

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Refer to other Specification for related information
- .2 Refer to Section 01 33 00 for Shop Drawing and Submission requirements.

1.02 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A23.3-14, Design of Concrete Structures.
 - .3 CSA-G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement.
- .2 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.03 SOURCE SAMPLING

- .1 Provide Departmental Representative with certified copy of mill test of steel supplied showing physical and chemical analysis.

1.04 SUBMISSIONS

- .1 Shop Drawings:
 - .1 Clearly indicate bar sizes, spacing, location and quantities of reinforcement and mesh with identifying code marks to permit correct placement without reference to structural drawings; to Reinforcing Steel Manual of Standard Practice.
 - .2 Detail placement of reinforcing where special conditions occur.
 - .3 Design and detail lap lengths and bar development lengths to CSA standard A23.1, unless otherwise specified on drawings.
- .2 Product Data/Samples:
 - .1 Provide product data for supports and spacers.
- .3 Test Results:
 - .1 Provide Mill Test Certificates cross referenced to the product supplied to the site.
- .4 Provide submissions in accordance with Section 01 33 00.

1.05 STORAGE

- .1 Store reinforcing steel on racks or sills that will permit easy access for identification and handling and prevent it from becoming coated with material which would adversely affect bond.

- .2 Do not store reinforcing steel in direct contact with the ground

1.06 MEASUREMENT FOR PAYMENT

- .1 This item will not be measured separately.
- .2 Chairs and spacers to be considered incidental to supply of reinforcement.

2 PRODUCTS

2.01 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 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.
- .4 Mechanical splices: subject to approval of Departmental Representative.

2.02 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2.
- .2 Obtain Departmental Representative's written approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Fabrication tolerances for reinforcing steel to Reinforcing Steel Manual of standard Practice
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar list.
- .5 Do not weld reinforcing steel.

3 EXECUTION

3.01 PLACING

- .1 Place reinforcing steel as indicated on placing drawings and in accordance with CSA-A23.1/A23.2.
- .2 Accurately place reinforcing in positions indicated and hold firmly during placing, compacting and setting of concrete.
- .3 Tie reinforcement where spacing in each direction is:
 - .1 Less than 300 mm: - tie at alternate intersections.
 - .2 300 mm or more: - tie at each intersection.

- .4 Ensure cover to reinforcement is maintained during concrete pour.

3.02 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.

3.03 CLEANING

- .1 Clean reinforcing before placing concrete.

3.04 INSPECTION

- .1 Do not place concrete until Departmental Representative has inspected and accepted reinforcement work in place.

3.05 SURFACE CONDITIONS

- .1 Reinforcement, at time concrete is placed, to be free from mud, oil or other non-metallic coatings that adversely affect bonding capacity.
- .2 Reinforcement, with rust, mill scale, or combination of both to be considered as satisfactory, provided minimum dimensions, including height of deformations, and mass of hand wire brushed test specimen are not less than specified requirements in applicable CSA Standards.

END OF SECTION

1 GENERAL

1.01 RELATED REQUIREMENTS

- .1 Refer to Section 01 33 00 for Shop Drawings and Submission requirements.

1.02 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C 494/C 494M-17, Standard Specification for Chemical Admixtures for Concrete.
- .2 CSA International
 - .1 CSA A23.1/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

1.03 SUBMISSIONS

- .1 Shop Drawings:
 - .1 Submit shop drawings and erection drawings for formwork and falsework. All such drawings to be stamped and signed by a Professional Engineer registered in the Province of Nova Scotia.
 - .2 Submit placement drawings for reinforcing steel.
 - .3 Submit placement drawings for miscellaneous items.
- .2 Product Data/Samples:
 - .1 Provide technical data and/or samples for curing compounds (winter/summer/green/white/red), evaporation retardant and finishing aids, expansion joint materials/sealants, grouts.
- .3 Certificates:
 - .1 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.Provide certification that plant, equipment, and materials to be used in concrete work comply with requirements of CSA A23.1.
 - .2 Provide certification that mix proportions selected will produce concrete of specified quality, yield, and strength and will comply with CSA A23.1. Provide certification that concrete will not include alkali - reactivity aggregates.
 - .3
 - .4
- .4 Methodology and Quality Control:
 - .1 Submit for review methodology and quality control procedures for the following:

