

**Part 1            General**

**1.1                SUMMARY**

- .1        This section covers supply, fabrication, and placement of embedded reinforcing steel in cast-in-place slabs.

**1.2                RELATED SECTIONS**

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

**1.3                REFERENCES**

- .1        ASTM International
  - .1        ASTM A143/A143M-07, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
- .2        CSA International
  - .1        CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
  - .2        CAN/CSA-A23.3-04(R2010), Design of Concrete Structures.
  - .3        CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
  - .4        CSA-G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
  - .5        CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .6        CSA W186-M1990(R2007), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .3        Reinforcing Steel Institute of Canada (RSIC)
- .4        RSIC-2004, Reinforcing Steel Manual of Standard Practice.

**1.4                MEASUREMENT PROCEDURES**

- .1        Include in Item 10 – Plaza Access Ramp on Form B: Prices, all costs for the supply, shipping, field cutting, field bending and placing of reinforcing steel in the new plaza access ramp.
- .2        No measurement will be made under this Section.

**1.5                SUBMITTALS**

- .1        Submit in accordance with Section 01 33 00 - Submittal Procedures.

**Part 2            Products**

**2.1                MATERIALS**

- .1        Substitute different size bars only if permitted in writing by the Contract Administrator.

- .2 Reinforcing steel: All reinforcing steel to be CAN/CSA-G30.18M grade 400R deformed bars except column ties and beam stirrups which shall be grade 400W.
- .3 Reinforcing steel: weldable low alloy steel deformed bars to CSA-G30.18.
- .4 Cold-drawn annealed steel wire ties: to ASTM A82/A82M.
- .1 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.
- .2 Plain round bars: to CSA-G40.20/G40.21.

## **2.2 FABRICATION**

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .2 Obtain Contract Administrator's written approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of Contract Administrator, 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 Contract Administrator with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis.
- .2 Upon request inform Contract Administrator 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 Contract Administrator.
- .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 drawings and in accordance with CSA-A23.1/A23.2.
- .2 Prior to placing concrete, obtain Contract Administrator's approval of reinforcing material and placement.

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

**END OF SECTION**

**Part 1            General**

**1.1            RELATED SECTIONS**

- .1    Section 03 20 00 – Concrete Reinforcing.
- .2    Section 31 00 99 - Earthwork

**1.2            REFERENCES**

- .1    Canadian Standards Association (CSA)
  - .1    CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
  - .2    CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005)
  - .3    CSA A283-06, Qualification Code for Concrete Testing Laboratories.
- .2    American Concrete Institute (ACI)
  - .1    ACI 309R-96, Guide for the Consolidation of Concrete.
- .3    American Society for Testing and Materials International (ASTM)
  - .1    ASTM C260/C260M-10a, Specification for Air-Entraining Admixtures for Concrete.
  - .2    ASTM C309-07, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - .3    ASTM C494/C494M-10a Standard Specification for Chemical Admixtures for Concrete.
  - .4    ASTM C928/C928M-09, Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs.
- .4    Canadian General Standards Board (CGSB)
  - .1    CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

**1.3            MEASUREMENT PROCEDURES**

- .1    No measurement will be made under this section for the cast-in-place concrete ramp.

**1.4            CERTIFICATES**

- .1    Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CSA-A23.1. Certification letter to be sealed by an engineer registered in the Province of Manitoba.
- .2    Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA-A23.1. Certification letter to be sealed by an engineer registered in the Province of Manitoba.

- .3 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA-A23.1. Certification letter to be sealed by an engineer registered in the Province of Manitoba.

## 1.5 QUALITY ASSURANCE

- .1 Minimum 1 week prior to starting concrete work, submit proposed quality control procedures for review by Contract Administrator on following items:
  - .1 Hot weather concrete.
  - .2 Cold weather concrete.
  - .3 Curing.
  - .4 Finishes.
  - .5 Formwork removal.

