaining the level of screeds. Set screeds with the surveyor's level or laser level.
- .9 Install pipe chairs at same time as installation of bottom layer of reinforcing to ensure conflicts are satisfactorily resolved.
- .10 All piping, pipe chairs and piping accessories are supplied and installed by the refrigeration equipment Subcontractor, who is also required to conduct all pressure testing as required by the refrigeration consultant.

### **3.7 Shop Drawings**

- .1 Submit shop drawings for concrete reinforcement, bar support and accessories for review by The Consultant at least 28 working days prior to the placement of rebar.
- .2 Clearly indicate bar sizes, grades, spacing, location and quantities of reinforcing mesh, bar supports and accessories and identifying code marks to permit correct placement without reference to structural drawings.
- .3 Placing drawings and bar lists will be reviewed for number and size of bars only and this review shall in no way relieve the Contractor of his responsibility for carrying for carrying out the Work in accordance with the drawings.

- .4 Substitution of imperial reinforcing sizes and grades will only be accepted if placing drawings showing imperial sizes are submitted to The Consultant for review. Approval must be obtained before any work is commenced.
- .5 Shop drawings should indicate procedures for forming, placing, and finishing the concrete in the refrigerated slab indicating equipment to be used, together with the resumes of experience of the key personnel who will be employed to do the work.

### **3.8 Placing Concrete**

- .1 Notify the Consultant and concrete testing agency a minimum five (5) days prior to placing concrete.
- .2 Prior to placing concrete, review refrigerated slab chairs, piping and reinforcing layout on site with General Contractor, Consultant and Structural, Mechanical and Refrigeration Engineers and concrete testing agency. Obtain Consultant's acceptance prior to placing concrete. Provide minimum 3 days' notice prior to such review.
- .3 Place concrete using the "wet screed" method. Set screeds to ensure an even level surface finish to tolerances specified in the Section. Screed the full width of the pour.
- .4 Place the refrigerated slab in one continuous pour. Make arrangements for the changing of work crews to ensure placing of concrete is carried out in one continuous sequence. Stagger shifts and the like, to maintain placement continuity.
- .5 Provide a spare concrete pumper set up and fully operational on site in case of breakdown to ensure continuous operation.
- .6 Do not displace or damage reinforcing and piping during placing of concrete
- .7 After placing, screed and compact concrete with high-frequency vibratory equipment. Vibrate in a manner consistent with the congested reinforcing and piping layout to ensure adequate compaction of concrete. Confirm vibration equipment with refrigeration contractor.

- .8 Float surface, further level and compact and polish it with a rotary steel trowel with trowel blades set fairly flat, using an average of three passes. Carefully remove excess water brought to the surface, prior to final finish.
- .9 The top of the refrigerated slab is to be brought to an even surface to the Floor Flatness and Floor Levelness tolerances below, measured in accordance with ASTM E1155M:
  - Overall Floor Flatness ( $F_F$ ) value = 45 (Very Flat)
  - Minimum Local Floor Flatness ( $F_F$ ) value = 35 (Very Flat)
  - Overall Floor Levelness ( $F_L$ ) value = 35 (Very Flat)
  - Minimum Local Floor Levelness ( $F_L$ ) value = 25 (Very Flat)
- .10 The Contractor will be required to grind all high areas of concrete as necessary to achieve these tolerances. The Contractor will not be permitted to fill low areas of concrete to meet these limits.
- .11 Saw cut joints are not permitted.

### **3.9 Curing and Protection**

- .1 Refrigerated slab shall be wet cured continuously for a minimum of 14-days.
- .2 Wet curing shall be accomplished by UltraCure wet curing blanket or equivalent.
- .3 Prevent all traffic on slab for three days after slab pour.
- .4 Leave all formwork in place for the duration of the wet curing.
- .5 Lighter construction loads, 1.0 kPa (20 psf) or less, may be permitted on the refrigerated slab only after the slab has gained at least 75% of the specified minimum 28-day strength as determined by tests on field cured cylinders, and only after the approval of Owner.
- .6 Do not circulate refrigerant until the slab has cured for a minimum 28 days. Follow cool down procedures of refrigeration Subcontractor in making ice.
- .7 Protect the finished concrete surface at all times from abrasion, concentrated construction point loads, and impact damage.

- .8 Take special care to protect exposed concrete edges from chipping.  
Ramp construction traffic over all edges.
- .9 Make good any damage to the refrigerated slab caused by construction operations at no cost to The Owner.

### **3.10 Adjustments**

- .1 The Contractor will be required to grind all high areas of concrete refrigerated slab as necessary to achieve these tolerances. The Contractor will not be permitted to fill low areas of concrete refrigerated slab to meet these limits.
- .2 Make good variations from the specified surface elevations and finish to the satisfaction of the Consultant.

### **3.11 Protection and Clean-Up**

- .1 Protect finished concrete slab from damage during course of construction. Fit all wheeled equipment on finished slab, with tire wraps and drip shields to prevent marking and staining.
- .2 As work proceeds and upon completion, clean-up and remove from the site all surplus materials and rubbish resulting from the work of this Section.

**END OF SECTION**

## **1.0 GENERAL**

### **1.1 Documents**

- .1 This section, along with the drawings, forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

### **1.2 Description of Work Included**

- .1 Provide all labour, materials, equipment, access, cooperation, coordination, and services to allow the testing of concrete and concrete reinforcement to be carried out by a Testing Agency.
- .2 The scope of the required quality assurance testing is described in this section to inform the Contractor of the type and scope of testing on the project and to allow the Contractor to make appropriate allowances.
- .3 It is the responsibility of the Contractor to schedule the testing described, to coordinate construction schedules with the Testing Agency, and to cooperate with the Testing Agency in the execution of this work.
- .4 Testing required by the Contractor for the Contractor's own quality control or as noted in clause 1.6.3 will be paid for by the Contractor.

