

## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

1. Section 01 33 00 - Submittal procedures.

### **1.2 REFERENCES**

1. Association canadienne de normalisation (CSA)/CSA International
  1. CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  2. CSA-O86S1-F05, Supplement No. 1 to CAN/CSA-O86-D09, Engineering Design in Wood.
  3. CSA O121-08(R2013), Douglas Fir Plywood.
  4. CSA O151-09, Canadian Softwood Plywood.
  5. CSA O153-13, Poplar Plywood.
  6. CAN/CSA-O325-07(R2013), Construction Sheathing.
  7. CSA O437 Series-F93(C2011), Standards for OSB and Waferboard.
  8. CSA S269.1-1975(R2003), Falsework for Construction Purposes.
  9. CAN/CSA-S269.3-FM92(C2013), Concrete Formwork, National Standard of Canada.
2. Underwriters' Laboratories of Canada (ULC)
  1. CAN/ULC-S701-11 Norme sur l'isolant thermique en polystyrène, panneaux et revêtements de tuyauterie.

### **1.3 SCOPE OF WORK**

1. Provide labour, equipment and material to build and install the formwork as specified on all plans and required for the complete and correct execution of the work.
  2. Provide and install the blade seals, if applicable.
  3. Make the construction, control and expansion joints as specified in the plans and specifications.
  4. Install all of the anchors, plates, supports, bolts and accessories that must be incorporated into the concrete works or required by other disciplines.
  5. Remove all of the formworks and waste generated in the course of the work.
  6. Make all of the openings in the formworks required by other disciplines.
  7. Caulk all of the construction, control and expansion joints.
  8. Implement and verify all of the levels and dimensions of the structures covered by this section.
  9. Provide and install the temporary shoring and braces, when required.
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10. Fill the cones of the tie-beams.

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

1. N/A.

#### **1.5 DELIVERY, STORAGE AND HANDLING**

1. Waste Management and Disposal :
  1. Place materials defined as hazardous or toxic in designated containers.
  2. Divert wood materials from landfill to a recycling reuse composting facility as approved by Departmental Representative.
  3. Divert plastic materials from landfill to a recycling reuse composting facility as approved by Departmental Representative.
  4. Divert unused form release material from landfill to an official hazardous material collections site as approved by the Departmental Representative.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

1. Formwork materials
  1. For concrete without special architectural features, use wood and wood product formwork materials to CAN/CSA-O86 and CAN/CSA A23.1.
  2. For concrete with special architectural features, use new high-density overlay plywood, compliant with the O121 standard.
  3. Rigid insulation board: to CAN/ULC-S701.
  4. Material for temporary structures: Compliant with the ACNOR S269.1 standard, Table 1. The materials must have a quality index or come with certificates, testing reports or other confirmations of conformity.
2. Form ties :
  1. For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface and fitted with polyethylene cones for apparent surfaces. After the removal of the formwork, no part of the tie-beams must appear less than 16 mm from the surface.
  2. For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.
3. Filling of the tie-beam cones: Quick setting, two-component cement based mortar modified with polymers, cement grey in colour. Compressive strength 20 MPa minimum after 24 hours and 50 MPa after 28 days.
4. Form oil: Chemical in nature, consisting of components that react with the free lime in the concrete to form water-insoluble soaps and that keep concrete from sticking to the forms, such as Grace's Releaser, ChemRex's Cast-Off or Euclid's Formshield Pure or equivalent approved.
5. Falsework materials: to CSA-S269.1.

6. Support for the caulking of construction or control joints: Flexcell, from Sternson or Scelco or Sika equivalent approved by the Departmental Representative.
7. Caulking of unexposed construction or control joints in unexposed conditions: Duoflex, from Sternson or Sikaflex 2C or equivalent from Scelco or equivalent approved by the Departmental Representative.

## **PART 3 - EXECUTION**

### **3.1 FABRICATION AND ERECTION**

1. Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings. The formwork contractor must take into account that tolerance regarding excavation bottoms is 100 mm and that additional formwork is not admissible for this value.
  2. Obtain Departmental Representative's approval for use of earth forms framing openings not indicated on drawings.
  3. Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete and obtain the approval of the Departmental Representative.
  4. Fabricate and erect falsework in accordance with CSA S269.1.
  5. Refer to architectural drawings for concrete members requiring architectural exposed finishes.
  6. Do not place shores and mud sills on frozen ground.
  7. Provide site drainage to prevent washout of soil supporting mud sills and shores.
  8. Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
  9. Align form joints and make watertight.
    1. Keep form joints to minimum.
  10. Unless otherwise indicated, use 30 mm bevel strips for any visible edges and all edges in contact with a waterproof liner or membrane.
  11. Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
  12. Construct forms for architectural concrete, and place ties as indicated.
    1. Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.
  13. Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.
    1. Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
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14. Anticipate an adequate camber in the beam and slab forms to correct form slump. This camber must be added to that which is required on the plans, if applicable.
15. If the formwork and temporary structures must be used again, comply with the CAN3-A23.1 standard, Article 11.
16. Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.
17. If sliding or floating forms are used, submit the details as specified in section 01 33 00 - *Submittal Procedures*, described in Part 1. The forms may or may not be accepted by the Departmental Representative following the evaluation of the working methods and of the proposed mechanical material.

