

**Part 1 General**

**1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International)
  - .1 CSA-A23.1/A23.2-2004, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA A283-00(R2003), Qualification Code for Concrete Testing Laboratories.
  - .3 CAN/CSA-A3000-03, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
    - .1 CSA-A3001-03, Cementitious Materials for Use in Concrete.

**1.2 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Provide testing results for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.
- .3 Concrete hauling time: provide for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete from batch time to time of discharge.

**1.3 QUALITY ASSURANCE**

- .1 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.
- .2 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by Departmental Representative on following items:
  - .1 Hot weather concrete.
  - .2 Cold weather concrete.
  - .3 Curing.
  - .4 Finishes.
  - .5 Formwork removal.
  - .6 Joints.
- .3 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.

**1.4 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 and concrete producer as described in CSA A23.1/A23.2.
- .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

## **Part 2 Products**

### **2.1 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.

### **2.2 MATERIALS**

- .1 Cement: to CSA A3001, Type HS.
- .2 Supplementary cementing materials: to CAN/CSA-A23.5, Type for Type C Flyash.
- .3 Water: to CSA A23.1/A23.2.
- .4 Aggregates: Fine and coarse aggregates: to CAN/CSA-A23.1, stockpiled separately.
- .5 Admixtures:
  - .1 Air entraining admixture: to CAN3-A266.1.
  - .2 Chemical admixture: to CAN3-A266.2. Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .6 Non-shrink compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.
  - .1 Compressive strength: 30 MPa at 28 days.
  - .2 Maintain surfaces and ambient air temperatures of minimum 10°C for a minimum period of 24 hours prior to, during and 72 hours after application.
  - .3 If grouting in exposed conditions, provide and maintain temporary weatherproof enclosures during preparation, grouting and curing.
  - .4 Mix grout dry and add water to bring mix up to desired consistency in a mechanical rotary mixer.
  - .5 Pre-mix grout in accordance with manufacturer's recommendations.
  - .6 For deep pockets and thickness greater than 25 mm, add 10 mm maximum coarse aggregate to the mix in the proportion of 50% weight of grout material used.
  - .7 Roughen and clean contact surfaces and thoroughly wet substrate concrete with water prior to grouting. No standing water to be present.
  - .8 Prepare grout no earlier than 10 minutes before use and place in final position within 30 minutes of mixing.

- .9 Grout using procedures in accordance with manufacturer's recommendations, which result in 100% contact over grouted area.
- .10 Finish and tool grout surfaces exposed to view in a workmanlike manner, consistent with finish of adjacent materials.
- .11 Prevent loss of moisture from concrete by maintaining surfaces continuously moist for at least seven days at a minimum temperature of 10°C after concreting.
- .7 Curing compound: to CSA A23.1/A23.2.white.

## 2.3 MIXES

- .1 Proportion normal density concrete in accordance with CAN/CSA-A23.1, Table 11. Alternative 1 to give following properties for all concrete.
- .2 Volume stability to be considered in mix proportions to prevent creep and shrinkage in accordance with Cl.4.1.1.9 and Cl.4.3.6 of CSA A23.1.
- .3 Do not change concrete mix without prior approval of Departmental Representative. Should change in materials source be proposed, the new mix design is to be approved by Departmental Representative.
- .4 Mix design to minimize shrinkage and to maximize water-tightness.
- .5 Use of super-plasticizer is allowed. Add to mix at jobsite immediately prior to placing concrete. Slump of concrete prior to super-plasticizer addition to be 20-50 mm. Slump of concrete after super-plasticizer addition to be maintained in the range of 120+30 mm during the discharge period.
- .6 One retempering of the mix is permitted with super-plasticizer during the discharge period. Retempering of the mix with water after the addition of super-plasticizer is not permitted.

Designation / Application	All
CSA Exposure Class	S-2
Minimum Specified Strength (MPa)	30
Age (days) for Specified Strength	28
Maximum W/CM Ratio	0.45
Maximum Aggregate Size	20
Exposure to Sulphate Attack	Y
Alkali Aggregate Reactivity Addressed (Y/N)	Y
Air Content	5-8%
Fly Ash Class	F or CI

## Part 3 Execution

### 3.1 PREPARATION

- .1 Obtain Departmental Representative's written approval before placing concrete.
  - .1 Provide 48 hours minimum notice prior to placing of concrete.
- .2 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing including provisions for adverse weather.

