

**Part 1 General**

**1.1 RELATED SECTIONS**

- .1 Section 03 20 00 - Concrete Reinforcing.
- .2 Section 03 30 00 - Cast-in-Place Concrete.

**1.2 REFERENCES**

- .1 In accordance with the following Canadian Standards Association (CSA) standards, most recent revisions:
  - .1 CSA-A23.1-[04]/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2 CSA-O86S1, Supplement No. 1 to CAN/CSA-O86-01, Engineering Design in Wood.
  - .3 CAN/CSA-S269.3, Concrete Formwork, National Standard of Canada

**1.3 SUBMITTALS**

- .1 Submit shop drawings for formwork and falsework and supports in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CAN/CSA-S269.3 for formwork drawings.
- .3 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete, in forms.
- .4 Indicate sequence of erection and removal of formwork/falsework to the Departmental Representative.
- .5 Each shop drawing submission shall bear stamp and signature of qualified professional engineer registered or licensed in the Province of Nova Scotia.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, handle and store formwork materials to prevent weathering, warping or damage detrimental to the strength of the materials or to the surface to be formed.
- .2 Waste Management and Disposal:
  - .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  - .2 Place materials defined as hazardous or toxic in designated containers.
  - .3 Divert unused form release material from landfill to an official hazardous material collections site as approved by the Departmental Representative.

- .4 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.

## **Part 2 Products**

### **2.1 MATERIALS**

- .1 Formwork materials:
  - .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-A23.1/A23.2 and CSA-O1213.
  - .2 Rigid insulation board: to CAN/ULC-S701.
- .2 Form ties:
  - .1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
- .3 Form release agent: non-toxic, biodegradable, low VOC.
- .4 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 15 to 24 mm<sup>2</sup>/s at 40 degrees C, flashpoint minimum 150 degrees C, open cup.

## **Part 3 Execution**

### **3.1 FABRICATION AND ERECTION**

- .1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Obtain Departmental Representative's approval for use of earth forms framing openings not indicated on drawings.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Do not place shores and mud sills on frozen ground.
- .5 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .6 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
- .7 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.
- .8 Provide 48 hours notice to Departmental Representative for inspection prior to concrete placement.

- .9 Prior to placing concrete, the elevations of forms shall be checked to verify drainage slopes.
- .10 During cold weather, remove ice and snow from within forms, do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and concrete construction proceed within a heated enclosure.

### **3.2 REMOVAL AND RESHORING**

- .1 Leave formwork in place for a minimum of 3 days after placing concrete.
- .2 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

**END OF SECTION**

**Part 1 General**

**1.1 REFERENCES**

- .1 In accordance with the following American Concrete Institute (ACI) standards, most recent revisions:
  - .1 SP-66, ACI Detailing Manual.
  - .2 ACI 315R, Manual of Engineering and Placing Drawings for Reinforced Concrete Structures.
- .2 In accordance with the following Canadian Standards Association (CSA) standards, most recent revisions:
  - .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  - .2 CAN/CSA A23.3, Design of Concrete Structures.
  - .3 CSA G30.18, Carbon Steel Bars for Concrete Reinforcement.
  - .4 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .3 In accordance with the following Reinforcing Steel Institute of Canada (RSIC) standards, most recent revisions:
  - .1 RSIC, Reinforcing Steel Manual of Standard Practice.

**1.2 SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice and ACI 315.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Nova Scotia.
    - .1 Indicate placing of reinforcement and:
      - .1 Bar bending details.
      - .2 Lists.
      - .3 Quantities of reinforcement.
      - .4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental, with identifying code marks to permit correct placement without reference to structural drawings.
      - .5 Indicate sizes, spacings and locations of chairs, spacers and hangers.
    - .2 Detail lap lengths and bar development lengths to CAN/CSA A23.3, unless otherwise indicated.
      - .1 Provide type B tension lap splices where indicated unless otherwise indicated.