## 1.6 ABBREVIATIONS

- .1 Cement: hydraulic cement or blended hydraulic cement (XXb - where b denotes blended).
  - .1 Type GU or GUb - General use cement.
  - .2 Type CI - with CaO content ranging from 8 to 20%.
- .2 SCM – Supplemental cementing materials.
- .3 SSD - Saturated surface dry.
- .4 WRA – Water reducing agent.

## 1.7 DELIVERY, STORAGE AND HANDLING

- .1 Concrete hauling time: maximum allowable time for concrete to be delivered to site of Work and discharged not to exceed 120 minutes after batching.
  - .1 Modifications to maximum time limit must be agreed to by the Contract Administrator and concrete producer as described in CSA A23.1/A23.2.
  - .2 Deviations to be submitted for review by Contract Administrator.
- .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

## Part 2 Products

### 2.1 MATERIALS

- .1 The concrete constituents shall comply with the following standards:
  - .1 Cement: to CAN/CSA-A3001.
  - .2 Blended Hydraulic cement: to CAN/CSA-A3001.
  - .3 Supplementary cementing materials: to CAN/CSA-A3001.
  - .4 Water: To CSA-A23.1.
  - .5 Aggregates: to CSA-A23.1. Coarse aggregates to be normal density.
  - .6 Air entraining admixture: ASTM C260.

- .7 Chemical admixtures: ASTM C494/C494M. Contract Administrator to approve accelerating or set retarding admixtures during cold and hot weather.

## 2.2 MIX REQUIREMENTS

- .1 Proportion normal density concrete in accordance with CSA-A23.1, Table 5, Alternative 1 to obtain the following performance:
  - .1 Type 1: Pavement Slab & Curbs
    - .1 Class of exposure: C-2
    - .2 Minimum compressive strength at 28 days: 32 MPa.
    - .3 Air category: 1 (5 to 8%)
    - .4 Supplemental cementing materials: Class CI Fly ash.
      - .1 Volume of SCM: Maximum 30% replacement
    - .5 Nominal size of coarse aggregate: 20 mm.
    - .6 Slump at point of discharge: consistent with placement and consolidation methods, equipment, and site conditions and as approved by Contract Administrator.

## 2.3 BONDING SLURRY

- .1 The bonding slurry shall consist of a cement/sand grout mixed in a 1:1 ratio by weight to a maximum water/cement ratio of 0.40 in accordance with CSA-A23.1 and as follows:
  - .1 1.0 kg Type GU to CSA A3001.
  - .2 1.0 kg SSD concrete sand to CSA A23.1.
  - .3 0.40 kg Water to CSA A23.1.
  - .4 High range water reducing agent to ASTM C494/C494M as required and approved by Contract Administrator.
  - .5 Volume batching will be permitted provided the volumes are calibrated by weight prior to batching. The measuring containers shall be clearly labelled, indicating material type, calibrated weight of material, and calibrated volume. The Contract Administrator reserves the right to randomly check batch weights.
  - .6 Shovel batching is strictly prohibited.
- .2 Alternative Method: Plastic concrete from same mix utilized for overlying concrete. Scrub plastic concrete. Scrub plastic concrete into substrate with stiff bristled broom or brush to produce a uniform thickness of 1/8" over entire area. Collect and remove all coarse aggregate prior to placement of the overlay.

## 2.4 ACCESSORIES

- .1 Evaporation retardant: Acceptable Product:
  - .1 MasterKure ER 50, formerly (Confilm) by BASF Building Systems at a minimum application rate of 4.9 m<sup>2</sup>/L.
  - .2 MasterKure CC, formerly (Kure-N-Seal) by BASF Building Systems at a minimum application rate of 4.9 m<sup>2</sup>/L.
- .2 Vapour Barrier: 10 mil polyethylene film to CAN/CGSB-51.34.

**2.5 GRANULAR BASE**

- .1 Comply with Section 31 00 99 - Earthwork.

