
Part 1 GENERAL

1.1 Related Work

- .1 Refer to other Specification Sections for related information on aggregates, form work and false work, concrete reinforcement, miscellaneous items.
- .2 Refer to Section 01 33 00 for Shop Drawing/ Submissions requirements.
- .3 Section 03 20 00 – Concrete Reinforcing.

1.2 Reference Standards

- .1 Do structural concrete work in accordance with CSA A23.1:19, Concrete Materials and Methods of Concrete Construction.
- .2 Do testing for concrete in accordance with CSA standard A23.2:19, Methods of Test for Concrete.
- .3 CSA A3000-2018, Cementitious Materials Compendium.
- .4 ASTM C494/C494M-19, Standard Specification for Chemical Admixtures for Concrete.
- .5 ASTM C309-19, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- .6 ASTM C881/C881M-20a, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
- .7 ASTM C260/C260M-10a (2016), Standard Specification for Air-Entraining Admixtures for Concrete.

1.3 Submissions

- .1 Product Data/Samples:
 - .1 Provide technical data and/or samples for curing compounds (winter/summer/green/white/red), evaporation retardant and finishing aids.
 - .2 Certificates:
 - .1 Minimum two (2) weeks prior to starting concrete work submit to *Departmental Representative* manufacturer's test data and certification by qualified independent inspection and testing laboratory that the following materials will meet specified requirements:
 - .1 Portland cement.
 - .2 Admixtures.
 - .2 Provide certification that plant, equipment, and materials to be used in concrete work comply with requirements of CSA A23.1.19
 - .3 Provide certification that mix proportions selected will produce concrete of specified quality, yield, and strength and will comply with CSA A23.1.19
 - .4 Provide certification that concrete will not include alkali - reactivity aggregates.
 - .3 Methodology and Quality Control:
 - .1 Submit for review methodology and quality control procedures for the following:
 - .1 Cold weather concreting.
 - .2 Hot weather concreting.
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- .3 Supporting reinforcing steel.
- .4 Protection and curing of concrete in cold and hot weather.

.4 Test Results:

- .1 Provide design mix tests results.
- .2 Provide mill test certificates for reinforcing steel.

1.4 Measurement for Payment

- .1 Heating of water and aggregates and providing cold weather protection will not be measured but considered incidental to the Work.
- .2 Supply and installation of ridged PVC sleeves, and curing compounds required will be considered incidental to the Work.

1.5 Storage of Materials

- .1 Store all materials to prevent contamination or deterioration, whether at the plant or at the job site.
- .2 Store cement in watertight bins or silos that provide protection from dampness and easy access for inspection and identification of each shipment whether at the plant or at the job site.
- .3 Prevent stored liquid admixtures and compounds from freezing and powdered admixtures and compounds from absorbing moisture.
- .4 Use storage methods which prevent damage and straining of pre-cast concrete elements.

1.6 Source Sampling

- .1 At least two (2) weeks prior to commencing work, inform *Departmental Representative* of proposed source of aggregates and provide access for sampling.

1.7 Ready-Mix Concrete Supply

- .1 Provide, with each load of concrete delivered to site, duplicate delivery slips containing following:
 - .1 Name of ready-mix batch plant.
 - .2 Serial number of ticket.
 - .3 Date and truck number.
 - .4 Project identification.
 - .5 Class of concrete or mix.
 - .6 Amount of concrete in cubic metres.
 - .7 Time of loading or first mixing of aggregate, cement and water.
 - .8 Time of discharge of concrete.
 - .9 Admixtures added at plant.
 - .10 Amount of water added at plant.

Part 2 PRODUCTS

2.1 Materials

- .1 Aggregates: to CSA A23.1, for Class "C-1" exposure.
- .2 Portland Cement: to CSA A3000, moderate type 2.
- .3 Water: to CSA A23.1.
- .4 Admixtures:
 - .1 Air entraining admixtures: to ASTM C494.
 - .2 Chemical admixtures: to CSA A3000 and ASTM C494.
 - .3 Pozzolan mineral admixtures: to CSA A3000.
- .5 Non-shrink grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents, of pouring and/or pumping consistency, capable of developing compressive strength of 50 MPa at 28 days.
- .6 Curing compound: To ASTM C309 and CSA A23.1 type 1, I-D, or 2.

2.2 Concrete Mixes

- .1 Prior to starting concrete work, submit to the *Departmental Representative* the proposed mix design(s) for approval. Mix design (s) to be in accordance with Alternative 1 of Table 5 in CSA A23.1. Comply with additional requirements of CSA A23.1, clause 4.1.1.5 for concrete exposed to sea water or sea water spray.
 - .1 Mix 1: Use concrete mix designed to produce air entrained concrete meeting the following requirements for concrete in rock sockets and piles:
 - .1 Cement to be moderate Portland cement, Type 20.
 - .2 Minimum compressive strength at 28 days: 40 MPa.
 - .3 Exposure: Class C-1.
 - .4 Maximum aggregate size to CSA A23.1 table 11, Group 1, 20 mm size.
 - .5 Minimum cement content 390 kg/m³.
 - .6 Air content: 5 to 8 %.
 - .7 Maximum water/cement ratio to be 0.40.
 - .8 Slump at time and point of discharge 80 mm ± 20 mm. Where the nature of the work requires larger slumps, they are to be obtained by the use of admixtures rather than increasing the water content. Use of such admixtures and the increase in slump to be approved by the *Departmental Representative* prior to implementation in the work.
 - .2 Modify concrete mix to the approval of the *Departmental Representative* to accommodate pumping.
 - .3 Admixtures to the approval of the *Departmental Representative* and the recommendation of the manufacturer. Admixtures must be dispersed separately into mixing water.
 - .4 Do not use calcium chloride or compounds containing calcium chloride.
 - .5 Weigh aggregates, cement, water and admixtures separately when batching. Inspect and test scales for accuracy as directed. Accuracy to be such that successive quantities can be measured to within one percent of desired amounts. Test certificates to be submitted to *Departmental Representative* upon request.
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- .6 Where seven day strength is less than 70% of specified 28 day strength, provide additional protection and curing, and make changes to mix proportions to the satisfaction of the *Departmental Representative*.
- .7 Provide certification that plant, equipment and all materials to be used in concrete comply with the requirements of CSA A23.1.
- .8 Provide certification from independent testing and inspection company that selected mix proportions will produce concrete of specified quality and can be effectively placed and finished for all work under this contract.
- .9 Use plasticizer to increase slump and workability.