### **1.3 QUALITY ASSURANCE**

- .1 Submit in accordance with Section 01 45 00 - Quality Control and as described in PART 2 - SOURCE QUALITY CONTROL.
  - .1 Mill Test Report: upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, minimum 4 weeks prior to beginning reinforcing work.
  - .2 Upon request submit in writing to Departmental Representative proposed source of reinforcement material to be supplied.

### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .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 off ground, in dry location and 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 Cold drawn annealed steel wire ties: to ASTM A82/A82M.
- .4 Deformed steel wire for concrete reinforcement: to [ASTM A82/A82M].
- .5 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2.
- .6 Mechanical splices: subject to approval of Departmental Representative.
- .7 Plain round bars: to CSA G40.20/G40.21.

### **2.2 FABRICATION**

- .1 Fabricate reinforcing steel in accordance with CSA A23.1/A23.2 ANSI/ACI 315R and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
  - .1 ACI 315R unless indicated otherwise.
- .2 Obtain Departmental Representative's written approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
  - .1 Welding of reinforcing steel to have prior approval of Departmental Representative.

- .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 Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.
- .2 Upon request inform Departmental 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 Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying slow and steady pressure.
- .3 Replace bars, which develop cracks or splits.

### **3.2 PLACING REINFORCEMENT**

- .1 Place reinforcing steel as indicated on placing drawings and in accordance with CSA A23.1/A23.2.
- .2 Use plain round bars as slip dowels in concrete.
  - .1 Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.
  - .2 When paint is dry, apply thick even film of mineral lubricating grease.
- .3 Prior to placing concrete, obtain Departmental 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 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 DESCRIPTION**

- .1 This section specifies requirements for design, supply and installation of cast-in-place concrete.

**1.2 RELATED SECTIONS**

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 35 29.06 – Health and Safety Requirements.
- .3 Section 01 35 43 – Environmental Procedures.
- .4 Section 01 45 00 – Quality Control.
- .5 Section 01 74 11 – Cleaning.
- .6 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .7 Section 03 10 00 – Concrete Forming and Accessories.
- .8 Section 03 20 00 – Concrete Reinforcing.

**1.3 REFERENCES**

- .1 In accordance with the following American Society for Testing and Materials (ASTM) standards, most recent revisions:
  - .1 ASTM C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.
  - .2 ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - .3 ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
  - .4 ASTM C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
- .2 In accordance with the following Canadian Standards Association (CSA) standards, most recent revisions:
  - .1 CAN3-A266.1, Air-Entraining Admixtures for Concrete.
  - .2 CAN3-A266.4, Chemical Admixtures for Concrete.
  - .3 CSA A23.1/A23.2 09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .4 CSA A283, Qualification Code for Concrete Testing Laboratories.
  - .5 CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
  - .6 CSA G30.18, Carbon Steel Bars for Concrete Reinforcement.

#### **1.4 ADMINISTRATIVE REQUIREMENTS**

- .1 Pre-installation Meetings: in accordance with Section 01 32 16.07 - Construction Progress Schedules: Bar (GANTT) Chart, convene pre-installation meeting 1 week prior to beginning concrete works.
  - .1 Ensure key personnel, site supervisor, Departmental Representative, specialty contractor - forming concrete producer, and testing laboratories attend.
  - .1 Verify project requirements.

#### **1.5 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 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.
- .3 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.
- .4 Provide two copies of WHMIS MSDS in accordance with Section 01 35 29.06 - Health and Safety Requirements and Section 01 35 43 - Environmental Procedures.

#### **1.6 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 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.
- .3 Minimum 2 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.
  - .8 Backfilling.
- .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.

#### **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Delivery and Acceptance Requirements:



- .1 Concrete hauling time: deliver to site of Work and discharge 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.

## **1.8 WASTE MANAGEMENT AND DISPOSAL**

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .2 Divert unused concrete material from landfill to facility capable of recycling materials.
- .3 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by Departmental Representative.
- .4 Prevent admixtures and additive materials from entering drinking water supplies or streams.