- .1 Cold weather concreting.
- .2 Hot weather concreting.
- .3 Concrete placement operations. Provide details of pour sequence and proposed layout of construction joints.
- .4 Concrete surface finishing operations.
- .5 Supporting reinforcing steel.
- .6 Protection and curing of concrete in cold and hot weather.
- .7 Submit methodology for curing and crack control. To be stamped and signed by a Professional Engineer registered to practice in the province of Nova Scotia. All concrete deck pours to be wet-cured for 7 days. Concrete deck to be sprayed with fogging machine until wet curing can begin.

- .5 Test Results:
 - .1 Provide design mix tests results.
 - .2 Provide mill test certificates for reinforcing steel.

1.04 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.

1.05 SOURCE SAMPLING

- .1 Inform Departmental Representative of proposed source of aggregates and provide access for sampling.

1.06 SOURCE SAMPLING

- .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.

2 PRODUCTS

2.01 MATERIALS

- .1 Aggregates: to CSA A23.1, for Class "C-1" exposure.
- .2 Portland Cement: to CSA A5, normal type 10.
- .3 Water: to CSA A23.1.
- .4 Admixtures:
 - .1 Air entraining admixtures: to CSA A23.5.
 - .2 Chemical admixtures: to CSA A23.5 and ASTM C494.
 - .3 Pozzolanic mineral admixtures: to CSA A23.5.
- .5 Curing compound: To ASTM-C309 and CSA A23.1 type 1, ID, or 2.
- .6 Adhesive Anchors: high strength epoxy to ASTM C881, Type IV, Grade 3. Acceptable material: Hilti HY-200 or approved equal.

2.02 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 Use concrete mix designed to produce air entrained concrete meeting the following requirements:
 - .1 Cement to be normal Portland cement, Type 10.
 - .2 Minimum compressive strength at 28 days: 35 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: 6 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.
- .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 mix proportions selected 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.

3 EXECUTION

3.01 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.

- .9 Comply with additional requirements of CSA A23.1, for concrete exposed to seawater environments during placement and curing.

3.02 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 drawings.

3.03 FORMWORK

- .1 Verify field dimensions to determine applicable sizes of formwork.
- .2 Design and construct form work to allow adequately for proper placement and consolidation while conforming with shape and dimensions shown on plans.
- .3 Formwork design will include closures at both top and bottom of form, and all necessary hardware to support the forms.
- .4 Upon request, submit drawings for review by the Departmental Representative before placement of concrete. Drawings, will show formwork details and illustrate dimensions, method of placing of concrete, connections and support.
- .5 Strip formwork after minimum seven (7) days. This condition might be waived only if an alternative method to curing and preventing alternate wetting and drying is provided, to the satisfaction of the Departmental Representative. This condition will be waived if the forms are left permanently in place, where approved by the Departmental Representative.

3.04 PLACEMENT OF CONCRETE

- .1 Place and consolidate concrete to CSA A23.1. Concrete to be placed in dry form condition.
- .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.

3.05 INSERTS

- .1 Set galvanized sleeves and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 X 100 mm not indicated on drawings must be approved by Departmental Representative.
- .2 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of all modifications from Departmental Representative before placing of concrete.
- .3 Galvanized items embedded in concrete will be completely separated from reinforcing steel.
- .4 Anchor bolts:
 - .1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.

3.06 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.

3.07 FINISHING

- .1 Finish concrete in accordance with CSA A23.1.

- .2 When concrete has hardened sufficiently, give surface a uniform finish free from porous spots, irregularities, depressions, small pockets or rough spots using a steel trowel.

3.08 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 A23.1-94 (or latest edition).
- .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 A23.1-14 and CSA A23.2-14 (or latest editions).
- .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.

3.09 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