### **3.2 REMOVAL AND RESHORING**

1. Once the concrete is poured, in weather conditions near 15 C, the Contractor may remove the forms after the following periods of time, providing that the curing method for free surfaces complies with the specifications and that they are satisfactory to the Departmental Representative:
  1. 48 h for walls and sides of beams;
  2. 48 h for columns;
  3. 28 days for beam soffits, slabs, decks and other structural members, or 7 days when replaced immediately with adequate shoring to standard specified for falsework;
  4. 12 days for footings and abutments.
2. Remove formwork when concrete has reached 75% of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring. The curing method for the free surfaces must comply with the specifications and prove to be satisfactory to the Departmental Representative.
3. Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.
4. Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

### **3.3 TOLERANCES**

1. N/A.

### **3.4 INSPECTION OF THE FORMWORK PRIOR TO CONCRETING**

1. Immediately prior to the pouring of concrete, inspect the formworks to make sure they are positioned correctly, adequately rigid, leak tight, clean, and that the walls have been adequately primed and free of snow, ice or other foreign substances.
  2. Make temporary openings at the bottom of deep elements, such as columns and walls, to facilitate cleaning and inspection. Regarding elements where space is restricted, the openings must be located where water can be used to flush out debris and then sealed at the same level as the bottom of the wall.
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### **3.5 PREPARATION OF THE FORMWORK PRIOR TO CONCRETING**

1. Use form oil on all of the prepared form walls. Use form oil that will not stain or modify the colour of the exposed concrete surfaces. Use only the required quantity and remove the form oil where it came in contact with the reinforcement structure. If a coating is applied to the concrete surface, make sure it is compatible with the form oil. If necessary, use another product for form removal.
2. Wet all untreated formwork surfaces to avoid shrinkage and wet the surfaces again immediately prior to concreting.

### **3.6 LINES AND LEVELS**

1. Mark all level and reference points.
2. During concreting, verify the lines, levels and alignment of the formworks.

### **3.7 CONSTRUCTION, CONTROL AND EXPANSION JOINTS**

1. N/A.

### **3.8 ELEMENTS TO BE INTEGRATED INTO THE CONCRETE AND CSST CERTIFICATE**

1. N/A.

### **3.9 REINFORCING STEEL ON STAND BY**

1. At some locations, reinforcement steel rods are indicated as standing by. The Contractor must take these details into account when preparing his bid. If required, he will have to perforate, notch or saw the formwork in order to respect the details shown.

**END OF SECTION**

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## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

1. Section 01 33 00 - Submittal Procedures.
2. Section 01 45 00 - Quality Control.
3. Section 01 74 11 - Cleaning.
4. Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### **1.2 REFERENCES**

1. American Concrete Institute (ACI)
  1. SP-66-04, ACI Detailing Manual 2004.
2. ASTM International
  1. ASTM A 82/A 82M-07, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
  2. ASTM A 143/A 143M-07, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
  3. ASTM A 185/A 185M-07, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
  4. ASTM A 775/A 775M-07b, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
3. CSA International
  1. CSA-A23.1-F09/A23.2-F09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  2. CAN/CSA-A23.3-F04 (R2010), Design of Concrete Structures.
  3. CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
  4. CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  5. CAN/CSA-G164-FM92 (C2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
  6. CSA W186-FM1990 (C2007), Welding of Reinforcing Bars in Reinforced Concrete Construction.
4. Institut d'acier d'armature du Canada (RSIC/IAAC)
  1. RSIC-2004, Reinforcing Steel Manual of Standard Practice.

### **1.3 SCOPE OF WORK**

1. Provide all material, equipment and labour required to build and install the steel framework required on all of the plans and/or required for the complete and correct execution of the structure.
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2. Provide and install all rod chairs, anchor bars and spacers in reinforced concrete inverts, walls, slabs and beams required to support the reinforcing steel.
3. Provide and install the cement bricks required to support the reinforcing steel and/or metal mesh in the slab on ground, footings and inverts.

#### **1.4 ACTION AND INFORMATIONAL SUBMITTALS**

1. N/A.

#### **1.5 QUALITY ASSURANCE**

1. Submit in accordance with Section 01 45 00 - *Quality Control* and as described in PART 2 - SOURCE QUALITY CONTROL.
  1. Mill Test Report: upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, minimum 2 weeks prior to beginning reinforcing work.
  2. Upon request submit in writing to Departmental Representative proposed source of reinforcement material to be supplied.

#### **1.6 DELIVERY, STORAGE AND HANDLING**

1. Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
2. Storage and Handling Requirements:
  1. Store materials off ground, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area to avoid rust formation.
  2. Protect the reinforcing steel if it must remain unused for long periods of time.
  3. Remove all important traces of rust from the steel before its installation, subject to the approval of the Engineer.
  4. Replace defective or damaged materials with new.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

1. Substitute different size bars only if permitted in writing by Departmental Representative.
  2. Reinforcing steel: billet steel, grade 400, deformed bars to CSA-G30.18, unless indicated otherwise.
  3. Reinforcing steel devant être soudées à des pièces d'acier incorporées au béton : weldable low alloy steel deformed bars to CSA-G30.18, nuance 400W.
  4. Cold-drawn annealed steel wire ties: to ASTM A 82/A 82M and G30.3.
  5. Deformed steel wire for concrete reinforcement: to ASTM A 82/A 82M and G30.3.
  6. Epoxy Coating of non-prestressed reinforcement: to ASTM A 775/A 775M.
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7. If required, Galvanizing of non-prestressed reinforcement: to CAN/CSA-G164, minimum zinc coating 610 g/m<sup>2</sup>.
  1. Protect galvanized reinforcing steel with chromate treatment to prevent reaction with Portland cement paste.
  2. If chromate treatment is carried out immediately after galvanizing, soak steel in aqueous solution containing minimum 0.2% by weight sodium dichromate or 0.2% chromic acid.
    - a. Temperature of solution equal to or greater than 32 degrees and galvanized steels immersed for minimum 20 seconds.
  3. If galvanized steels are at ambient temperature, add sulphuric acid as bonding agent at concentration of 0.5% to 1%.
    - a. In this case, no restriction applies to temperature of solution.
  4. Chromate solution sold for this purpose may replace solution described above, provided it is of equivalent effectiveness.
    - a. Provide product description as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
8. Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2 and related supplements, with sufficient strength and appropriate for the frame used. The General Contractor must use vinyl covered chairs.
9. Mechanical splices: subject to approval of Departmental Representative.
10. Plain round bars: to CSA-G40.20/G40.21.