## **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.

### **2.2 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 Cement: hydraulic cement Type GU to CSA A23.1/A23.2 and CSA A3001.
- .3 Water: to CSA A23.1.
- .4 Aggregates: to CSA A23.1/A23.2.
- .5 Admixtures:
  - .1 Air entraining admixture: to CSA A23.1/A23.2 and CAN3-A266.1
  - .2 Chemical admixture: to CSA A23.1/A23.2 and CAN3-A266.4, Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing
  - .3 Obtain authorization from Departmental Representative for use of super plasticizing admixture, water reducer, and/or other admixtures as approved by Departmental Representative to achieve designed concrete properties.
- .6 Concrete shall be normal and shall have a unit weight of 2400 kg/m<sup>3</sup>.
- .7 Curing compound: to CSA A23.1/A23.2 white and ASTM C309.

## **2.3 MIXES**

- .1 Alternative 1 - Performance Method for specifying concrete: to meet Departmental Representative performance criteria to CSA A23.1/A23.2.
- .2 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.
  - .1 Provide concrete mix to meet following plastic state requirements:
    - .1 Uniformity: to CSA A23.1.
    - .2 Workability: free of loss of mortar, segregation.
    - .3 Slump:
      - .1 Concrete Wall: 80+-30 mm.
    - .4 Air Content: 4- 7%
    - .5 Finishability: amount of bleeding.
    - .6 Set time: 2 hours maximum.
  - .2 Provide concrete mix to meet following hard state requirements:
    - .1 Durability and class of exposure: F-2.
    - .2 Compressive strength at 28 days:
      - .1 Concrete Wall: 35 MPa minimum.
      - .2 Rock Anchor Grout: 50 MPa minimum.
        - .1 35 MPa minimum at 3 days.
    - .3 Intended Application: Concrete Wall, Rock Anchors.
    - .4 Aggregate size:
      - .1 20 mm maximum.
- .3 Provide quality management plan to ensure verification of concrete quality to specified performance.
- .4 Concrete supplier's certification: both batch plant and materials meet CSA A23.1 requirements.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Obtain Departmental Representative'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 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 Departmental Representative'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 rock, drill holes in existing rock.
  - .1 Place steel dowels of deformed steel reinforcing bars and pack solidly with shrinkage compensating grout 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 walls excepts were indicated in plans or approved by Departmental Representative.
  - .2 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated in plans or approved by Departmental Representative.
  - .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified in plans, obtain written approval of modifications from Departmental Representative before placing of concrete.
  - .4 Confirm locations and sizes of sleeves and openings shown on drawings.
- .3 Drainage holes and weep holes:
  - .1 Install weep holes as indicated.
- .4 Finishing and curing:
  - .1 Finish concrete to CSA A23.1/A23.2.
  - .2 Use procedures as reviewed by Departmental Representative or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.
  - .3 Use curing compounds compatible with applied finish on concrete surfaces. Applied finish on concrete: Provide written declaration that compounds used are compatible.

### **3.3 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 Time/date of concrete pours.
  - .2 Slump.
  - .3 Air content.
  - .4 Compressive strength at 3, 7, 28 and 56 days.
  - .5 Air and concrete temperature.
  - .6 Weather.

- .2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Departmental Representative 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 Departmental Representative will pay for costs of tests as specified in Section 01 29 83 - Payment Procedures for Testing Laboratory Services.
- .5 Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .6 For compressive strength testing, a minimum of 3 cylinders and 2 field cured cylinders are required for:
  - .1 Each day's pour.
  - .2 Each type of grade of concrete.
  - .3 Each change of supplier.
  - .4 Additional test specimens shall be taken whenever requested by the Departmental Representative to verify the concrete quality.
- .7 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.
- .8 Inspection or testing by Consultant will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

### **3.4 CLEANING**

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
- .2 Provide appropriate area on job site where concrete trucks can be safely washed.
- .3 Using appropriate safety precautions, collect liquid or solidify liquid with inert, noncombustible material and remove for disposal. Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

**END OF SECTION**