

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 Cast-in-Place Concrete

1.2 REFERENCE STANDARDS

- .1 American Concrete Institute (ACI)
 - .1 ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structure.
- .2 American National Standards Institute/American Concrete Institute (ANSI/ACI)
 - .1 ANSI/ACI 315, Details and Detailing of Concrete Reinforcement.
- .3 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 775/A 775Mc, Specification for Epoxy-Coated Reinforcing Steel Bars.
- .4 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN3-A23.3-94, Design of Concrete Structures for Buildings.
 - .3 CSA G30.3, Cold Drawn Steel Wire for Concrete Reinforcement.
 - .4 CSA G30.5, Welded Steel Wire Fabric for Concrete Reinforcement.
 - .5 CSA G30.14, Deformed Steel Wire for Concrete Reinforcement.
 - .6 CSA G30.15, Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
 - .7 CAN/CSA-G30.18, Billet-Steel Bars for Concrete Reinforcement.
 - .8 CAN/CSA-G40.21, Structural Quality Steels.
 - .9 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 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: weldable low alloy steel deformed bars to CAN/CSA-30.18.
- .4 Cold-drawn annealed steel wire ties: to CSA G30.3.
- .5 Deformed steel wire for concrete reinforcement: to CSA G30.14.
- .6 Welded steel wire fabric: to CSA G30.5.
- .7 Welded deformed steel wire fabric: to CSA G30.15.
- .8 Epoxy coating of non-prestressed reinforcement: to ASTM A 775/A 775M.
- .9 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1.
- .10 Mechanical splices: subject to approval of Department Representative.
- .11 Plain round bars: to CAN/CSA-G40.21.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1, and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Obtain Department Representative's approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

- .1 Upon request, provide Department Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to commencing reinforcing work.
- .2 Upon request inform Department Representative of proposed source of material to be supplied.

Part 3 Execution

3.1 FIELD BENDING

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

3.2 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on approved placing drawings and in accordance with CAN/CSA-A23.1.

- .2 Use plain round bars as slip dowels in concrete. Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint. When paint is dry, apply a thick even film of mineral lubricating grease.
- .3 Prior to placing concrete, obtain Department Representative's approval of reinforcing material and placement.
- .4 Ensure cover to reinforcement is maintained during concrete pour.
- .5 Protect epoxy and paint coated portions of bars with covering during transportation and handling.

3.3 FIELD TOUCH-UP

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

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C109/C109M, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50-mm Cube Specimens).
 - .2 ASTM C260, Specification for Air-Entraining Admixtures for Concrete.
 - .3 ASTM C309, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .4 ASTM C332, Specification for Lightweight Aggregates for Insulating Concrete.
 - .5 ASTM C494, Specification for Chemical Admixtures for Concrete.
 - .6 ASTM C827, Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
 - .7 ASTM C939, Test Method for Flow of Grout for Preplaced-Aggregate Concrete.
 - .8 ASTM D1751, Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - .9 ASTM D1752, Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .2 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A5, Portland Cement.
 - .2 CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction.
 - .3 CAN/CSA-A23.2, Methods of Test for Concrete.
 - .4 CAN/CSA-A23.5, Supplementary Cementing Materials.
 - .5 CAN/CSA A363, Cementitious Hydraulic Slag.

1.2 SAMPLES

- .1 At least 4 weeks prior to commencing work, inform Department Representative of proposed source of aggregates and provide access for sampling.

1.3 CERTIFICATES

- .1 Submit certificates in accordance with Section 01 33 00 - Submittals.
- .2 Minimum 4 weeks prior to starting concrete work submit to Department Representative manufacturer's test data and certification by qualified independent inspection and testing laboratory that following materials will meet specified requirements:
 - .1 Portland cement.
 - .2 Blended hydraulic cement.
 - .3 Supplementary cementing materials.
 - .4 Grout.
 - .5 Admixtures.

- .6 Aggregates.
- .7 Water.
- .8 Waterstops.
- .9 Waterstop joints.
- .10 Joint filler.
- .3 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CAN/CSA-A23.1.
- .4 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1.
- .5 Submit mix design in accordance with Section 01 33 00 - Submittals and a minimum of 7 days prior to delivery of any concrete to site.

