

## **Part 1            GENERAL**

### **1.1            REFERENCES**

- .1    Abbreviations and Acronyms:
  - .1    Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement.
    - .1    Type GU, GUb and GUL - General use cement.
    - .2    Type MS and MSb - Moderate sulphate-resistant cement.
    - .3    Type MH, MHb and MHL - Moderate heat of hydration cement.
    - .4    Type HE, HEb and HEL - High early-strength cement.
    - .5    Type LH, LHb and LHL - Low heat of hydration cement.
    - .6    Type HS and HSb - High sulphate-resistant cement.
  - .2    Fly ash:
    - .1    Type F - with CaO content less than 15%.
    - .2    Type CI - with CaO content ranging from 15 to 20%.
    - .3    Type CH - with CaO greater than 20%.
  - .3    GGBFS - Ground, granulated blast-furnace slag.
- .2    Reference Standards:
  - .1    ASTM International
    - .1    ASTM C 260/C 260M, Standard Specification for Air-Entraining Admixtures for Concrete.
    - .2    ASTM C 309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
    - .3    ASTM C 494/C 494M, Standard Specification for Chemical Admixtures for Concrete.
    - .4    ASTM C 1017/C 1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
    - .5    ASTM D 412-06ae2, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
    - .6    ASTM D 624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
    - .7    ASTM D 1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
    - .8    ASTM D 1752, 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)
    - .1    CAN/CGSB-37.2, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.

- .2 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .3 CSA International
  - .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA A283, Qualification Code for Concrete Testing Laboratories.
  - .3 CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

## 1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: in accordance with Section 01 14 10 – Scheduling and Management of Work, convene pre-installation meeting one week prior to beginning concrete works.
  - .1 Ensure key personnel, site supervisor, Departmental Representative speciality contractor - finishing, forming concrete producer testing laboratories attend.
  - .1 Verify project requirements.

## 1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 At least 4 weeks prior to beginning Work, provide Departmental Representative with samples of materials proposed for use as follows:
  - .1 5 L of curing compound.
  - .2 1 m length of each type of joint filler.
  - .3 1 m length of each type of waterstops.
  - .4 3 kg of each type of supplementary cementing material.
  - .5 10 kg of each type of blended hydraulic cement.
  - .6 5 kg of each admixture.
  - .7 1 kg of each fine and coarse aggregate.
- .3 Provide testing, inspection results and reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.
- .4 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.
- .5 Concrete hauling time: provide for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.
- .6 Provide two copies of WHMIS MSDS in accordance with Section 01 35 30 - Health and Safety Requirements 01 35 43 - Environmental Procedures.

#### **1.4 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Provide Departmental Representative, minimum 4 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 4 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.
- .5 Sustainability Standards Certification:
  - .1 Construction Waste Management: provide copy of plan.

#### **1.5 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.
    - .1 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.
    - .2 Deviations to be submitted for review by Departmental Representative.
  - .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
- .2 Packaging Waste Management: remove for reuse by manufacturer of pallets, crates, padding, and 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 Alternative 2 - Prescription: 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 Consultant and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

**2.3 MATERIALS**

- .1 Portland Cement: to CSA A3001, Type GU HS.
  - .1 Reduction in cement from Base Mix to Actual Supplementary Cementing Materials (SCMs) Mix, as percentage.
- .2 Blended hydraulic cement: Type GUb HSb to CSA A3001.
- .3 Portland-limestone cement: Type GUL to CSA A23.1.
- .4 Supplementary cementing materials: with minimum 20% Type F CI CH fly ash replacement N GGBFS, by mass of total cementitious materials to CSA A3001.
- .5 Water: to CSA A23.1.
- .6 Aggregates: to CSA A23.1/A23.2.
- .7 Admixtures:
  - .1 Air entraining admixture: to ASTM C 260.
  - .2 Chemical admixture: to ASTM C 494. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
  - .3 Corrosion-inhibiting admixture: to ASTM C494.
  - .4 Lithium-based admixture: to ASTM C494.
  - .5 Shrinkage-reducing admixture (SRA): to ASTM C494.
  - .6 Viscosity-modifying agent (VMA): to ASTM C494.
- .8 Shrinkage compensating grout: premixed compound consisting of metallic/non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.
  - .1 Compressive strength: 25 MPa at 28 days.
- .9 Curing compound: to CSA A23.1/A23.2 white and ASTM C 309, Type 1-chlorinated rubber Type 1-D with fugitive dye.

- .10 Mechanical waterstops: ribbed labyrinth extruded PVC Arctic Grade of sizes indicated with shop welded prewelded corner and intersecting pieces with legs not less than mm long:
  - .1 Tensile strength: to ASTM D 412, method A, Die "C", minimum MPa.
  - .2 Elongation: to ASTM D 412, method A, Die "C", minimum 275 250%.
  - .3 Tear resistance: to ASTM D 624, method A, Die "B", minimum 30 kN/m.
- .11 Premoulded joint fillers:
  - .1 Bituminous impregnated fiber board: to ASTM D 1751.
  - .2 Sponge rubber: to ASTM D 1752, Type I, flexible firm grade.
  - .3 Self-expanding Standard cork: to ASTM D 1752, Type II III.
- .12 Weep hole tubes: galvanized steel plastic.
- .13 Dampproof membrane:
  - .1 Kraft/polyethylene membrane:
    - .1 Plain: .05 .10 .75 mm thick polyethylene film bonded to asphalt treated creped kraft.
    - .2 Reinforced: two .05 .10 .75 mm thick polyethylene films bonded each side of asphalt treated creped kraft paper, reinforced with 13 x 13 mm fibreglass scrim.
    - .3 Membrane adhesive: as recommended by membrane manufacturer.
  - .2 Bitumen impregnated protection board:.
  - .3 Cavity drainage board:.
- .14 Polyethylene film: mm thickness to CAN/CGSB-51.34.