### 3.2 INSTALLATION/APPLICATION

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
- .2 During concreting operations:
  - .1 Development of cold joints are not allowed.
  - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
- .3 Pumping of concrete is permitted only after approval of equipment and mix.
- .4 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .5 Protect previous Work from staining.
- .6 Clean and remove stains prior to application for concrete finishes.
- .7 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .8 Do not place load upon new concrete until authorized by Departmental Representative.
- .9 Minimum 3 days to elapse between adjacent pours (continuous sequence pattern).
- .10 Maximum 11 m pour length between construction joints in any direction.
- .11 Temperature of the concrete during discharge into the forms is to be between 10°C and 22°C. The temperature of the mix is to be maintained below 22°C maximum temperature. Typical methods of reducing mix temperature include evaporative cooling of aggregate stockpiles, use chilled batch water or the inclusion of ice to the mix at the plant, taking care to maintain the design water/cementing material ratio. Obtain approval of Departmental Representative for proposed method of temperature control.
- .12 Do not place concrete against any surfaces such as rebar, concrete or formwork that have a surface temperature of less than 5°C.
- .13 Consolidate concrete using internal vibrators. Use pencil vibrators where larger sizes are unsuitable.
- .14 Sleeves and inserts:
  - .1 Set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
  - .2 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Departmental Representative before placing of concrete.
  - .3 Confirm locations and sizes of sleeves and openings shown on drawings.
  - .4 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .15 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 Departmental Representative.
- .3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.
- .4 Set bolts and fill holes with shrinkage compensating grout.
- .16 Grout under base plates and machinery using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.
- .17 Finishing and curing:
  - .1 Finish concrete to CSA A23.1/A23.2. Concrete tolerance - use straight edge method, Class A.
  - .2 Protect surfaces from excessive drying before and during finishing operations. The use of fly ash concrete will tend to increase the setting time of a concrete mix while reducing the amount of bleed water available to balance evaporation. Rapid loss of moisture from the surface of the concrete can result in defects such as plastic shrinkage cracking, crazing and/or crusting.
  - .3 Use procedures as reviewed by Departmental Representative to remove excess bleed water. Ensure surface is not damaged.
  - .4 Reservoir interior wall surfaces shall be given a sack rubbed finish to A23.1. Bug holes are to be filled.
  - .5 Apply hardener to all interior floor surfaces except on the pads and where coating is specified.
  - .6 All tie recesses are to be grouted with waterproof grout.
  - .7 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.
- .18 Joint fillers:
  - .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative.
  - .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 construction joints as indicated.
  - .4 Install joint filler.

### **3.3 CRACK REPAIR**

- .1 Utilize the best possible care and construction techniques to minimize cracking of concrete walls and slabs.
- .2 Cracks which do appear shall be routed out on each face and repaired with Cementitious waterproof grout in accordance with manufacturer's recommendations, except that cracks which are in excess of 0.50 mm width, or deemed by the Departmental Representative to be structurally detrimental, or subject to movement, shall be grouted with pressure injected epoxy resin.
- .3 Obtain approval from Departmental Representative of pressure grouting techniques and epoxy materials to be utilized prior to proceeding with the work.

- .4 Depth of epoxy grouting shall be sufficient to restore structural integrity and/or water-tightness, as required, but shall not be less than 100 mm.
- .5 Cure crack repairs to manufacturer's instructions.

### **3.4 CURING**

- .1 In accordance with CSA A23.1 - Concrete Materials and Methods of Concrete Construction.
- .2 Provide wet curing for not less than seven (7) consecutive days in all cases, at not less than 10°C. In addition, suspended slabs shall be continuously cured until the concrete has attained a minimum of 80% of the specified strength.
- .3 Acceptable curing methods:
  - .1 Ponding or continuous sprinkling.
  - .2 Absorptive mat or fabric kept continuously wet.
  - .3 Other moisture retaining method approved by the Departmental Representative.
- .4 Provide insulation, hoarding and/or heating as required to prevent freezing during inclement weather.
- .5 During hot weather, begin curing process immediately after finishing.

### **3.5 COLD WEATHER & HOT WEATHER CONCRETING**

- .1 Protection and preparation to comply with CSA A23.1.
- .2 Hot weather concreting procedures are to be followed when ambient air temperature exceeds 20°C during the placing period.

### **3.6 SURFACE TOLERANCE**

- .1 Concrete tolerance to CSA A23.1 Straightedge Method.

### **3.7 FIELD QUALITY CONTROL**

- .1 Site tests: conduct tests as follows in accordance with Section 01 45 00 – Quality Control
  - .1 Concrete pours.
  - .2 Slump.
  - .3 Air content.
  - .4 Compressive strength at 7 and 28 days.
  - .5 Air and concrete temperature.
- .2 Concrete testing: to CSA A23.1/A23.2 by testing laboratory approved by Departmental Representative and paid for by Contractor.
- .3 Take concrete samples for testing in accordance with CSA A23.2. One (1) strength test shall consist of test cylinders for each 50 m<sup>3</sup> of concrete, or portions of each mix type of concrete or each separate type of structural element in any one (1)-day's pour. For concrete with specified twenty-eight (28) day strength, strength test shall consist of minimum three (3) test cylinders. Test first cylinder at seven (7) days and remaining two (2) at twenty-eight (28) days.

- .4 Every load or batch of concrete shall be tested for air content and slump until satisfactory control is established and the Departmental Representative requires fewer tests. Whenever a test falls outside the specified limits, the testing frequency shall revert to one (1) test per load or batch until satisfactory control is re-established.
- .5 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.

### **3.8 CLEANING**

- .1 Provide appropriate area on job site where concrete trucks and be safely washed.
- .2 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.
- .3 Prevent admixtures and additive materials from entering drinking water supplies or streams.
- .4 Using the appropriate safety precautions, collect liquid or solidify liquid with inert, non-combustible material and remove for disposal.
- .5 Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

**END OF SECTION**