1.4 QUALITY ASSURANCE

- .1 Minimum 4 weeks prior to starting concrete work, submit proposed quality control procedures in accordance with Section 01 33 00 - Submittals for Department Representative's approval for following items:
 - .1 Falsework erection.
 - .2 Hot weather concrete.
 - .3 Cold weather concrete.
 - .4 Curing.
 - .5 Finishes.
 - .6 Formwork removal.
 - .7 Joints.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Use excess concrete for: additional paving, post footing anchorage, swale rip-rap reinforcing, footing bottom, storm structure covers, underground utility pipe kickers, storm pipe flared end section, toe wash protection.
- .2 Use trigger operated spray nozzles for water hoses.
- .3 Designate a cleaning area for tools to limit water use and runoff.
- .4 Carefully coordinate the specified concrete work with weather conditions.
- .5 Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, noncombustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.
- .6 Choose least harmful, appropriate cleaning method which will perform adequately.

Part 2 Products

2.1 MATERIALS

- .1 Portland cement: to CAN/CSA-A5.
- .2 Supplementary cementing materials: to CAN/CSA-A23.5.
- .3 Water: to CAN/CSA-A23.1.
- .4 Aggregates: to CAN/CSA-A23.1. Coarse aggregates to be normal density.
- .5 Air entraining admixture: to CAN3-A266.1.
- .6 Chemical admixtures: to CAN3-A266.2. Department Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Shrinkage compensating grout: pre-mixed compound consisting of non-metallic aggregate, Portland Cement, water reducing and plasticizing agents.
- .8 Post-Tensioning ducts: to CAN/CSA-A23.1.
- .9 Curing compound: to CAN/CSA-A23.1 Type-D with fugitive dye.
- .10 Concrete reinforcement: to Section 03200 – Concrete Reinforcement.

2.2 MIXES

- .1 Except where indicated or specified otherwise provide concrete mix as follows.
 - .1 Cement: Type 50 Portland cement for all works.
 - .2 Minimum compressive strength at 28 days: 32 MPa.
 - .3 Minimum cement content: 315 kg/m³ of concrete.
 - .4 Nominal size of coarse aggregate: 14 - 20 mm.
 - .5 Slump at time and point of discharge: 25 to 80 mm.
 - .6 Air content: 5 to 8 %.
 - .7 Maximum water cement ratio: 0.45.
 - .8 Exposure Classification: C-2.
- .2 Do not change concrete mix without prior approval of Department Representative. Should change in material source be proposed, new mix design to be approved by Department Representative.
- .3 Concrete placed after September 30 shall attain the specified strength in 7 days.
- .4 The strength level of 32 MPa shall be considered to be achieved if the averages of all sets of 3 consecutive tests equal or exceed the specified strength and no individual strength test is more than 5 MPa below specified strength.

Part 3 Execution

3.1 PREPARATION

- .1 Obtain Department Representative's approval before placing concrete. Provide 24 h ours notice prior to placing of concrete.

- .2 Pumping of concrete is permitted only after approval of equipment and mix.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Prior to placing of concrete obtain Department Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .6 In locations where new concrete is dowelled to existing work, drill holes in existing concrete. Place steel dowels of deformed steel reinforcing bars and pack solidly with shrinkage compensating grout to anchor and hold dowels in positions as indicated.
- .7 Do not place load upon new concrete until authorized by Department Representative.

3.2 CONSTRUCTION

- .1 Do cast-in-place concrete work in accordance with CAN/CSA-A23.1.
- .2 Finishing.
 - .1 Finish concrete in accordance with CAN/CSA-A23.1.
 - .2 Use procedures acceptable to Department Representative or those noted in CAN/CSA-A23.1 to remove excess bleed water. Ensure surface is not damaged.
 - .3 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.
- .3 Joint fillers.
 - .1 Locate and form isolation joints as required. Install joint filler in accordance with ASTM D1751.

3.3 SITE TOLERANCE

- .1 Concrete tolerance in accordance with CAN/CSA-A23.1 straight edge method.

3.4 FIELD QUALITY CONTROL

- .1 A qualified testing laboratory shall be engaged and paid for by the Contractor to perform all quality control tests. Copies of test results shall be sent directly to the Contractor and Department Representative.
- .2 Sampling:
 - .1 Samples of concrete shall be obtained in accordance with CSA test Method A23.2-1C for sampling plastic concrete.