### **1.3 Related Work Specified Elsewhere**

- .1 Section 03 20 00 – Concrete Reinforcing
- .2 Section 03 30 00 – Structural Cast-in-Place Concrete
- .3 Section 03 16 00 – Refrigerated Slab

### **1.4 Reference Standards**

- .1 Testing of concrete and reinforcement shall conform to the requirements of the following Building Code:
  - .1 BC Building Code - 2018
- .2 Testing of concrete and reinforcement shall conform to the requirements of the following Standards unless otherwise required by this specification:
  - .1 CSA A23.1 – Concrete Materials and Methods of Concrete Construction
  - .2 CSA A23.2 – Test Methods and Standard Practices for Concrete

- .3 The revision date of all referenced codes, standards, and guidelines shall be as indicated in the above referenced Building Code. Where no reference is made within the Building Code, the latest published edition shall be used.
- .4 Where the Standard is referenced in this specification, it shall mean the documents specified in this clause and their referenced Standards.
- .5 A copy of A23.1 and A23.2 shall be kept on site by the Contractor for the duration of the work and be made available for reference.
- .6 Where there are differences between the specifications and drawings and the codes, standards, or acts, the most stringent shall govern.

### 1.5 Definitions - For This Section

- .1 "Owner", "Contractor", and "Consultant" as per the General Conditions and Definitions.
- .2 "Specialty Engineer" is a Professional Engineer registered in British Columbia responsible for components designed by the Contractor and who seals and signs shop drawings.
- .3 "Testing Agency" shall mean a third party testing and inspection agency.
- .4 "Standard" and "Standards" shall mean the reference standards listed under "Reference Standards" in this section.

### 1.6 Appointment of Testing Agency

- .1 A CSA-approved Testing Agency shall be appointed to test concrete, reinforcement, and grout as per this specification and shall include:
  - .1 Review of initial mix designs.
  - .2 Testing as outlined in Article 3.0.
- .2 Unless stated otherwise in Division 0 / Division 1 the Testing Agency shall be engaged by the Owner.
- .3 The Contractor shall pay for testing not covered in clause **Error! Reference source not found.** 1.1, which shall include but not be limited to:
  - .1 Review of Contractor-requested mix design changes.



- .2 Any waiting time incurred by the Testing Agency in excess of 30 minutes.
- .3 Testing required by the Contractor for stripping of formwork, such as field-cured cylinders, etc.
- .4 Any additional costs due to overtime, shift work, holiday or weekend work, except that the Owner will pay for holiday or weekend pickup when the concrete was placed on a regular workday.
- .5 Retesting or additional testing of concrete or reinforcement where tests have failed to meet the specified requirements.

## **1.7 Submittals**

- .1 The Contractor shall submit the following documents:
  - .1 Testing and Inspection Reports
    - .1 Reports shall be simultaneously distributed to the following parties:
      - .1 Consultant
      - .2 Contractor
      - .3 Owner
    - .2 Reports indicating defective works should be distributed immediately.
    - .3 Reports shall be submitted within five (5) business days.

## **2.0 DUTIES**

### **2.1 Responsibility of the Contractor**

- .1 The Contractor shall cooperate fully with the Testing Agency.
- .2 The Contractor shall give the Testing Agency at least 24 hours prior notice of concrete placement.

- .3 It is the Contractor's responsibility to provide a finished product that meets the specification. If initial tests indicate that the concrete failed to meet the specification, the Consultant shall decide if any additional testing is necessary. This testing shall be done by a CSA-approved Testing Agency, but need not be the Owner's agency. The proposed additional testing shall have prior approval of the Consultants.
- .4 Strengths of cored samples must equal the specified strength if tested dry or 85% of specified if tested wet, with wet or dry tests as per the Standard.

## **2.2 Responsibility and Duties of the Testing Agency**

- .1 The Testing Agency has the authority to, and is expected to reject any concrete not meeting the specifications.
- .2 All testing results and reviews performed by the Testing Agency shall be submitted as noted in section 1.7.
- .3 The Testing Agency shall immediately notify the Consultant if concrete is being placed without their notification, or if insufficient notice is provided.
- .4 Bring low 7-day, 28-day, and 56-day strength tests to the immediate attention of the Consultant and the Contractor.
- .5 At the completion of the project, the Testing Agency to provide a signed letter to the Owner, with a copy to the Consultant. The letter shall confirm that testing has been carried out as per the specifications and that the Contractor and Consultant have been notified of any deficiencies in material properties.

## **3.0 TESTING - CONCRETE AND REINFORCEMENT**

### **3.1 General**

- .1 All strength tests shall be numbered consecutively and the cylinders marked as follows:
  - .1 7-Day Test: Marked "A".
  - .2 28-Day Test: Two cylinders marked "B" and "C".
  - .3 56-Day Test: Where these are required by the drawings and specifications, two cylinders marked "D" and "E".

- .2 All tests reports shall record:
  - .1 Name of Project
  - .2 Date and time of sampling
  - .3 Name of supplier
  - .4 Delivery truck number
  - .5 Batch time and discharge time
  - .6 Identification of sampling and testing technicians
  - .7 Exact location in the structure of the concrete sampled
  - .8 Design strength of concrete sampled
  - .9 Admixtures, cement type, maximum aggregate size
  - .10 Air and concrete temperature
  - .11 Slump, and air content
- .3 All field-cured cylinders shall be marked "F".
- .4 Slump tests shall be performed prior to the addition of superplasticizers.
- .5 Tests for slump and air content shall be taken with each strength test and as required by the specifications and drawings.

### **3.2 Regular Testing - Concrete**

- .1 To conform to the Standard, except each test shall consist of a minimum of three cylinders - one for 7-day strength and two for 28-day strength.
- .2 Regular testing applied to all elements not listed in Clause 3.3 Full-Time Testing - Concrete.

### **3.3 Full-Time Testing - Concrete**

- .1 Full time testing shall apply to:
  - .1 Concrete specified as exposure class F-1, F-2, C-XL, A-XL, C-1, A-1, and C-2 in non-parking applications.