## 2.4 MIXES

- .1 Alternative 1 - Performance Method for specifying concrete: to meet Consultant 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 Provide concrete mix to meet following plastic state requirements:
    - .1 Uniformity:.
    - .2 Workability: free of surface blemishes loss of mortar colour variations segregation.
    - .3 Finishability: amount of bleeding.
    - .4 Set time: hours maximum.
  - .3 Provide concrete mix to meet following hard state requirements:
    - .1 Durability and class of exposure: C-XL C-1 A-1 C-2 A-2 C-3 A-3 C-4 A-4 F-1 F-2 N.
    - .2 Compressive strength at 28 56 90 120 age: 35 5070 Mpa minimum.
    - .3 Intended application:.
    - .4 Aggregate size mm maximum.

- .5 Volume stability: acceptable volume change range due to shrinkage, creep and freeze thaw cycle.
- .6 Pre-Qualification:.
- .7 Other special requirements:.
- .4 Provide quality management plan to ensure verification of concrete quality to specified performance.
- .5 Concrete supplier's certification: both batch plant and materials meet CSA A23.1 requirements.

### **Part 3 EXECUTION**

#### **3.1 PREPARATION**

- .1 Obtain Consultant's written approval before placing concrete.
  - .1 Provide 24 hours minimum notice prior to placing of concrete.
- .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 Pumping of concrete will not be permitted is permitted only after approval of equipment and mix.
- .5 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .6 Prior to placing of concrete obtain Consultant's approval of proposed method for protection of concrete during placing and curing in adverse weather .
- .7 Protect previous Work from staining.
- .8 Clean and remove stains prior to application for concrete finishes.
- .9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .10 In locations where new concrete is dowelled to existing work, drill holes in existing concrete.
  - .1 Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.
- .11 Do not place load upon new concrete until authorized by Departmental Representative.

#### **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 Consultant.
  - .2 Where approved by Consultant, 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 Consultant.
  - .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Consultant before placing of concrete.
  - .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.
  - .2 Grout anchor bolts in preformed holes or holes drilled after concrete has set only after receipt of written approval from Consultant.
    - .1 Formed holes: 100 mm minimum diameter.
    - .2 Drilled holes: 25 mm minimum diameter larger than bolts used to manufacturers' recommendations. e of erection.
- .4 Finishing and curing:
  - .1 Finish concrete to CSA A23.1/A23.2.
  - .2 Use procedures as reviewed by Consultant or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.
  - .3 Provide screed float swirl-trowelled finish unless otherwise indicated.
  - .4 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.
- .5 Waterstops:
  - .1 Install waterstops to provide continuous water seal.
  - .2 Do not distort or pierce waterstop in way as to hamper performance.
  - .3 Do not displace reinforcement when installing waterstops.
  - .4 Use equipment to manufacturer's requirements to field splice waterstops.
  - .5 Tie waterstops rigidly in place.
  - .6 Use only straight heat sealed butt joints in field.
  - .7 Use factory welded corners and intersections unless otherwise approved by Consultant.
- .6 Joint fillers:
  - .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Consultant.

- .2 When more than one piece is required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
- .3 Locate and form isolation expansion joints as indicated.
- .4 Install joint filler.
- .5 Use 12 mm thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise.

### **3.3 SURFACE TOLERANCE**

- .1 Concrete tolerance to CSA A23.1 Straightedge Method FF = 25: FL = 20 Waiviness Index Method to tolerance schedule as indicated.

### **3.4 FIELD QUALITY CONTROL**

- .1 Site tests: conduct tests as follows in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
  - .1 Concrete pours.
  - .2 Slump.
  - .3 Air content.
  - .4 Compressive strength at 7 and 28 days.
  - .5 Air and concrete temperature.
- .2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Consultant for review to CSA A23.1/A23.2.
  - .1 Ensure testing laboratory is certified to CSA A283.
- .3 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and Departmental Representative.
- .4 Consultant will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .5 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.
- .6 Inspection or testing by Consultant will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

### **3.5 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management.
  - .1 Divert unused concrete materials from landfill to local quarry facility after receipt of written approval from Departmental Representative.
  - .2 Provide appropriate area on job site where concrete trucks and be safely washed.



- .3 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by Departmental Representative.
- .4 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.
- .5 Prevent admixtures and additive materials from entering drinking water supplies or streams.
- .6 Using appropriate safety precautions, collect liquid or solidify liquid with inert, noncombustible material and remove for disposal.
- .7 Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

**END OF SECTION**