.3 Test Cylinders:

- .1 Test cylinders shall be made and stored in accordance with CSA Test Method A23.2-3C for making and curing concrete compression and Flexural Test Specimens.
- .2 Not less than one strength test shall be made from samples from each 100 m³ of concrete placed, and in no case shall there be less than one test from each days pour.
- .3 Each strength test shall consist of three test cylinders, one tested at 7 days and two at 28 days. All test cylinders representing concrete placed after September 30 shall be tested at 7 days.
- .4 Compressive strength of test cylinders shall be in accordance with CSA Test Method A23.2-9C compressive strength of Cylindrical Concrete Specimens and shall be the average of the strengths of the test cylinders tested at the same age.
- .5 The strength level of the concrete shall be considered satisfactory if the averages of all sets of three consecutive strength tests for the concrete are equal to or exceed the specified strength and no individual strength test is more than 5 MPa below the specified strength.

.4 Air Content:

- .1 Air content determinations shall be made in accordance with CSA Test Method A23.2C for air content of Plastic Concrete by the Volumetric Method.
- .2 During construction start-up, every load or batch of concrete shall be tested until such time as satisfactory control of the air content has been established. Air content tests taken with the test cylinders will be sufficient once satisfactory control has been established.
- .3 Whenever a test falls outside the specified limits the testing frequency shall revert to one test per load or batch until such time as satisfactory control is re-established.

.5 Slump:

- .1 Slump tests made in accordance with CSA Test Method A23.2-5C.
- .2 Slump of concrete shall be made in conjunction with each strength test.

3.5 FAILURE TO MEET REQUIREMENTS

.1 Strength:

- .1 In the event that the concrete tested in accordance with these specifications fails to meet the strength requirements, the Department Representative shall have the right to any one or all of the following at the expense of the Contractor:
 - .1 Change the concrete mix proportions for the remainder of the work.
 - .2 Core the portions of the work in question and test in accordance with CSA Test Method A23.2-14C, obtaining and testing drilled cores for compressive strength testing.
 - .3 Replace the concrete, represented by the tests, with concrete which meets those specifications.

- .2 Air Content:
 - .1 If the measured air content falls outside the limits specified, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, the load of concrete shall not be used for construction.
 - .2 Where deemed necessary, the Department Representative will test hardened concrete for air content and spacing factor by the linear traverse method ASTM Designation C457, Modified Point - Count Method, Air-Paste Ratio Method of Calculation. Concrete tested by this method using a magnification of 60x and found to have a spacing factor greater than 0.2 mm will be rejected, and complete replacement of the work will be required.
 - .3 Linear traverse testing costs will be borne by the Contractor.
- .3 Slump:
 - .1 If the measured slump falls outside the limits specified, a check test shall be made immediately in another portion of the same batch. In the event of a second failure, the Department Representative may refuse to permit the use of the batch.

3.6 REPAIR

- .1 Repair defective areas while concrete is still plastic, otherwise wait until carving is complete.
- .2 Where directed, remove defective work and replace with new concrete.
- .3 Where directed, grind off high surface irregularities.

3.7 COLD WEATHER REQUIREMENTS

- .1 When the atmospheric temperature is lower than 5°C, all aggregates and water shall be preheated.
- .2 When depositing concrete at freezing or near freezing temperatures, the concrete shall have a temperature of between 10°C and 30°C and shall be maintained at a temperature of at least 10°C for 3 days.
- .3 If hot water is used in mixing, the water and aggregates shall be mixed for ½ minute prior to adding the cement.
- .4 If a temperature of 10°C cannot be maintained for 3 days after placing, concrete placing shall cease.

3.8 HOT WEATHER REQUIREMENTS

- .1 When the atmospheric temperature is higher than 23°C, the concrete temperature at the time of placing shall not exceed 30°C.
- .2 In the event this limit is exceeded, the concrete operations shall be suspended until the constituent materials of the concrete are cooled.

3.9 JOINT SEALING

- .1 A cut or preformed joint, 25 mm in depth and a maximum of 12 mm wide, shall be provided at the top of all separately poured, abutting concrete structures. A hot poured elastic type sealer shall be placed in this joint, in accordance with the manufacturer's recommendations.

END OF SECTION