- .2 Full time testing shall conform to the Standard and regular testing except:
  - .1 The Testing Agency shall have a representative on the job site at all times that the concrete requiring full time testing is being placed.
  - .2 Test the slump and air content from every truck and reject any concrete not within specification.
  - .3 For concrete mixes meeting 3.3.1.1, test the compressive strength with a frequency not less than 1 test for every 25 cu. m. The first and last batch of concrete to be placed each day shall always be tested.
- .3 Full time testing applies for the duration of the project as follows:
  - .1 Provide full-time testing for all elements listed in 3.3.1 and for each mix type by the Supplier until the satisfactory control of the concrete mix is established by the Testing Agency.
    - .1 For slump and air content, satisfactory performance shall be established from test results on not less than 5 consecutive batches of concrete placed.
  - .2 Where Regular Testing has been initiated for a mix, the Testing Agency shall resume Full Time Testing per 3.3.2 if any test fails to satisfy the Standard, the agreed strength criteria or as directed by the Structural Consultant or Owner.
  - .3 Where a mix type has not been utilized on the project for more than 30 consecutive days, Full Time Testing shall apply until satisfactory compliance with this Standard is re-established.

### **3.4 Field-Cured Cylinders**

- .1 Field-cured cylinders shall be protected against wind and stored on the floor immediately below the slab they represent, unless the floor below is heated. In that case, they shall be stored on top of the slab but covered with a plywood box. The cylinders are to be undisturbed at this location until picked up by the Testing Agency. Field-cured cylinders are not to be stored in temperature-controlled containers.

### **3.5 Testing of Reinforcing Bars and Accessories**

- .1 The Testing Agency shall, over the duration of the project, perform at least one tensile and bend test for each bar size and mill stamp used on the project. Such testing shall comply with the applicable CSA documents. Further testing may be requested at the Consultant's discretion.
- .2 The Testing Agency will select the bars to be tested from the reinforcing supplied to the construction site, not from the suppliers' yard. The Contractor shall cut the bars to the required length and replace the shortened bars without cost to the Owner.
- .3 The Contractor shall supply mill certificates of chemical analysis in accordance with CSA G30.18R and G30.18W for all bar supplied to site.
- .4 When requested, provide samples of support accessories (chairs, bolsters, spacers) that are intended to be used.

**END OF SECTION**

## **1.0 GENERAL**

### **1.1 Documents**

- .1 This section, along with the drawings, forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

### **1.2 Description of Work Included**

- .1 Provide all labour, materials, equipment, and services necessary to supply and install reinforcing steel work shown or indicated in all the contract drawings and specifications including accessories such as hanger bars, spirals, wire ties, support bars, chairs, spacers, supports, or other devices required to position reinforcing properly.

### **1.3 Related Work Specified Elsewhere**

- .1 Section 03 00 50 – Testing of Concrete and Reinforcement
- .2 Section 03 30 00 – Structural Cast-in-Place Concrete
- .3 Section 03 16 00 – Refrigerated Slab

### **1.4 Reference Standards**

- .1 Concrete reinforcing shall conform to the requirements of the following Building Code:
  - .1 BC Building Code - 2018
- .2 Concrete reinforcing shall conform to the requirements of the following Standards unless otherwise required by this specification:
  - .1 CSA A23.1 – Concrete Materials and Methods of Concrete Construction
  - .2 CSA A23.2 – Test Methods and Standard Practices for Concrete
  - .3 CSA A23.3 – Design of Concrete Structures
  - .4 ASTM A1064M – Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
  - .5 CSA G30.18 - Carbon Steel Bars for Concrete Reinforcement

- .6 CSA W47.1 – Certification of Companies for Fusion Welding of Steel
- .7 Reinforcing Steel Institute of Canada (RSIC) – Manual of Standard Practice
- .8 ASTM A820M – Standard Specification for Steel Fibers for Fiber-Reinforced Concrete
- .9 ASTM C1116M – Standard Specification for Fiber-Reinforced Concrete
- .3 The revision date of all referenced codes, standards, and guidelines shall be as indicated in the above referenced Building Code. Where no reference is made within the Building Code, the latest published edition shall be used.
- .4 Where the Standard is referenced in this specification, it shall mean the documents specified in this clause and their referenced Standards.
- .5 A copy of A23.1 and A23.2 shall be kept on site by the Contractor for the duration of the work and be made available for reference.
- .6 Where there are differences between the specifications and drawings and the codes, standards, or acts, the most stringent shall govern.

### **1.5 Definitions - For This Section**

- .1 “Owner”, “Contractor”, and “Consultant” as per the General Conditions and Definitions.
- .2 “Specialty Engineer” is a Professional Engineer registered in British Columbia responsible for components designed by the Contractor and who seals and signs shop drawings.
- .3 “Standard” and “Standards” shall mean the reference standards listed under “Reference Standards” in this section.

### **1.6 Testing**

- .1 As per Section 03 00 50 - Testing of Concrete and Reinforcement.

## **2.0 PRODUCTS**

### **2.1 General**

- .1 Products shall satisfy the requirements of the Standard unless otherwise specified herein or on the drawings.

### **2.2 Materials**

- .1 Reinforcing bars shall conform to the Standard unless otherwise specified herein or on the drawings.
- .2 Reinforcing bars to be welded shall conform to the Standard, G30.18W.
- .3 Welded wire fabric shall conform to the Standard; size and gauges as shown on the drawings.
- .4 Welded wire fabric for slabs shall be delivered in flat sheets.
- .5 In suspended parking slabs, bar support chairs shall be plastic or plastic coated.
- .6 Chairs, Bolsters, Bar Supports, Spacers: To CSA A23.1. In the case of concrete exposed to view or weather, the accessories shall be such that no metal is permitted to come closer than 40 mm (1-5/8") from a formed face and 50 mm (2") from a troweled surface. Use precast concrete supports for exposed concrete beams and soffits and concrete cast against soil/rock. Precast concrete supports shall be made of concrete of quality and strength at least equal to that specified for the member in which they are used.
- .7 Steel fibers shall meet the requirements of ASTM A820 Type 1, deformed fibers. Minimum ultimate tensile strength shall be 1036 MPa. Minimum aspect ratio shall be 80. Minimum fiber length shall be 60 mm. Maximum fiber diameter shall be 0.03 inches. Steel fibers shall be Dramix RC 80/60 BN manufactured by Bekaert Corporation.
- .8 Steel fiber concrete shall be proportioned as required in ASTM C1116, alternative 3, in consultation with fiber manufacturer based on the required concrete properties indicated on drawings and specifications.