**Part 3 Execution**

**3.1 PREPARATION**

- .1 Obtain Contract Administrator's approval before placing concrete. Provide 24 hours notice prior to placing of concrete.
- .2 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .3 Prior to placing of concrete obtain Contract Administrator's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .4 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .5 In locations where new concrete is dowelled to existing work, drill holes in existing concrete. Place steel dowels of deformed steel reinforcing bars and epoxy grout to anchor and hold dowels in positions as indicated. Refer to Section 03 20 00.
- .6 Do not place load upon new concrete until authorized by Contract Administrator.
- .7 Provide formwork and falsework as required.
- .8 Place reinforcing steel and install dowels to Section 03 20 00 - Concrete Reinforcement. Provide dowels at locations shown on the drawings.
- .9 Obtain Contract Administrator's approval before placing concrete. Provide 24 hours notice prior to placing of concrete.
- .10 Prior to placing of concrete obtain Contract Administrator's approval of proposed method for protection of concrete during placing and curing in adverse weather. Protection and curing must comply with the hot weather and cold weather requirements of CSA-A23.1.
- .11 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .12 In locations where new concrete is dowelled to existing work, drill holes in existing concrete. Place steel dowels of deformed steel reinforcing bars and epoxy grout to anchor and hold dowels in positions as indicated.
- .13 Provide temporary bridging as required to permit access to all areas during placement, finishing and curing.
- .14 Do not place concrete until screed rails for hand operated strike-off devices are in place and firmly secured.
  - .1 Rails to be of type, and so installed, that no springing or deflection will occur due to weight of finishing equipment.

- .2 Set rails or headers to elevations to produce deck true to required grade and cross section.
- .3 Use polyethylene film or plastic coated tape if necessary to prevent concrete from bonding to rails.
- .4 Do not treat rails with release agents or parting compounds.
- .5 Subject to approval of the Contract Administrator, screed rail anchors which remain in the concrete may be used provided they are non-corroding and sit a minimum of 30 mm below the finished surface of the concrete.

### 3.2 MIX PRODUCTION

- .1 Concrete to be mixed, delivered and placed in accordance with CSA A23.1.
- .2 Concrete to be batched and mixed at a ready mix plant and delivered to site in ready to place form.
- .3 Control of slump on the job site to be in accordance with CSA-A23.1 except as otherwise specified below:
  - .1 The addition of water to increase slump is strictly prohibited unless prior written permission from concrete supplier is obtained.
  - .2 The use of WRA may be required to aid in placement of the concrete and obtain adequate consolidation in heavily reinforced sections.
  - .3 WRA addition shall occur at the batch plant or on site. For site addition, concrete supplier to provide written notice minimum 2 weeks prior to commencement of concrete work, indicating recommended dosages based on slump at point of discharge.
  - .4 Site addition WRA will be the responsibility of the concrete supplier.
  - .5 Slump and air must be measured both before and after addition of WRA.

### 3.3 PLACEMENT

- .1 Place concrete work in accordance with CSA-A23.1.
- .2 When concrete is placed by pump, the initial slurry used to prime the pump shall not be incorporated into the topping. The slurry shall be trapped and disposed off-site.
- .3 Ensure high points and slopes to drains as shown on drawings are maintained.
- .4 Pour concrete continuously between predetermined construction and control joints. Do not break or interrupt successive pours such that cold joints occur. Install a construction dam or bulkhead in case of a delay longer than 60 minutes. During delays between 5 and 60 minutes, protect the end of the placement with damp burlap.
- .5 Protect freshly placed concrete from exposure to dust, debris and precipitation.
- .6 Sleeves and inserts.
  - .1 No sleeves, ducts, pipes or other openings shall pass through concrete members except where indicated or approved by Contract Administrator.
  - .2 Electrical conduits, junction and fixture boxes shall not be embedded within concrete members.



- .3 Sleeves and openings greater than 100 x 100 mm not indicated, must be approved by Contract Administrator.
- .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Contract Administrator before placing of concrete.
- .5 Check locations and sizes of sleeves and openings shown on drawings.
- .6 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.