## **2.2 FABRICATION**

1. Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
2. Unless otherwise indicated in the plan, hooks must be standard and sizes must comply with the Reinforcing Steel Institute of Canada's manual of standards.
3. Obtain Departmental Representative's written approval for locations of reinforcement splices other than those shown on placing drawings.
4. Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
5. Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.
  1. Ship epoxy coated bars in accordance with ASTM A 775A/A 775M.

## **2.3 SOURCE QUALITY CONTROL**

1. Upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 2 weeks prior to beginning reinforcing work.
  2. Upon request inform Departmental Representative of proposed source of material to be supplied.
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## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

1. If galvanised reinforcing steel is used, galvanizing is to include chromate treatment
  1. Duration of treatment to be 1 hour per 25 mm of bar diameter.
2. If applicable, conduct bending tests to verify galvanized bar fragility in accordance with ASTM A 143/A 143M.

### **3.2 FIELD BENDING**

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

### **3.3 PLACING REINFORCEMENT**

1. Place reinforcing steel as indicated on placing drawings and in accordance with CSA-A23.1/A23.2.
  2. Use plain round bars as slip dowels in concrete.
    1. Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.
    2. When paint is dry, apply thick even film of mineral lubricating grease.
  3. Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
  4. Ensure cover to reinforcement is maintained during concrete pour.
  5. Protect epoxy coated portions of bars with covering during transportation and handling.
  6. Make mechanical splices where indicated on the shop drawings.
  7. Clean the reinforcing elements prior to concreting.
  8. In slabs on ground, footings and inverts, reinforcements and/or meshes will be installed on chairs, supports and/or cement bricks. The technique consisting in lifting the reinforcement and/or mesh with a hook when pouring the concrete is prohibited, as is the use of stones or wood pieces. Regarding structural slabs, the reinforcement of the lower bed must be installed on continuous supports. Steel wire supports for the reinforcement of the higher layers are prohibited. Use plastic supports.
  9. The technique consisting in moving a structural rod under a reinforcement bed in order to use it as an anchoring bar or support bar is prohibited. If bars are to be used for anchoring or support, they must be additional bars.
  10. **Welding the reinforcement bars shown on the plans is prohibited**, unless otherwise specified. If welding is required, weldable steel compliant with the G30.18 nuance 400 W standard is required.
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11. Wall and column bars must be installed using formworks or templates prior to concreting.

### 3.4 FIELD TOUCH-UP

1. Touch up damaged and cut ends of epoxy coated or galvanized reinforcing steel with compatible finish to provide continuous coating.

### 3.5 CLEANING

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

### 3.6 INCORPORATION OF REINFORCEMENT IN CONCRETE (TYPICAL, UNLESS OTHERWISE INDICATED ON THE PLANS)

1. Incorporation in concrete must be measured from the surface of the concrete to the crenulation closest to the reinforcement or up to the surface of smooth bars or wires, as the case may be.
2. The reinforcement includes bar filaments (or ligatures), stirrups and the main steel.
3. Regarding textured architectural surfaces, incorporation in concrete must be measured from the deepest point of the textured surface.
4. The minimum net depths (in mm) of the reinforcement bars in concrete is as follows, unless otherwise indicated :

SURFACE CONDITIONS	EXPOSURE CLASSIFICATION		
	Unexposed <sup>(1)</sup>	Exposed to freeze-thaw cycle	Expose to chlorides <sup>(2)</sup>
Concrete against the ground and in permanent contact with the latter	75	75	75
Columns, walls, beams, curbs and projections	40	40	60
Slabs	25	40	60
Relation between incorporation and the nominal diameter of the bars	1.0	1.5	2.0
Relation between incorporation and the maximum nominal size of the aggregate	1.0	1.5	2.0

#### Notes:

- (1) Unexposed concrete only applies to concrete that will continually be maintained as dry in a conditioned space, i.e. all of the elements will be inside the vapor barrier around the building.
- (2) Subject or not to the freeze-thaw cycle.

**3.7 SUPERVISION**

1. For the entire duration of concreting, the General Contractor will assign a worker to the construction site, who will re-position the reinforcement steel bars and/or metal mesh that may move during the pouring.