### **3.0 EXECUTION**

#### **3.1 General**

- .1 All phases of concrete reinforcement work shall be in accordance with the Standards unless otherwise specified herein or on the drawings. The Contractor shall ensure that the work is executed only by workers skilled and experienced in their trade.
- .2 The Contractor shall notify the Consultant at least 24 hours before any concrete is placed in order that the Consultant may review the work.
- .3 Identify with a tag each bundle of bars with a code mark corresponding to that appearing on the bar list.
- .4 Bend reinforcement once only and at room temperature of 18°C. Do not straighten or re-bend reinforcement. Do not use bars with kinks or bends not shown on the drawings.
- .5 Replace bars that develop cracks or splits.
- .6 Non-galvanized reinforcement to be electrically isolated from galvanized steel including but not limited to reinforcement, hardware (sleeves, conduit) , embedded plates, structural steel, or window washing anchors.
- .7 Williams All-Thread - Bar must not be welded or subjected to the heat of a torch or used as a ground.

#### **3.2 Field Bending**

- .1 Do not field bend reinforcement except where indicated or authorized in writing by the Consultant.
- .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 Construction Joints in Cast-in-Place Concrete**

- .1 Obtain acceptance from the Consultant for details of construction joints not shown.

- .2 Continue reinforcement through the joint in its normal position. Add additional reinforcement across the joint as shown or directed. Where a mechanical splice is required at a construction joint, use of the LENTON Formsaver type coupler manufactured by nVent or approved equivalent is appropriate.

### **3.4 Fabrication**

- .1 Fabricate all reinforcing to the Standard and contract documents.
- .2 Reinforcing bars shall be cold bent. Bars shall not be straightened or re-bent.
- .3 Splices in reinforcing bars at locations not shown on the drawings must be submitted for review by the Consultant. Such splices shall conform to the Standards.
- .4 Steel stud assemblies for shear reinforcement shall be fabricated in accordance with ASTM A1044/A1044M.

### **3.5 Product Delivery, Storage, and Handling**

- .1 Store reinforcement in a manner to prevent excessive rusting and fouling with dirt, grease, form-oil, and other bond-breaking coatings.
- .2 Reinforcement at the time concrete is placed shall be free from excessive rusting, mud, oil, or other coatings that adversely affect its bonding capacity.

### **3.6 Placing**

- .1 Reinforcing of size and shapes shown on the structural drawings shall be accurately placed in accordance with the drawings and the requirements of the Standard.
- .2 Reinforcement shall be adequately supported by chairs, spacers, support bars, hangers, or other accessories, and secured against displacement within the tolerances permitted in the Standard. Support devices contacting surfaces exposed to the exterior shall be non-corroding.
- .3 Bars that are not part of the structural design or drawings, and whose only function is supporting other reinforcing in lieu of other support accessories, shall be considered accessories.

- .4 All reinforcement shall be adequately tied and chaired to maintain it in the specified location during pouring. Lifting of reinforcing or welded wire mesh into specified position during the concrete pour will not be allowed.
- .5 Tolerances for bar placement shall be as per the Standard. Tolerances shall not be used to justify the use of chair, bolsters, or chair/support combinations that result in improper cover.
- .6 Williams All-Thread Bar must not be welded, subjected to the high heat of a torch, nor used as a ground.
- .7 Field cutting is to be done with an abrasive wheel or band saw.
- .8 Prior to concreting, accurately place reinforcement, support, and secure against displacement, as indicated on reviewed placing drawings and in accordance with CSA A23.1. Tack welding of reinforcement to secure in place will not be permitted.
- .9 Do not 'wet set' reinforcement into fresh concrete.
- .10 Secure reinforcement in columns and walls using sufficient spacers on each face to maintain the requisite distance between reinforcement and column or wall face and so that vertical bars are plumb.
- .11 Where continuous drop panels or slab thickenings are noted on the drawings, place bottom slab reinforcement in the bottom of the continuous drop panel or slab thickening, unless noted otherwise on the drawings.
- .12 Where toppings are placed on waterproof membranes, vapour barriers, and the like, prevent reinforcement or tie wire from contacting these items.
- .13 Ensure that longitudinal bars in beams have adequate vertical spacing between layers in accordance with the Standard.
- .14 All splice locations are subject to review by the Consultant.

### **3.7 Construction Review**

- .1 No concrete shall be placed until the Consultant has completed a review of reinforcement in place. The Contractor shall provide a minimum of 24 hours notice of the time when the reinforcement will be substantially in place and ready for the Consultant's review. A minimum of 6 hours is to be provided for review and any required remedial work prior to concrete placement.

- .2 The Consultant's general review during construction and inspection and testing by Independent Inspection and Testing Companies reporting to the Consultant are both undertaken to inform the Owner of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of contractual responsibility.

### **3.8 Tolerances**

- .1 Perform fabrication and setting so that completed work will be within the tolerances set out in CSA A23.1.
- .2 These tolerances are acceptable with regard to structural requirements. Interfacing tolerances may not be compatible with the above. Review and coordinate interfacing tolerances so that the various elements come together properly.

**END OF SECTION**

## **1.0 GENERAL**

### **1.1 Documents**

- .1 This section, along with the drawings, forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.

### **1.2 Description of Work Included**

- .1 Provide all labour, materials, equipment, and services necessary to supply and install cast-in-place concrete work shown or indicated in all the contract drawings and specifications including concrete toppings, bases, sumps, curbs, posts, manholes, pits, paving, sidewalks, equipment bases or curbs, grouting of baseplates, etc.
- .2 Coordinate concrete placement fully with other trades. Ensure other related work, such as inserts, dowels, sleeves, reinforcement, etc., is complete before placing concrete.