### 3.4 FINISHING

- .1 Finish concrete in accordance with CSA-A23.1/A23.2.
- .2 Consolidate concrete in accordance with CSA A23.1 and ACI 309.
- .3 Under adverse conditions only, excess bleed water may be removed from the surface using procedures acceptable to Contract Administrator and those noted in CSA-A23.1. Ensure surface is not damaged.
- .4 Immediately after final finishing apply approved evaporation retardant at indicated coverage rate. Evaporation retardant is not to be applied during finishing operations nor should it be worked into the surface.
- .5 Unless otherwise indicated round edges of formed joints in pavements with a 10 mm radius edging tool.
- .6 Flatwork:
  - .1 Continuously consolidate and finish to specified elevations, ensuring thickness and required elevations are maintained.
  - .2 Use of a floating vibratory screed to consolidate the top surface of the concrete will be mandatory.
    - .1 The use of screed rails may be required to meet required surface tolerances.
    - .2 Move vibrating screed forward as rapidly as possible while allowing proper consolidation and finishing of the concrete surface. Extended use of a vibratory screed may result in segregation of the concrete producing excessive mortar at the surface which can result in a weak surface layer.
  - .3 Immediately after concrete has been placed and consolidated, bull-float slab surface to a smooth uniform surface.
  - .4 When the surface is sufficiently set to accommodate the weight of a person with only minor indentation of the surface, and all bleed water has evaporated, **use one pass of a power float surface to smooth out the surface**. A light hand trowel will then be necessary to smooth out irregularities and provide a hard, dense surface.
  - .5 Use of hand trowels will be required to hand finish areas the finishing machine cannot reach.
  - .6 Surface free of all trowel marks and ridges.

### 3.5 FINISHING

- .1 Following consolidation and screeding, the surface shall be immediately bull-floated to close and smooth the surface.
- .2 The specified finish shall be Class A as defined by CSA-A23.1 and meet the following requirements.
  - .1 Straightedge value:  $\pm 8$  mm
  - .2 Surface texture:
    - .1 Structural slabs and overlays to receive membranes: surface to be free of all trowel marks and ridges.
    - .2 Miscellaneous curbs, pads, stairs not scheduled to receive surface treatment: nonslip broomed surface free of all trowel marks and ridges.
- .3 Immediately after final finishing, apply additional coat of evaporation reducer to prevent drying shrinkage. Apply at manufacturers recommended coverage. **Evaporation reducer is not to be applied during any finishing operation nor should it be worked into the surface.**
- .4 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.
- .5 Finishing Vertical Formed Surface
  - .1 Finishing of formed surfaces shall commence immediately after stripping the forms.
  - .2 All form ties and other metal items shall be removed or cut back to a depth of at least 20 mm from the surface of the concrete.
  - .3 Patch surface defects as directed by Contract Administrator.
  - .4 All formed surfaces shall receive a smooth-form finish in accordance with CSA-A23.1.
  - .5 Vertical surfaces of curbs, walls, up-stands, etc. shall receive a smooth-rubbed finish in accordance with CSA A23.1.

### 3.6 JOINTS

- .1 Install control joints at locations shown on the drawings. Joints shall correspond to location of slip dowels.
- .2 Location of control and construction joints:
  - .1 Concrete pavements: As shown on Drawings.
  - .2 Other flatwork not shown on drawings: not more than 15' on-centre and matching joints in adjacent work.
  - .3 Control joints in upstand walls and curbs to be formed matching joints in adjacent work (no more than 15' on-centre) and using a 1/2" x 1/2" form strip on each face. Tool in joints along top surface corresponding to form strips.
- .3 Control joints and construction joints shall be formed or tooled at locations shown. Refer to Drawings for paving patterns and joint locations.
  - .1 All joints to be sawcut via specialized dry-process cutting.

- .1 Sawcut to a minimum of one 1.5" or one-quarter of the depth of the slab, whichever is greater, following initial set of concrete.
- .2 Timing of the saw cutting will vary with weather conditions however are typically completed within 1 to 4 hours after final finishing. Timing of the saw cutting will be the responsibility of the Contractor. Sawcutting 24 hours following placement will not be permitted.
- .4 Where paving abuts curbs, walls and other vertical surfaces use 12 mm asphalt impregnated fibre board.
- .5 Unless otherwise indicated, all control and construction joints to be filled with a flexible joint sealant in accordance with 07910.

