

# CAST-IN-PLACE CONCRETE

GUELPH TRANSIT OPERATIONS & MAINTENANCE  
WATSON ROAD FACILITY  
WATER RECLAMATION PROJECT

SECTION 03300  
PAGE 1 OF 10  
JUNE 2013

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## **PART 1 GENERAL**

### **1.1 Scope of Work**

- .1 Cast-in-place concrete work shown on the drawings and as specified herein including the following:
  - (a) Tank foundations.
  - (b) Trench extensions and concrete floor

### **1.2 Related Work**

- .1 Precast Concrete Tanks: Section 03400

### **1.3 Reference Standards**

- .1 Canadian Standards Association:
  - CSA A23.1 - Concrete Materials and Methods of Concrete Construction
  - CSA A5 - Portland Cement/Masonry Cement/Blended Hydraulic Cement
  - CSA A23.2 - Methods of Test for Concrete
  - CSA A266.2 - Chemical Admixtures for Concrete
  - CSA A266.1 - Air Entraining Admixtures for Concrete
  - CSA G30.18 - Billet – Steel Bars for Concrete Reinforcement
  - CSA A269.1 - Falsework for Construction Purposes
  - CSA A269.3 - Concrete Formwork

### **1.4 Requirements of Regulatory Agencies**

- .1 Materials and workmanship shall comply with the requirements of the following:
  - (a) CRSI Manual of Standard Practice.
  - (b) Concrete Materials and Methods of Concrete Construction (CSA A23.1).
  - (c) Ontario Building Code

### **1.5 Workmanship**

- .1 The work shall be carried out by a recognized Contractor having at least five (5) years experience and mechanics skilled in the use of the materials specified.

## CAST-IN-PLACE CONCRETE

GUELPH TRANSIT OPERATIONS & MAINTENANCE  
WATSON ROAD FACILITY  
WATER RECLAMATION PROJECT

SECTION 03300  
PAGE 2 OF 10  
JUNE 2013

---

### **1.6**    **Warranty**

- .1     The Contractor shall provide a written, signed warranty, guaranteeing the repair of defects in materials and workmanship of this section. Warranty shall be for a period of two (2) years from date of Substantial Performance of work in accordance with section 00711 Supplementary General Conditions.

### **1.7**    **Submittals**

- .1     Refer to Section 01300 Product Data.
- .2     Reinforcing Steel
  - (a)    Submit six (6) copies of reinforcement detail drawings.
- .3     Formwork
  - (a)    Submit six (6) copies to the Consultant of detailed Shop Drawings of the proposed false and formwork for supporting concrete. Such drawings shall show design loads, type of equipment to be used for placing the concrete, method of construction, type and grade of materials, and any further information which may be required by the Consultant or any other authority having jurisdiction.
  - (b)    Attention should be given to the side pressures on the forms; details showing the method of securing the forms against side pressures must be shown on the drawings.
  - (c)    Falsework drawings shall be designed and sealed by a Professional Engineer licensed to practice in the Province of Ontario.
  - (d)    Review by the Consultant of such drawing shall in no way relieve the Contractor of his responsibility under the Contract for the successful completion of the Work, or for the adequacy and safety of the falsework.

### **1.8**    **Storage and Handling**

- .1     All reinforcing material shall be handled with care and shall not be dropped from trucks.
- .2     Skids or mechanical lifting equipment shall always be used when the weight of steel bundles is in excess of what can comfortably be handled by hand.

## CAST-IN-PLACE CONCRETE

**GUELPH TRANSIT OPERATIONS & MAINTENANCE  
WATSON ROAD FACILITY  
WATER RECLAMATION PROJECT**

**SECTION 03300  
PAGE 3 OF 10  
JUNE 2013**

---

### **1.9    Sampling**

- .1    In accordance with Section 1300 Product Data. Sampling of all materials, including concrete, will be done by the Consultant or his representative. The Contractor shall give the Consultant or his representative every reasonable facility for obtaining proper representative samples. Concrete for the making of compression test cylinders shall be supplied by the Contractor, without charge to the Owner.