**END OF SECTION**

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## **PART 1 - GENERAL**

### **1.1 RELATED REQUIREMENTS**

1. Section 01 33 00 - Submittal Procedures.
2. Section 01 45 00 - Quality Control.
3. Section 01 74 11 - Cleaning.
4. Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

### **1.2 REFERENCES**

1. Abbreviations and Acronyms :
  1. Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement :
    - a. Type GU, GUb and GUL - General use cement.
    - b. Type MS and MSb - Moderate sulphate-resistant cement.
    - c. Type MH, MHb and MHL - Moderate heat of hydration cement.
    - d. Type HE, HEb and HEL - High early-strength cement.
    - e. Type LH, LHb and LHL - Low heat of hydration cement.
    - f. Type HS and HSb - High sulphate-resistant cement.
  2. Fly ash :
    - a. Type F - with CaO content less than 15%.
    - b. Type CI - with CaO content ranging from 15 to 20%.
    - c. Type CH - with CaO greater than 20%.
  3. GGBFS - Ground, granulated blast-furnace slag.
2. Reference Standards :
  1. ASTM International
    - a. ASTM C171-07, Standard Specification for Sheet Materials for Curing Concrete.
    - b. ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
    - c. ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
    - d. ASTM C494/C494M-13, Standard Specification for Chemical Admixtures for Concrete.
    - e. ASTM C1017/C1017M-013, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
    - f. ASTM C882/C882M-13a, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.

- g. ASTM D412-06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
  - h. ASTM D624-00(2007), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
  - i. ASTM D1751-04(2008), Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  - j. ASTM D1752-04a(2008), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
2. Canadian General Standards Board (CGSB)
- a. CAN/CGSB-37.2-M88, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.
  - b. CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
3. CSA International
- a. CSA A23.1/A23.2-F09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - b. CSA A283-06(R2011), Qualification Code for Concrete Testing Laboratories.
  - c. CSA A3000-F08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
  - d. CSA-A5 / A8 / A362-98, Portland Cements / Masonry cements / Cement compounds.

### **1.3 SCOPE OF WORK**

- 1. Provide and cast concrete in place. Provide the equipment and labour required to complete the concreting work indicated on all plans.
- 2. Finish the concrete surfaces.
- 3. Repair the defective concrete surfaces.
- 4. Heat and cure the concrete.

### **1.4 ADMINISTRATIVE REQUIREMENTS**

- 1. N/A.

### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- 1. Provide submittals in accordance with Section 01 33 00 - *Submittal Procedures*.
  - 2. Provide testing results reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.
  - 3. Submit two (2) copies of the most recent technical data sheets for the specified products. These sheets must show the physical properties of the material and include details on the installation method, restrictions, constraints and other manufacturer recommendations.
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4. Provide a document produced by the manufacturer certifying that the latter officially recognizes the contractor in charge of the execution of the work as an authorized contractor.
5. Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.
6. Concrete hauling time: provide for review by Departmental Representative deviations exceeding maximum allowable time specified in section 2.5 of Part 2 for concrete to be delivered to site of Work and discharged after batching.

## **1.6 QUALITY ASSURANCE**

1. Quality Assurance: in accordance with Section 01 45 00 - *Quality Control*.
2. Provide Departmental Representative, minimum 2 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.
  1. Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements.
3. Minimum 2 weeks prior to starting concrete work, provide proposed quality control procedures for review by Departmental Representative on following items :
  1. Falsework erection.
  2. Hot weather concrete.
  3. Cold weather concrete.
  4. Curing.
  5. Finishes.
  6. Formwork removal.
  7. Joints.
4. Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

## **1.7 DELIVERY, STORAGE AND HANDLING**

1. Delivery and Acceptance Requirements :
    1. Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
      - a. Do not modify maximum time limit without receipt of prior written agreement from Departmental Representative laboratory representative and concrete producer as described in CSA A23.1/A23.2.
      - b. Deviations to be submitted for review by Departmental Representative.
    2. Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
  2. Packaging Waste Management: remove for reuse and return by manufacturer of packaging materials in accordance with Section 01 74 21 - *Construction/Demolition Waste Management and Disposal*.
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## **PART 2 - PRODUCTS**

### **2.1 DESIGN CRITERIA**

1. Alternative 1 - Performance : to CSA A23.1/A23.2 and as described in MIXES of PART 2 - PRODUCTS.

### **2.2 PERFORMANCE CRITERIA**

1. Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Departmental Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

### **2.3 MATERIALS**

1. Cement : for general use, to CSA A-A5/A8/A362.
2. Water : to CSA A23.1.
3. Aggregates: to CSA A23.1/A23.2.
4. Admixtures :
  1. Air entraining admixture: to ASTM C260.
  2. Chemical admixture: to ASTM C494. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
5. Concrete adhesive: three-component (3) anticorrosion coating and binding agent, cement and modified water-based epoxy:
  1. Bonding strength/concrete (CAN/CSA A23.2-6B): 2-3 MPa.
  2. Bonding strength/steel (CAN/CSA A23.2-6B): 1-2 MPa.
  3. Bonding strength at 14 days (ASTM C882) fresh on fresh: 20.7 MPa.
  4. Bonding strength at 14 days (ASTM C882) curing time in the open 12 hours: 13.8 MPa.
6. Acceptable materials or products: When materials or products are specified by brand, consult the instructions to the bidders regarding the procedure for the approval of replacement materials or products.

### **2.4 MIXES**

1. Alternative 1 - Performance Method for specifying concrete: to meet Departmental Representative performance criteria to CSA A23.1/A23.2.
    1. Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.
  2. Prepare normal density concrete as specified in standard A23.1 in order to obtain the required mix for all of the types of concrete specified in the plans and specifications and in accordance with the exposure types.
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3. Concrete type: Unless otherwise indicated in the drawings, anticipate the use of the following types of concrete:

1. Building foundations (footings, interior of piles) unless otherwise indicated N-1

Concrete Type	Usual Application and Degree of Exposure Considered <sup>(1)</sup>	Strength at 28 Days (MPa) <sup>(6)</sup>	Chloride Ion Permeability <sup>(5)</sup>	Entrained Air <sup>(7)</sup>	Aggregates Maximum <sup>(2)</sup> (mm)	Maximum Water/Cement Ratio
N-1	General use Unexposed	30 (26 max at 7 days)	---	3 at 5 %	20	(3)
N-2	General use Exposed	35 (30 max at 7 days)	---	5 at 8 %	20	(3)
M-1	Lean concrete <sup>(4)</sup> Unexposed	10	---	4 at 7 %	20	(3)

**Notes :**

(1) Concrete exposure: To freeze-thaw cycles and/or de-icing salts (chlorides). For exposure classes, see A23.1, Table 1.