Part 3 EXECUTION

3.1 General

- .1 Obtain *Departmental Representative's* approval before placing concrete. Provide 24 hours notice of intended placement. Concrete to be placed in dry form condition.
- .2 Place, consolidate, finish, cure and protect concrete to CSA A23.1 except where specified otherwise.
- .3 Prior to placing of concrete, obtain *Departmental Representative's* approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .4 Comply with additional requirements of CSA A23.1 except where specified otherwise, for concrete exposed to seawater environment.
- .5 Do not commence placing concrete until *Departmental Representative* has inspected/reviewed forms, inserts, dowels, reinforcing steel, joints; conveying, consolidation and protective methods.
- .6 Ensure that reinforcement and anchorage are not disturbed during placing.
- .7 Maintain accurate records of placed concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .8 Do not place load(s) upon new concrete until *Departmental Representative* is satisfied that the Contractor has carried out all calculations and tests necessary to confirm that the load(s) will not cause damage or create a safety hazard. Calculations and tests to be stamped by a Professional Engineer registered in the Province of Nova Scotia.

3.2 Reinforcing Steel

- .1 Place new reinforcing steel according to Section 03 20 00.
- .2 Provide 75 mm minimum cover for all reinforcing steel unless indicated otherwise on the drawings.

3.3 Placement of Concrete

- .1 Place and consolidate concrete to CSA A23.1. Concrete to be placed in dry form condition, by coordinating pour with low tide.
- .2 If allowed by *Departmental Representative*, pump concrete to following requirements:
 - .1 Arrange equipment so that no vibrations result which might damage freshly placed concrete.
 - .2 Where concrete is conveyed and placed by mechanically applied pressure, provide suitable equipment.

- .3 Operate pump so that concrete, without air pockets, is produced.
- .4 When pumping is discontinued and concrete remaining in pipe line is to be used, void pipe line in a manner that prevents contamination of concrete or separation of ingredients.
- .3 Concrete will be deposited in all cases as neatly as practicable, directly in its final position, and will not be caused to flow in a manner to permit or cause segregation.
- .4 Each layer of concrete will be vibrated and tamped with an appropriate vibrator as allowed by the *Departmental Representative*. The concrete must be compacted to the maximum practicable density, free of air pockets, and until it is in complete contact with the reinforcement and formwork.

3.4 Protection and Curing

- .1 Provide protection and curing in accordance with CSA A23.1.
- .2 Protect concrete with windproof shelter to allow free circulation of inside air around fresh concrete. Do not let walls of shelter touch formwork and provide sufficient space for removal of formwork.
- .3 Supply approved heating equipment to maintain inside air at following temperatures:
 - .1 For an initial three days, at not less than 10° C nor more than 25° C at surfaces.
 - .2 At not less than 10° C for an additional 4 consecutive days or for the time necessary to attain 70% of the specified 28-day compressive strength of the concrete.
 - .3 Reduce temperature near end of curing period at rate not exceeding 20° C per day.
 - .4 Do not overheat.
- .4 Keep concrete surfaces continuously moist during protection stage and allow concrete to dry before removal of protection.
- .5 Freshly deposited concrete will be protected from premature drying and excessively hot and cold temperatures, will be maintained without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete. It will be protected from harmful effects of sunshine, drying winds, cold weather, running or surface water and mechanical shock.

3.5 Finishing

- .1 Finish concrete in accordance with CSA A23.1 and as shown on the Project Drawings.

3.6 Field Quality Control

- .1 Inspection and testing of concrete and concrete materials will be carried out by Testing Laboratory designated by the *Departmental Representative* in accordance with CSA A23.1 and CSA A23.2.
- .2 *Departmental Representative* will pay for costs of tests as specified in Section 01 45 00.
- .3 *Departmental Representative* will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .4 If tests do not meet requirements of the *Departmental Representative*, take such measures as indicated in CSA A23.1 and CSA A23.2.
- .5 Arrange and pay for inspection and testing when necessary for production control to meet requirements.
- .6 Inspection and testing by *Departmental Representative* will not augment Contractor's quality control or relieve him of contractual responsibility.

3.7 Defective Work

- .1 Concrete is defective when:
 - .1 Failing to meet any requirement of this specification.
 - .2 Concrete contains honeycombing or embedded debris.
 - .3 28-day strength in any area is less than 95% of specified minimum.
- .2 Repair or remove and replace defective work as directed by the *Departmental Representative*.
- .3 Take corrective measures as directed by the *Departmental Representative* to prevent occurrence of further defective concrete.

END OF SECTION