### **1.3 Related Work Specified Elsewhere**

- .1 Section 03 00 50 – Testing of Concrete and Reinforcement
- .2 Section 03 20 00 – Concrete Reinforcing
- .3 Section 03 16 00 – Refrigerated Slab

### **1.4 Reference Standards**

- .1 Concrete work shall conform to the requirements of the following Building Code:
  - .1 BC Building Code - 2018
- .2 Concrete work shall conform to the requirements of the following Standards unless otherwise required by this specification:
  - .1 CSA A23.1 – Concrete Materials and Methods of Concrete Construction
  - .2 CSA A23.2 – Test Methods and Standard Practices for Concrete
  - .3 CSA A23.3 – Design of Concrete Structures
  - .4 CSA A3000 – Cementitious Materials Compendium

- .5 ACI 347 – Guide to Formwork for Concrete
- .6 CSA S269.1 – Falsework and Formwork
- .3 The revision date of all referenced codes, standards, and guidelines shall be as indicated in the above referenced Building Code. Where no reference is made within the Building Code, the latest published edition shall be used.
- .4 Where the Standard is referenced in this specification, it shall mean the documents specified in this clause and their referenced Standards.
- .5 A copy of A23.1 and A23.2 shall be kept on site by the Contractor for the duration of the work and be made available for reference.
- .6 Where there are differences between the specifications and drawings and the codes, standards, or acts, the most stringent shall govern.

## **1.5 Definitions - For This Section**

- .1 “Owner”, “Contractor”, and “Consultant” as per the General Conditions and Definitions.
- .2 “Specialty Engineer” is a Professional Engineer registered in British Columbia responsible for components designed by the Contractor and who seals and signs shop drawings.
- .3 “Standard” and “Standards” shall mean the reference standards listed under “Reference Standards” in this section.

## **1.6 Submittals**

- .1 Keep a record at the job site showing time and place of each pour of concrete, together with a transit-mix delivery slip certifying contents of pour. Make the record available to the Owner for inspection upon request. Upon completion of this portion of work, submit placing records and delivery slips to the Owner.
- .2 Submit details of proposed methods of concrete curing and provisions for weather protection to the Consultant for review.
- .3 Submit plan locations and details of construction joints for the Consultant’s review.
- .4 Certificates

- .1 The concrete supplier shall have a current "Certificate of Ready Mixed (or Mobile Mix) Concrete Production Facilities," as issued by the National Ready Mixed Concrete Association (NRMCA). The certificate shall be submitted to the Consultant upon request.
- .2 When requested, prior to beginning work and when any change in materials or source of supply is proposed, provide the following certificates prepared by an independent inspection company. The cost of this work shall be borne by the Contractor.
  - .1 Certification that all raw materials used in the production of concrete proposed for the work comply with requirements of the specifications and CSA A23.1. Specifically, the Contractor must confirm that aggregates used will not react with alkalis in the concrete to cause deleterious expansion.
  - .2 Certification that compressive strength, water-cement ratio, slump, entrained air content, and other specified properties will be met using the proposed mixes.
- .3 Concrete Quality Plan
  - .1 When requested, submit a complete "Concrete Quality Plan", in the format provided by the NRMCA.
  - .4 When requested and well in advance of construction, submit complete details of placing and consolidation procedures for sloping roofs, including details of construction and placing of top forms and top form panel.

## **2.0 PRODUCTS**

### **2.1 General**

- .1 Products shall satisfy the requirements of the Standard unless otherwise specified herein or on the drawings.
- .2 Provide samples of materials upon request.

### **2.2 Materials**

- .1 Mixing water shall conform to the Standard.
- .2 Air entraining admixtures to the Standard.

- .3 Calcium chloride, either as a raw material or as a constituent in other admixtures, shall not be used unless approved in writing by the Consultant.
- .4 Curing compounds shall conform to the specification and shall also be compatible with specified floor hardeners, covering adhesives, and waterproofing compounds.
- .5 Grout shall be pre-approved, pre-mixed, and non-shrink conforming to the Standard. Exposed grout shall be non-staining, cement grey in colour.
- .6 Modulus of Elasticity (E): For each concrete mix design,
  - .1 the average (mean) of the Modulus of Elasticity (as measured by appropriate testing) at all times during construction is to be not less than the value shown on the structural drawings, or not less than  $4,500\sqrt{f'_c}$  MPa if no value is shown on the structural drawings.
- .7 Concrete: Normal density concrete with air-dry density of  $23 \pm 1$  kN/cu. m. Conform to CSA A23.1.
- .8 Cement Type: General Use Portland Cement (Type GU) or Low Heat of Hydration Portland Cement (Type LH) meeting the requirements of CSA A3000.
- .9 Shrinkage Control Fibres: "Dramix" steel fibres by Bekaert or approved alternative, 60/1.05.
- .10 Bonding Agent: Use Sika Sikdur 32 epoxy bonding agent for all bonded topping installations.
- .11 Curing Compound: Conform to CSA A23.1.
- .12 Grout Beneath Base Plates: Non-shrink, non-metallic, flowable grout, In Pakt or approved alternative having a compressive strength at 28 days of at least 35 MPa (5 ksi). Where grout is exposed to view or weather, use non-ferrous grout.



.13 Supplementary Cementing Materials (SCMs)

- .1 It is anticipated that one or more supplementary cementing materials will have to be used in the concrete to produce a mix with acceptable fresh and hardened concrete properties and acceptable thermal characteristics during hardening. The materials will be one or more of the following:
  - .1 Granulated blast furnace slag
  - .2 Fly-ash
  - .3 Silica fume
- .2 SCMs – fly ash, granulated blast furnace slag, or silica fume – shall comply with the requirements of CSA A23.1 and A3000.
- .3 The supplier shall submit evidence satisfactory to the Owner to demonstrate that the storage and dispensing facilities for SCMs do not have any deleterious effects on the materials themselves. These facilities will not expose these materials to such effects as the agglomeration or balling of particles, any separation or change in effective particle size of solids in slurries, freezing and thawing, or excessive heat.

.14 Aggregates

- .1 The concrete supplier shall demonstrate by appropriate tests and test results that the aggregates chosen have the potential to meet the design strength requirements specified herein.
- .2 Coarse Aggregate: Crushed rock conforming in all respects to CSA A23.1. The maximum size of the coarse aggregates shall be 20 mm but smaller maximum sizes may be used.
- .3 Fine Aggregate: Natural and conforming to CSA A23.1.