### 3.7 CURING

- .1 Cure and protect concrete in accordance with requirements CSA A23.1.
- .2 Concrete surfaces to be cured at a minimum temperature of 10°C for the entire curing period.
- .3 Curing methods shall be in accordance with CSA A23.1 unless otherwise indicated.
  - .1 Basic curing methods shall consist of one of the following:
    - .1 polyethylene sheet;
    - .2 forms in contact with concrete surface; or
    - .3 curing compounds to ASTM C309 at manufacturer's specified applications rates, when approved by Contract Administrator.
  - .2 Requirements for wet-curing:
    - .1 Immediately after final finishing, protect exposed surface against plastic shrinkage by means of a fog spray and/or evaporation reducer, until the concrete has enough strength to support the placement of the wetted burlap. When an evaporation reducer is used, intermittent reapplication may be required if the film evaporates before initiation of the wet cure.
    - .2 Burlap to be thoroughly presoaked by immersing it in water for a period of at least 24 hours immediately prior to placement.
    - .3 Commence wet curing with burlap and water as soon as the surface will support the weight of the wetted burlap without deformation. Burlap to be applied in one layer with strips overlapping at least 75 mm and be securely held in place without marring the concrete surface.
    - .4 Wet curing with burlap and water must be maintained for the periods indicated. Periodic rewetting by means of a soaker hoses, sprinklers, or other suitable methods approved by the Contract Administrator may be necessary.
- .4 Curing Schedule:
  - .1 Concrete paving slabs, slabs-on-grade, sidewalks, and exposed curbs subject to foot or vehicular traffic:
    - .1 7d at  $\geq 10^{\circ}\text{C}$  and for time necessary to attain 70% of the specified strength with a **wet-curing period of not less than 3d** followed by the application of a cure and sealing compound.

- .5 Unless noted otherwise the curing regime shall be consistent with the Class of Exposure. Refer to related sections for curing of concrete repair materials.

### 3.8 FIELD QUALITY CONTROL

- .1 Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory designated by Contract Administrator in accordance with CSA-A23.1 and Section 01450 - Quality Control and as described herein.
  - .1 Testing laboratory to be certified in accordance with CSA A283.
- .2 The Contractor will pay for costs of tests via the testing cash allowance as per Section 01210 - Allowances.
- .3 Frequency and Number of Tests:
  - .1 Not less than one strength test per 50 m<sup>3</sup> of concrete placed and not less than one test for each class of concrete placed on any one day.
  - .2 Slump and air measurements will be completed on each of the initial 3 loads of concrete per day of casting to ensure satisfactory control of the air content is established. If adequate control of air content is not established within the first 3 loads of concrete or if a test falls outside the specified limits, the testing frequency shall revert to one test per load until satisfactory control is re-established. Costs for additional testing will be the responsibility of the concrete supplier.
- .4 Contract Administrator may take additional test cylinders during cold weather concreting or when concrete quality is suspect. Cure cylinders on job site under same conditions as concrete which they represent.
- .5 Non-destructive Methods for Testing Concrete shall be in accordance with CSA-A23.2.
- .6 Inspection or testing by Contract Administrator will not augment or replace Contractor quality control nor relieve contractual responsibility.

### 3.9 DEFECTIVE CONCRETE

- .1 Defective concrete: cracking, spalling, scaling and concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.
- .2 Repair or replacement of defective concrete will be determined by the Contract Administrator, based on the specifications and the above guidelines.
- .3 Do not patch, fill, touch-up, repair or replace exposed concrete except upon express direction of Contract Administrator for each individual use.
- .4 Modify or replace concrete not conforming to lines, detail and elevations indicated on drawings.
- .5 Repair or replace concrete not properly placed, resulting in excessive honeycombing and other defects in critical areas of stress.
- .6 Notify the Contract Administrator of proposed methods of repairing or replacing defective concrete. Methods of repairing or replacing defective concrete shall be acceptable to the Contract Administrator.

**END OF SECTION**