(2) Aggregates: Provide a certificate compliant with A23.2 confirming that the aggregates are not subject to alkali-aggregate reactions. Anticipate the use of aggregates 10 mm maximum for concreting in thin spaces. Adjust the parameters of the mix, if necessary, to preserve the characteristics of the hardened concrete.

(3) Maximum water/cement ratio: Must be determined based on the dosage required and the specifications.

(4) Lean concrete: If pumpability is desired, enrich the water/cement ratio as required.

(5) Chloride ion permeability: Conduct pre-qualification tests compliant with A23.2.

(6) Strength at 7 days: See Article 2.2.4 for prior tests.

(7) Entrained air: Air content required at the pouring locations in the forms (i.e. at the concrete pump outlet).

4. In order to validate the proposed mix, two weeks at the latest before the beginning of the work, provide the Departmental Representative with a document produced by an independent laboratory recognized by the Departmental Representative, confirming that the mixes proposed by the General Contractor will produce concrete that will meet the requirements of the specifications and of the A23.1 standard. These mixes must have been tested at 7 days in the last six months. The average strength of six (6) samples per mix must fall within the following percentages of strength at 28 days:

1. Cements  $G_u$  et  $G_{u_b} - SF = 75\% \pm 10\%$ .
2. Cements  $G_{u_b} - S/SF$ ,  $G_{u_b} - F/SF$  and ternary =  $70\% \pm 10\%$ .

5. If required and following the tests and control results for the concrete at the site, the mixes must be corrected at the satisfaction of the Departmental Representative and meet the specifications.

6. Upon request, provide a document confirming that the mixing facility and the materials used to manufacture the concrete are compliant with the requirements of the CSA-A23.1 standard.

7. Obtain the approval of the Departmental Representative before using chemicals other than those specified.
8. The use of calcium chloride is prohibited at all times.
9. Base slump for all of the mixes is 80 mm  $\pm$ 30 (except for M-1 concrete: 100 mm  $\pm$ 30). The slump may be modified by the General Contractor based on the required workability of the concrete and its placement. When superplasticizer is added to facilitate placement, the maximum slump is limited to 175 mm.
10. Adjust the mixes if variations occur at the concrete producer level.

## **2.5 CONCRETE PROCUREMENT**

1. The truck number and the characteristics of the concrete mix must appear on the bills of lading accompanying the delivery of premixed concrete.
2. Unless instructed in writing by the Departmental Representative, adding water to the water already in the concrete mix, whether during transportation or after its delivery on site, is prohibited.
3. The concrete must be unloaded less than 2 hours after water and cement come into contact. After that period of time, the concrete will be refused. If the ambient temperature is 27 °C or more, the unloading delay is shortened to 90 minutes.

## **2.6 SURFACE FINISH**

1. Exterior concrete sidewalks and slabs
  1. All exterior concrete slabs and pavements will be finished with exposed aggregate.
  2. The Little Farm sector is a sector of heritage interest and particular attention should be paid when making concrete slabs with exposed aggregate.
  3. Aggregate should be rounded granite types (river stone). Prior to the completion of the slabs and pavements, submit a minimum of three (3) samples of different aggregates available for selection by the Departmental Representative. The color of the aggregates must marry front of the stone before the building of the Little Farm and the plastered coating the back cover.
  4. Prior to the establishment of the slabs and sidewalks, developer sample plates 2 'x 2' will be made to show different degrees of exposure aggregates and for validation and acceptance by the Ministry Representative. The aggregates need to be well distributed within the concrete, so as to ensure a homogeneous and uniform finish during application of the retarder.
  5. The finishing of concrete slabs must be performed by a qualified and experienced installer. When submitting its bid, the Contractor shall submit a form certifying the experience of its concrete finisher.
  6. Before the establishment of concrete, ensure that all other construction stakeholders have completed or suspended their work in the casting area. Verify that no contaminant was left too close to the casting zone. The site superintendent and others are responsible for cleaning the elements that could contribute to contaminate the concrete and the surface finish by the elements of the flight (eg. Sawdust, plastic wrap, etc.). Set aside to foot traffic or vehicles to prevent damage of the fresh surface or insufficiently resistant. Use appropriate barricades and signs.
  7. Weather condition: Check 24 hours in advance, the weather conditions before setting up the concrete. In the case of rain, snow, extreme temperatures imminent, reporter concreting at a later day.