.15 Unshrinkable Fill

- |    |                                 |                         |
|----|---------------------------------|-------------------------|
| .1 | Cement Type                     | General Use GU Portland |
| .2 | <u>Minimum</u> 24-Hour Strength | 0.07 MPa (10 psi)       |
| .3 | <u>Maximum</u> 28-Day Strength  | 0.4 MPa (60 psi)        |
| .4 | Class of Exposure               | N/A                     |

- .5 Size of Coarse Aggregate 20 mm to 40 mm
- .6 Slump at Point of Discharge 150 mm to 200 mm
- .7 Calcium chloride or pozzolanic mineral admixtures shall not be used. Air entraining admixtures may be added if desired by the Contractor.
- .16 Sealant for Exposed Separation Strips, Construction Joints, and Temporary Opening Joints: Multi-Component Polyurethane 'Sikaflex 2C-SL' by Sika, or approved alternate.

### 3.0 EXECUTION

#### 3.1 General

- .1 All phases of concrete work shall be in accordance with the Standard unless otherwise specified herein or on the drawings. The work shall be executed only by experienced and skilled workers.
- .2 The Contractor shall notify the Consultant at least 24 hours before any concrete is placed to allow the Consultant to review the work.
- .3 Prior to the initial supply of concrete to the project, the contractor must schedule a "Pre-Pour Meeting" as outlined in the Concrete Supplier's Concrete Quality plan.

#### 3.2 Mix Designs

- .1 Concrete mixes shall be proportioned by the supplier to meet the compressive strength, exposure class, and other performance specifications noted in the contract documents. In addition, concrete mix design shall satisfy the transport, placing, and finishing requirements of the Contractor. All concrete shall be normal weight unless noted otherwise. Concrete types are specified in accordance with CSA A23.1 Table "Alternate methods for specifying concrete", Alternate 1.
- .2 Concrete mix design is the responsibility of the supplier, including the use of admixtures, alone or in combination. The supplier is also responsible for ensuring the plastic and hardened properties of the concrete meet the construction and specified requirements. This includes the long-term performance of the hardened mix.
- .3 Pump mix slumps shall also conform to the above.

- .4 Water/Cement ratios and air contents for exposure class shall be as per the Standard.
- .5 The proposed mixes shall be submitted to the Consultant and Testing Agency for review.
- .6 The mix designs shall note the constituents by the properties required by the structural drawings, and the structural elements for which the mix is to be used.

### **3.3 Testing**

- .1 As per Section 03 00 50 - Testing of Concrete and Reinforcement

### **3.4 Placing of Concrete**

- .1 Conveying and placing of concrete is to conform to the Standard.
- .2 All concrete shall be consolidated by means of vibrators of appropriate size operated by experienced workers.
- .3 The use of vibrators to transport concrete shall not be permitted.
- .4 Cement slurry used to prime concrete pumps shall be discarded and not placed in the project.
- .5 Immediately before placing concrete, clean forms and reinforcement of foreign matter.
- .6 A maximum time limit of 120 min from the time of initial mixing to complete discharge shall be observed. Exemptions to the maximum time limit, if required, shall be agreed upon by the Engineer, Owner, and the concrete supplier prior to placement of the concrete. In some circumstances, set retarders or hydration stabilizers may be used to extend the discharge time.
- .7 During hot weather conditions, as defined by CSA A23.1, do not use concrete mixed more than 1 hour after introduction of mixing water.
- .8 Remove concrete spilled onto forms around hoisting equipment before depositing concrete in these areas.

.9 Pumping Concrete

- .1 Pumping or pneumatic placing of concrete shall only be used if the velocity of discharge is reduced to a point where no separation or scattering of the concrete occurs, and the consistency of the mix has been designed to allow such a system with no adverse effects on the quality of concrete.
- .2 Excess grout or mortar used to lubricate pipelines, or washout water, must not be discharged into the forms.

.10 C-XL Concrete

- .1 All C-XL (extended service life concrete) shall be wet cured at a temperature of at least 10°C for a period of seven consecutive days and for a time necessary to attain 70% of the specified compressive strength, whichever is greater. Wet curing shall commence immediately after placement and finishing of concrete

**3.5 Openings and Inserts**

- .1 The Contractor shall notify all trades sufficiently in advance to ensure that provision is made for openings, inserts, and fasteners. The Contractor shall cooperate with all trades in the forming and setting of all slots, sleeves, bolts, dowels, hangers, inserts, conduits, clips, etc. Any embedded hardware may be subject to review by the Consultant.
- .2 Openings and sleeves shown on the structural drawings must be confirmed with mechanical, electrical, and architectural drawings.
- .3 Openings and sleeves not shown on the structural drawings must be approved by the Consultant.
- .4 Do not pass sleeves, ducts, pipes, or other openings through joists, beams, columns, or wall zones without written approval of the Consultant.
- .5 Do not eliminate, cut, or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications by the Consultant before placing concrete.

**3.6 Construction and Control Joints**

- .1 Construction joints shall conform to the Standard, it will be sufficient to place fresh concrete on a clean rough surface unless directed otherwise by the Consultant or otherwise noted on the structural drawings.

- .2 Unless noted otherwise on the drawings, a joint in the slab-on-grade may be a pour joint, trowelled joint, saw cut, or other pre-approved method. The depth of joints shall be a minimum of 1/4 of the thickness of the slab. Saw cut joints are to be completed within 12 hours of placing. Alternative joint details are to be submitted in writing to the Consultant.
- .3 Construction joints not shown in the drawings or specifications shall be subject to the approval of the Consultant. The Consultant may require keys or extra reinforcing to be provided at the Consultant's discretion with associated costs borne by the Contractor.
- .4 The existing concrete surface at construction joints shall be brought to a saturated surface dry condition immediately prior to placement of concrete.
- .5 Construction joints exposed to view may be subject to non-structural review by Consultant.
- .6 Supply and install pre-molded waterstops in construction joints where indicated on the drawings. Weld joints to make watertight. Install waterstops in accordance with manufacturer's specifications and recommendations. Waterstop procedures require approval of Consultant.
- .7 Obtain approval from RJC for location and details of construction joints not shown.
- .8 The maximum length of a concrete slab pour shall be 40 m (120'-0).
- .9 The maximum length of a concrete foundation wall pour shall be 15 m (50').
- .10 If the construction joint (including joints around temporary openings) will be exposed in its permanent condition, such as in a parking garage, the joint must be caulked as outlined under the Materials section.