### **1.10   Testing**

- .1    In accordance with section 1400 Quality Control. All testing will be done and paid for by the Contractor under the cash allowance.
- .2    Copy of mix designs, sieve analysis and specific gravity of aggregates with report from testing agency, shall be submitted to the Consultant for his review.
- .3    Tests for determining alkali content shall be carried out in accordance with ASTM Standard C114-83A paragraph 17.1 Standard Method of Chemical Analysis of Hydraulic Cement.
- .4    Concrete testing shall be in accordance with CSA-A23.4.
- .5    Concrete which does not meet the specified strength requirements or which show excessive surface honeycombing or other serious defects, including defects due to rough handling, shall be rejected and replaced by the manufacturer at his own expense.

## **PART 2   PRODUCTS**

### **2.1    Materials**

- .1    Concrete materials shall be as specified in CSA A23.1.
- .2    Water: Verify that no salts are present which will cause efflorescence.
- .3    Cement: Normal Portland Cement, Type 30.
- .4    Aggregate: Natural sand, gravel, or crushed rock with a maximum size of 20mm. CSA Standard A23.1 shall govern for approval and control of fine and coarse aggregates, and their grading. Provide aggregate from the same source for entire project for concrete exposed to view.
- .5    All concrete shall contain an approved non-retarding water reducing agent and an approved compatible air-entraining agent in compliance with C.S.A. Standard

## CAST-IN-PLACE CONCRETE

**GUELPH TRANSIT OPERATIONS & MAINTENANCE  
WATSON ROAD FACILITY  
WATER RECLAMATION PROJECT**

**SECTION 03300  
PAGE 4 OF 10  
JUNE 2013**

CAN3-A23.1-00 both of which shall be added in accordance with manufacturer's recommendations.

- .6 Formwork shall be in accordance to CSA A23.4 and shall be free from warp, straight and free from defects which would weaken the formwork or blemish the concrete.
- .7 Reinforcing steel shall be deformed billet steel in accordance with CSA G30.18 with a minimum yield strength of 400 MPa. Stirrups and ties may be of intermediate grade, minimum yield 300 MPa.
- .8 Chairs, spacers or ties: to CSA A23.1.
- .9 Form stripping agent shall be colourless non-staining mineral oil, free of kerosene.
- .10 Joint Sealer: Duoflex 333, or approved equal.
- .11 Expansion joint material shall be 12mm Sealtight Ceramar closed cell PVC foam joint filler as manufactured by W.R. Meadows, or approved equal.
- .12 Cure and seal finish shall be W.R. Meadows 1220 white pigmented curing compound.

### **2.2 Strength and Consistency**

- .1 Ready-Mix concrete shall be suitable an C-1 exposure classification in accordance with CSA A23.1, and shall have a minimum compressive strength of 30 MPa in seven (7) days and 35 Mpa in twenty-eight (28) days, a minimum cement content of 365 kg per cubic meter, a maximum water/cementing materials ratio of 0.40, a slump at time and point of discharge between 60 mm and 90 mm, and 5 to 8% air entrainment.
- .2 **The use of calcium chloride, slag, silica-fume or fly ash will not be permitted.**

## **PART 3 EXECUTION**

### **3.1 Formwork**

- .1 Formwork shall be in accordance with C.S.A. A23.1 and CSA S269.3.
- .2 Forms shall conform to shapes, lines and dimensions of the members as called for on the plans and shall be of sufficient strength and rigidity to withstand the construction loads without undue deflection, including
  - (a) Vertical loads based on concrete weighing 2400 kg/m<sup>3</sup> (150 lbs/cu ft).