8. Ensure the establishment in accordance with CSA A23.1.
  9. Confirm external laboratory, if applicable, 24 hours in advance.
  10. Confirm Order of the concrete from the producer at least 24 hours in advance, ensuring the compliance of the date, time, mixing, quantities, intervals between delivery of concrete strength The aggregate size, air driven rate, the type of establishment and color.
  11. Confirm the concrete producer will be for the finished concrete with exposed aggregate so that the mixture used is adequate for this type of finish.
  12. Confirm exposure intended for aggregates and coloring concrete.
  13. Confirm whether there will be adding granular surface and caliber.
  14. After finishing the surface with a trowel, spray the surface with a retarder consistent with the desired degree of exposure. According to the manufacturer's recommendations, clean the surface with a water jet pressure.
2. Slabs on ground and structural slabs (unless otherwise indicated):
    1. Concrete without entrained air: Monolithic finish smoothed with a steel trowel.
    2. Concrete with entrained air: Monolithic finish with a magnesium trowel.
  3. When a wet dash is required on the concrete's surface, coordinate the desired finish with architectural drawings and the wet dash supplier.
  4. When a leak tight membrane is required on the concrete's surface, anticipate an appropriate finish taking adherence into consideration (coordinate with architectural drawings and the membrane supplier).
  5. Based on the options provided by the concrete supplier, cement could be added to the concrete mix. Specific finishing methods will have to be anticipated to take the added cement into consideration.
  6. Wet curing: See Article 3.5.

## **2.7 FINISHING PRODUCTS FOR CONCRETE SLABS**

1. N/A.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

1. Obtain Departmental Representative's written approval before placing concrete.
  1. Provide 24 hours minimum notice prior to placing of concrete and specify the area of work involved and the estimated time of concrete placement.
2. Place concrete reinforcing in accordance with Section 03 20 00 - *Concrete Reinforcing*.
3. During concreting operations :
  1. Development of cold joints not allowed.
  2. Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.

4. Ensure reinforcement and inserts are not disturbed during concrete placement.
5. Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
6. Protect previous Work from staining.
7. Clean and remove stains prior to application for concrete finishes.
8. Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
9. Do not place load upon new concrete until authorized by Departmental Representative or in accordance with Section 03 10 00 - *Concrete Forming and Accessories*
10. Transport the concrete from the truck to its destination using means that will keep the concrete components from separating or from significantly altering its consistency.
11. The concrete dropping height must never exceed 1.5 m. The use of sliders and chutes placed to avoid concrete segregation must be used.
12. Concrete is compacted using vibrators plunged into its mass. Vibrators must be inserted fairly close together to obtain complete compactness. Excessive vibration that could cause the separation of the concrete's components must be avoided. Do not force the concrete into place horizontally with the vibrators.
13. An adequate number of vibrators must be kept on site. Emergency vibrators must be available at all times, in case the regular vibrators fail.
14. Prior to concrete placing, formworks must be cleaned and the water drained from them.
15. Concrete must not be placed in water without special permission and then, only strictly as specified and instructed by the Departmental Representative
16. Concrete curing and protection: As specified in the A23.1 standard and these specifications. The latter will prevail on the standard.
17. Prior to placing fresh concrete against hardened concrete, apply a concrete adhesive to the latter.

### **3.2 INSTALLATION/APPLICATION**

1. Do cast-in-place concrete work to CSA A23.1/A23.2.
  2. Sleeves and inserts :
    1. Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through joists, beams, column capitals or columns, except where indicated or approved by Departmental Representative.
    2. Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
    3. Sleeves and openings greater than 100 x 100 mm not indicated, must be reviewed by Departmental Representative.
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4. Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Departmental Representative.
  5. Confirm locations and sizes of sleeves and openings shown on drawings.
  6. Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
3. Anchor bolts :
    1. Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.
  4. Grout under base plates and machinery using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.

### **3.3 SURFACE TOLERANCE**

1. Concrete tolerance to CSA A23.1.

### **3.4 FIELD QUALITY CONTROL**

1. An independent laboratory retained and paid for by the Departmental Representative will take samples and conduct tests at regular intervals in order to determine if the concrete in place meets the specified quality requirements.
  2. Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Departmental Representative for review to CSA A23.1/A23.2.
    1. Ensure that the testing laboratory is certified according to standard CSA A283.
  3. The General Contractor must cooperate fully with this testing by granting access to the site and equipment, by supplying the labour and material necessary for the preparation of the tubes, and by storing the samples to avoid issues or losses. The General Contractor will provide a closed space available exclusively for the storage of the samples.
  4. Three (3) tubes will be filled with concrete from the day's placement. If the day's placement exceeds 100 m<sup>3</sup>, three (3) additional tubes per 50 m<sup>3</sup> will be filled with concrete.
  5. The samples and tests must be processed as close as possible from the point of placement in the forms (e.g. at the outlet of the concrete pump, conveyor or bucket) in order to obtain accurate concrete properties.
  6. The tubes will be stored and cured as laboratory specimens. One will be broken after 7 days and the other two after 28 days. Occasionally, the laboratory will fill a fourth tube, which will serve as a control specimen on site and will be broken at its request.
  7. All of the testing methods (destructive or not) and storage and curing facilities must meet the requirements of the CSA-A23.1/A23.2 standard.
  8. If the concrete is mixed at the plant, the air content and slump will be tested from each truck mixer. If the concrete is mixed at the construction site, control will take place every four (4) cubic meter of concrete or more frequently if required by the Departmental Representative.
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9. For testing purposes, submit small and large aggregates to the Departmental Representative, as well as the mix formula, as specified in standard A23.2.

### **3.5 CURING**

#### 1. General

1. Curing must begin immediately after placing and finishing and the temperature and humidity during the curing period must be suitable to ensure that the concrete will achieve proper strength, durability and other properties.
2. All of the concrete surfaces must be cured (e.g. sides and top of walls).
3. The material required to ensure the protection of the concrete and curing must be made available and be ready to be used prior to the beginning of concrete placement.

#### 2. Curing types and duration

1. Concrete must cure for a minimum duration of 7 consecutive days following placement. During that period, the temperature of the concrete must be higher than 10 °C. The duration of curing must be extended until the concrete achieves a degree of strength higher than 70 % of the specified strength.