### **3.7 Curing and Protection**

- .1 Curing procedures shall be in accordance with the Standard. Alternate methods with Consultants approval, may be used providing they produce concrete that meets the contract documents.
- .2 Cold and hot weather protection shall comply with the Standard or the requirements on the structural drawings, whichever are more rigorous.
- .3 Concrete placed during extreme drying conditions shall satisfy A23.1.

- .4 (Reference Standard CSA A23.1/A23.2) Contractor shall submit a plan for curing to the Owner, for review and approval, together with other tender documents. The curing plan shall be prepared in strict accordance with the Standard, including:
- .1 The method for protecting the concrete from evaporation of surface moisture from the fresh concrete.
  - .2 The 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 The time of initiation and duration of curing.
  - .5 Provisions to address potential problems such as high winds and hot and cold weather.
  - .6 The limitations of access, if any, to the surfaces being cured.
- .5 (Reference Standard CSA A23.1/A23.2) All concrete mixes proportioned for C-XL class of exposure shall have Extended Curing. Concrete mixes that meet the definition of HVSCM-1 and where classes of exposure C-1, A-1, F-1, S-1, and S-2 apply shall have Extended Curing. For other exposure classifications, concrete mixes that meet the definition of HVSCM-1 or 2 shall have Additional Curing.
- $\text{HVSCM-1} = \text{FA}/40 + \text{S}/45 > 1.00$
  - $\text{HVSCM-2} = \text{FA}/30 + \text{S}/35 > 1.00$
- where FA = fly ash (Type F, C11, or CH content of the concrete (% mass of total cementing materials) and S = slag content of the concrete (% mass of total cementing materials)
- Additional Curing = 7 days at  $> 10^{\circ}\text{C}$  for a time necessary to attain 70% of the specified strength. When using silica fume concrete, additional curing procedures shall be used. See Standard.
  - Extended Curing = a wet-curing period of 7 days. The curing types allowed are ponding, continuous sprinkling, absorptive mat, or fabric kept continuously wet.
- .6 Contractor shall obtain the approval of the Owner for proposed means of monitoring concrete curing conditions. Contractor shall be responsible for confirming completion of curing.

- .7 Protect all concrete in accordance with CSA A23.1, the concrete supplier's requirements, and as specified herein to prevent freshly deposited concrete from freezing, being exposed to abnormally high temperatures or temperature differentials, premature drying, and moisture loss for a period of time necessary to develop the specified properties of the concrete.
- .8 Protection of Completed Work
  - .1 At all times during the work, protect exposed concrete, exposed masonry, and other exposed members from staining or becoming coated with concrete leakage due to continuing concreting operations. Members that become coated may be classed as defective by the Consultant.
  - .2 Protect exposed members from staining due to rusting of reinforcement projecting beyond construction joints.
  - .3 Take suitable measures to prevent spalling and cracking damage occurring to the structure due to water freezing in expansion joints, small holes, slots, or depressions, and take suitable measures to prevent damage occurring to foundations and the like due to frost action in the soil or backfill.
  - .4 Application of de-icing salts on completed work is not permitted.
- .9 Wet Curing
  - .1 The following provisions apply to the slabs in the following locations:
    - .1 Ramp
    - .2 Refrigerated Slab
  - .2 Basic Curing Period: The concrete shall be protected from premature drying and extremes of temperatures, and shall be wet cured at a temperature of at least 10°C for a period of three consecutive days. Wet curing shall commence immediately after placement and finishing of the concrete.
  - .3 Additional Curing for Durability: Immediately following the Basic Curing Period, continue to wet cure the concrete (at a minimum temperature of 10°C for an additional four consecutive days or until the concrete reaches 75% of its 28-day compressive strength, whichever is greater.

- .4 Wet curing is to be achieved using one or more of the techniques outlined in CSA A23.1.
- .5 If an absorptive mat or fabric material is used, it is imperative that it be kept continuously wet by means of sprinklers, soaker hoses, or another acceptable means.
- .6 The use of curing compounds will not be permitted in these areas.
- .7 When requested, submit a detailed description of the procedures that will be employed to wet cure.
- .8 As a minimum, the procedures shall indicate:
  - .1 the method for protecting the concrete from evaporation of surface moisture from the fresh concrete;
  - .2 the 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 the time of initiation and duration of curing;
  - .5 provisions to address potential problems such as high winds and hot and cold weather; and
  - .6 the limitations of access, if any, to the surfaces being cured.
- .9 Submit a 300 mm x 300 mm (12" x 12") sample of each type of material (absorptive mat, fabric, plastic film, waterproof paper etc.) that will be used to wet cure the concrete.

### **3.8 Slabs-on-Grade**

- .1 Do not place concrete slabs-on-grade until the specified sub-floor material has been placed, inspected, and approved.
- .2 Do not place concrete on a frozen sub-grade, or on one that contains frozen materials.
- .3 Do not place concrete on a sub-grade that has been frozen and thawed until the sub-grade has been reviewed by the geotechnical engineer and approved. If, in the geotechnical engineer's opinion, the bearing capacity of the sub-grade has been compromised, remove the affected materials and replace with compacted granular fill at no additional cost to the Owner.



- .4 Upon approval of the placement of the sub-floor material and setting of reinforcement, place and consolidate concrete, and finish and cure as specified herein.
- .5 Where slab-on-grade is exposed to de-icing chemicals, provide an approved sealant at the joint between the slab-on-grade and abutting surfaces.
- .6 Construction joints may be provided in slabs-on-grade so that pours on any one day may be kept to reasonable sizes. Locate construction joints to the Consultant's approval.