#### 3. Curing methods

1. Concrete curing is achieved through one or several of the following methods:
  - a. Ponding or continuous watering;
  - b. Water retaining material (canvas or other absorptive material kept wet (Ultracure curing blanket or equivalent));
  - c. Forms in contact with the concrete's surface
  - d. Other water retaining materials approved by the Departmental Representative.

#### 4. Curing materials

1. Materials used to cure concrete must meet the requirements of one of the following standards:
    - a. ASTM C171 Sheet Materials for Curing Concrete.
    - b. ASTM C309 Liquid Membrane – Forming Compounds for Curing Concrete.
  2. The water used for curing must not have damaging effects on concrete.
  3. Notes on curing products:
    - a. Most liquid curing products are not suitable for concrete surfaces that will be bonded with a subsequent layer of concrete or with another surface covering. However, they are suitable if the products are to be removed completely after curing through sandblasting or a known solvent, or if tests clearly show that traces of the product will not reduce bond below specified values.
    - b. The curing products must be applied to form a film sufficiently thick and continuous on the concrete's surface. The mix and application method must comply with the manufacturer's recommendations. This film must be protected to ensure it remains intact for the entire curing period.
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5. Reduction of the curing period
  1. Reducing the curing period through means to obtain the specified concrete strength over a shorter period of time must be authorized by the Departmental Representative.
6. Curing during extreme temperatures
  1. Curing in hot weather
    - a. When the ambient temperature reaches 27°C or higher, curing during the first three (3) days must be achieved through uninterrupted watering or the use of a water retaining material maintained constantly wet, in order to use cooling as a result of evaporation.
  2. Curing in cold weather
    - a. During freezing weather, curing with water must cease 12 hours before the end of the protection period.

### **3.6 CONCRETE PROTECTION**

1. General
  1. Freshly placed and finished concrete must be adequately protected against unfavorable conditions, such as high winds, precipitation, frost, abnormally high temperatures, temperature variations, premature drying and loss of moisture during the period of time required for the concrete to achieve the desired characteristics. In addition, work or other disturbances near the concrete that may affect new concrete negatively, such as soil compaction, pile driving, vibrations, etc., must be taken into consideration when selecting the protection measures.
  2. The General Contractor is responsible for the determination of the various criteria required to establish adequate protection methods based on site conditions. The data will be submitted to the Department Representative for verification and approval. In addition the measuring instruments will have to be made available, upon request from the Department Representative, for periodic validation.
2. Protection against evaporation
  1. If the evaporation rate of superficial moisture is higher than 0.50 kg/m<sup>2</sup>, additional action must be taken to prevent the quick drying of the concrete's surface. The General Contractor must implement at least two of the most appropriate measures listed below:
    - a. Water the support prior to concrete placement;
    - b. Build sun screens above the concrete during finishing;
    - c. Lower the temperature of the concrete to bring the evaporation rate under 0.50 kg/m<sup>2</sup>hr, while respecting the temperature restrictions applicable to the concrete at placement time;
    - d. Cover the concrete surface with a white polyethylene sheet in between the various finishing operations;
    - e. Spray water (fogging) on the concrete immediately after placement and before the finishing, taking care to avoid water accumulation that would alter the quality of the cement paste;
    - f. Place and finish the concrete at night.

#### Note

The General Contractor must estimate the evaporation rate using Figure D1 in Appendix D of the A23.1 standard, based on relative humidity measurements, the temperature of the concrete and of

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the ambient air and on wind speed, to be submitted to the Departmental Representative for verification.

### 3.7 CONCRETING IN HOT WEATHER

1. Then ambient temperature is 27°C or higher or when it is likely that temperature will reach 27°C during concrete placement (based on the weather forecasts for the area), the General Contractor must take special care to protect the concrete from the effects of hot and dry weather.
2. Under the intense dry conditions defined in Item 3.4.2 (protection against evaporation), the forms, framework, fresh concrete and concreting materials must be protected against direct sunlight or cooled through fogging.
3. The temperature of the concrete during placement must be as low as possible and must not in any way exceed the temperatures listed in the table entitled "Temperature Range for Concrete Placement". When the temperature of the concrete remains higher than 25°C during placement, the General Contractor must consider using an additive to delay setting, at his own expense.

### 3.8 CONCRETING IN COLD WEATHER

1. General
  1. If temperature is 5°C or lower, or if there is a possibility that it will drop under 5°C in the 24 hours following concrete placement (based on the weather forecasts in the area), all of the material required to protect the concrete and curing must be available on site and ready to use prior to concrete placement.
  2. In addition, the concrete must be adequately protected during the entire curing period. During curing, the temperature of the concrete must be continually maintained above 10°C and the maximum temperature variation allowed between the concrete surface and the ambient temperature must not be exceeded.
  3. Protection must be ensured through heated shelters, blankets, insulation or a combination of all of the above.
2. Temperature range of concrete at placement time
  1. At placement time, the temperature of the concrete mix must comply with the following table:

**TEMPERATURE RANGE FOR CONCRETE PLACEMENT**

ELEMENT THICKNESS	TEMPERATURE (°C)	
	Minimum	Maximum
Less than 0.3 m	10	35
Between 0.3 m to less than 1 m	10	30
Between 1 m and 2 m	5	25
In excess of 2 m	5	20

3. Preparations for concrete placement in cold weather
  1. Prior to the placement of the concrete on the entire surface, snow and ice must be removed. Calcium chloride must not be used as a de-icing agent in the forms. Concrete must not be placed on a surface where the temperature is lower than 5°C or on a surface that could make the

temperature of the concrete drop below the minimum range allowed in the table entitled "Temperature Range for Concrete Placement".

4. Protection methods

1. Heated shelters

- a. The shelters must be built in such a way as to resist driving wind and snow and be reasonably air tight. There must be sufficient space between the concrete and the shelter to allow the circulation of heated air. The shelter must be heated with live steam, forced heated air or using fixed heating devices or others. At concrete placement time and during the curing period, the concrete surfaces must be protected against direct exposure to combustion gas or drying caused by heating devices, using forms or an impervious membrane.
- b. Avoid combustion gases inside the heated shelters by using indirect-fired heaters as this could cause severe health problems and the concrete surface could be damaged by carbonation and others.

2. Protection blankets and insulation

- a. The type of protection blanket and the quantity of insulation required to ensure proper curing in cold weather must be determined by the General Contractor based on the ACI306R standard ("Guide to cold weather concreting"), and on the ambient temperature and wind speed (chill factor), the size and shape of the concrete structure and on the bond strength of the concrete. Submit the calculations to the Departmental Representative for verification.

3. Minimum protection during curing

- a. When the exterior temperature is 5°C or lower, appropriate blankets and sufficient insulation must be properly placed on the concrete elements.

5. Maximum temperature variation allowed

- 1. During the protection and curing period, the minimum variations between the temperature of the concrete surface and the ambient temperature must be respected in order to reduce cracking.
- 2. In addition, to avoid cracking at the end of the curing period due to abrupt changes in temperature, some protection must be maintained until the temperature variation between the concrete and the ambient air is equal or lower than the variations indicated in the following table.

**MAXIMUM TEMPERATURE VARIATION ALLOWED BETWEEN THE CONCRETE SURFACE AND AMBIENT AIR (WIND 25 KM/H AT MOST)**

Concrete Thickness (m)	Maximum Temperature Variation Allowed (°C) Length/Height Ratio of the Structure *				
	0**	3	5	7	20 or more
< 0.3	29	22	19	17	12
0.6	22	18	16	15	12
0.9	18	16	15	14	12
1.2	17	15	14	13	12
> 1.5	16	14	13	13	12

\* "Length" is the greatest restricted size and "Height" is the unrestricted size.

\*\* Very high and thin elements, such as poles.

### **3.9 TEMPERATURE RECORDS**

1. It is the responsibility of the General Contractor to determine and record the ambient temperature and that of the concrete during the protection and curing period. The records must include the date, time and location of each temperature measurement. In cold weather, the temperature of the shelters and concrete surfaces must be monitored, among other activities. In hot weather, the ambient temperatures and those of the concrete surface must be recorded, as well as wind speeds and relative humidity. The temperatures must be recorded on the form attached to this section. Upon request, the temperature records must be sent to the Departmental Representative for verification.

### **3.10 NON-CONFORM CONCRETE**

1. The Departmental Representative may require the demolition, replacement or repairs with regard to any concrete deemed non-conform to the specifications.
2. If the strength of placed concrete measured through sampling proves to be inadequate versus the specifications, the Departmental Representative may require financial compensation based on the provisions of the CCDG. The control laboratory will be responsible for the calculation of the penalty.

### **3.11 OPENINGS IN CONCRETE**

1. N/A.

### **3.12 CONSTRUCTION JOINTS**

1. N/A.

### **3.13 SEALANT AND HARDENER**

1. N/A.

### **3.14 SAW KERFS IN SLABS**

1. N/A.

### **3.15 CLEANING**

1. Clean in accordance with Section 01 74 11 - *Cleaning*.
  2. Waste Management: separate waste materials for reuse/recycling in accordance with Section 01 74 21 - *Construction/Demolition Waste Management and Disposal*.
    1. Provide appropriate area on job site where concrete trucks and be safely washed.
    2. Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by Departmental Representative.
    3. Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard
    4. Prevent admixtures and additive materials from entering drinking water supplies or streams.
    5. Using appropriate safety precautions, collect liquid or solidify liquid with inert, non-combustible material and remove for disposal.
-

6. Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

### **3.16 ANNEXE**

1. Records
  1. Temperature records

**END OF SECTION**

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Project : \_\_\_\_\_  
BPR project number : \_\_\_\_\_  
Reading by : \_\_\_\_\_



temperature records

Checked item, date and time	During the concrete pouring					During the concrete curing									
	A.T. (°C)	R.H. (%)	C.T. (°C)	W. Speed (km/h)	evap. rate	A.T. (°C)			C.T. (°C)			R.H. (%)			
						Time	7h00	12h00	16h00	7h00	12h00	16h00	7h00	12h00	16h00
Day 1						Day 1									
						Day 2									
						Day 3									
						Day 4									
						Day 5									
						Day 6									
						Day 7									
						Time	7h00	12h00	16h00	7h00	12h00	16h00	7h00	12h00	16h00
Day 1						Day 1									
						Day 2									
						Day 3									
						Day 4									
						Day 5									
						Day 6									
						Day 7									
						Time	7h00	12h00	16h00	7h00	12h00	16h00	7h00	12h00	16h00
Day 1						Day 1									
						Day 2									
						Day 3									
						Day 4									
						Day 5									
						Day 6									
						Day 7									
						Time	7h00	12h00	16h00	7h00	12h00	16h00	7h00	12h00	16h00

\* the verificated item must be clearly described and located

R.H. : Relative humidity  
C.T. : Concrete temperature  
W. Speed : Wind speed  
Evap. rate : Evaporation rate  
A.T. : Ambient temperature