### **3.9 Making Good**

- .1 Where directed by the Consultant, make good temporary openings left in concrete construction around pipes, ducts, and the like using a mortar of the same proportions as the surrounding work. Reinforce mortar with welded wire fabric where openings exceed 75 mm (3"). Roughen existing surfaces to receive mortar or apply suitable bonding agent such that mortar will be securely bonded to existing concrete.

### **3.10 Grouting Beneath Base Plates**

- .1 Grout beneath plates bearing on concrete with an approved non-shrink flowable grout. Conform with the manufacturer's directions for mixing and placing grout. Completely fill voids below plates. Fill voids left by shims after shims are removed.
- .2 During cold weather, preheat base plates and footings and maintain temperature at minimum 12°C for 6 days after grouting.

### **3.11 Concrete Work at Existing Structure**

- .1 Before proceeding with any work in or adjacent to the existing structure, verify that conditions are as indicated on the drawings. If they are not, advise RJC of discrepancies and do not proceed until RJC has given instructions.
- .2 Prior to proceeding with the work, determine the exact founding elevations of existing footings adjacent to the new work. Report these findings to RJC before proceeding further.
- .3 Install footings adjacent to existing footings in the sequences indicated, and against undisturbed soil as shown, and so that the stability of the existing footings and existing slabs on grade are maintained at all times. Temporarily support existing foundations as required.

- .4 Where openings are shown to be cut into the existing structure, drill at corners and saw-cut remainder such that saw-cuts do not extend into structure to be retained. Overcutting may require major structural strengthening.

### **3.12 Mass Concrete**

- .1 Massive pours may set up temperature rises and gradients that may cause severe cracking and in extreme cases, loss of strength.
- .2 Plan and carry out concreting operations, protect and cure the concrete so as to prevent these conditions from occurring.
- .3 Design mix and employ construction procedures in accordance with CSA A23.1 such that the maximum temperature in the concrete and the maximum temperature difference from interior of mass to outside face do not exceed those specified in CSA A23.1. Use insulation or other approved techniques to achieve this.
- .4 Conduct a mat concrete test pour using the proposed mix design and a representative volume of concrete. Arrange for an inspection and testing company to install and monitor thermocouples in both the test pour and the final pour and report the temperature results achieved.
- .5 In addition to the other requirements of this and other related specification sections, adhere to the following:
  - .1 Maximum size of aggregate: 40 mm (1-1/2").
  - .2 Temperature of the concrete at the time of placing: Between 7°C and 20°C (45°F and 68°F).
- .6 Just prior to placing, bring surfaces upon or against which concrete will be placed above the freezing point.
- .7 Provide appropriate insulation and protection to the concrete surfaces for at least seven consecutive days immediately after concrete placement.
- .8 Do not remove insulation and protection until the temperature between average ambient and 75 mm (3") below the top of concrete is 30°C or less. Use a system of thermocouples placed at or below the surface of the concrete to determine concrete temperature.

- .9 Plan the entire concreting operation in advance taking into account rate of pour; size and number of high frequency vibrators; nature, capacity, and location of housing equipment; possible use of a retarder; ability to receive, place, and discharge at the planned rate; along with other considerations. Submit the plan of operation to the Consultant for review in advance, along with the concrete mix.
- .10 Arrange for an inspection and testing company to install and monitor thermocouples in both the test pour and the final pour and report the temperature results achieved.
- .11 Place concrete in maximum 450 mm (1'-6") lifts and thoroughly vibrate each layer and extend vibration into lower layers.
- .12 Advance each layer at least 6 m (20 ft.) before starting next layer.
- .13 Employ necessary procedures to keep temperature differential within concrete to 20°C or less.

### **3.13 Patching**

- .1 Honeycombing, exposed reinforcement, and other defects shall be repaired and patched by the Contractor at the Contractor's cost to the satisfaction of the Consultant using a procedure preapproved by the Consultant. Exposed patching must also be accepted by the Consultant.
- .2 Immediately after the removal of forms, all bolts, ties, nails, or other metal not specifically required for construction purposes shall be removed or cut back to a depth of 25 mm (1") from the surface of the concrete.

### **3.14 Tolerances**

- .1 Tolerances shall conform to the Standard or the requirements on the structural or architectural contract documents, whichever are more rigorous.
- .2 Variations in building lines that result in extension of the building over lot lines or restriction lines will not be permitted.
- .3 These tolerances are acceptable with regard to structural requirements. Interfacing tolerances may not be compatible with the above. Review and coordinate interfacing tolerances so that the various elements come together properly.

### **3.15 Finishing - Floors**

- .1 Finishing shall conform to CSA A23.1 - Section 7.7 as a minimum. Care shall be taken during finishing to maintain the cambers specified on the structural drawings. See also the architectural drawings and specifications for additional finish requirements.
- .2 Unless noted otherwise, floor finishes shall be Class A "Conventional slab on grade and elevated floors" with and overall F-number  $F_F = 45$  and  $F_L = 35$ .

### **3.16 Openings through Structural Work**

- .1 If, after any part of the structural work has been completed, it is required that additional openings be made through the structure, the Consultant shall be so informed. No opening, including cored sleeves, shall be made through completed work without authorization in writing from the Consultant.
- .2 Where the location of openings is approved, locate the reinforcement by x-ray, GPR, cover meter, or other positive means as required by the Consultant and adjust the location of the opening so that no reinforcement is cut unless specifically approved otherwise in writing by the Consultant.
- .3 In the case of precast concrete slabs, holes shall be cut or drilled only by the precast concrete fabricator.

### **3.17 Rejection of Defective Work**

- .1 In the event that concrete tests do not conform to the requirements of this specification, or when conditions are such to cause doubt about the safety of the structure, testing of the structure will be undertaken at the direction of the Consultant. This may entail further concrete tests, coring, or load testing as per the Standard, or any other test the Consultant deems suitable. Such test shall be made at the expense of the Contractor and to the satisfaction of the Consultant.
- .2 Where, in the opinion of the Consultant, material or workmanship fails to meet the requirements of the specification, such work may be rejected. Work rejected shall be replaced or repaired to the approval of the Consultant and at no additional cost to the Owner.

**END OF SECTION**