## CAST-IN-PLACE CONCRETE

- (b) Live load allowance for impact, runways, buggies, etc. equal to  $3.6 \text{ KN/m}^2$  (75 lbs/sq ft).
  - (c) Horizontal force equal to 2% of any vertical and live loads.
- .3 Form sheeting shall be BCLMA Grading and Dressing Rule No. 59 or to C.S.A. 043 – Construction Grade S4S/pine or spruce and a minimum of 30mm thick. All exposed surface forms shall be lined with large sheets of “Rezited Sylvaply”, 6mm thick or “Tempered Masonite”, 4.5mm thick or equal, properly applied to prevent buckling; 20mm fir plywood with sanded face to the concrete may be used in place of 30mm form sheeting and lining.
- .4 Where 20mm fir plywood is used studding shall not be over 400mm center to center. No studding smaller than 150mm x 50mm will be allowed. All material used for studding shall be spruce or pine, dressed on two (2) edges. Walings shall not be over 760mm apart center to center or as directed by the Consultant. All walers shall be not less than 100mm x 150mm or equal in section.
- .5 All tie rods for reinforcing the forms shall be of such type or design as may be removed from the front or exposed surface of the structure without cutting the face of the structure. The portion of the tie rod remaining in the structure must be at least 50mm in from the face of the concrete and all holes left by the removal of the rods must be neatly filled with cement mortar. The rods projecting from unexposed or back of structures must be cut off flush with the surface of the concrete and any holes filled with cement mortar. Wire ties and snap ties will not be permitted.
- .6 All walers shall be adequately braced and shored from side of excavation, etc. Size and spacing of tie rods must be such that, in the opinion of the Consultant, they will maintain the pressure of concrete.
- .7 The foregoing sizes and spacing of forms, walers, studs, etc., shall only be regarded as minimum requirements and shall not necessarily be adequate for all structures.
- .8 Forms for exposed surfaces may be either new plywood or steel as authorized by the Consultant; plywood in sheets and prefabricated plywood or steel panels may be re-used; providing their condition is such as to produce a surface equal to that which would be attained using new materials.
- .9 Where prefabricated panels are used, care shall be taken to ensure that adjacent panels remain flush. Where metal forms are used, all bolts and rivets shall be countersunk and well ground to provide a smooth, plane surface.

## CAST-IN-PLACE CONCRETE

- .10 It shall be permissible to use the forms over again where possible, provided they are thoroughly cleaned and in good condition after being removed from the former portions of the Work. The Consultant shall be the sole judge of their condition and his decision shall be final regarding the use of them again. "Sylvaply" Masonite, etc., shall not be used more than four (4) times, and will be thoroughly cleaned before using.
- .11 Provide temporary openings at bottom of all deep units to facilitate cleaning and inspection.
- .12 The inside of all forms shall be carefully and thoroughly wetted before concrete is placed, or, when required, thoroughly coated with a non-staining, form release agent. Such coating shall be applied before reinforcing is placed.
- .13 All embedded material shall be maintained free of the release agent. Faces in contact with cast-in-place concrete or to receive waterproofing shall also be maintained free of the release agent.
- .14 Before any load is placed on the falsework, the Consultant must be furnished with a statement from the Formwork Professional Engineer whose stamp appears on the falsework plans certifying that he has examined the falsework and found it to be satisfactory for the purpose for which it was designed.

### **3.2 Fabricating Reinforcing**

- .1 Fabricate reinforcing in accordance with CSA A23.1

### **3.3 Placing Reinforcing**

- .1 Immediately before placing, thoroughly clean reinforcement of mud and debris that may destroy or reduce the bond.
- .2 Accurately place reinforcing steel in positions as shown on the approved detail drawings and hold firmly during placing, compacting and setting of concrete.
- .3 The reinforcement where spacing in each direction is:
  - (a) Less than 300mm: - tie at alternate intersections.
  - (b) 300mm or more: - tie at each intersection.
- .4 Do not field bend reinforcement except where indicated or authorized by Consultant. When authorized, bend without heat, applying a slow and steady pressure. Replace bars that develop cracks or splits.

## CAST-IN-PLACE CONCRETE

- .5 Metal reinforcement shall be accurately placed according to the plans and firmly secured in position by a non-staining type, galvanized steel, plastic coated steel, plastic or other approved chairs, spacers or ties. The use of stones, bricks, wood or concrete block as supports will not be permitted.
- .6 Do not drive bars through sub-grade or muds to act as bar supports.
- .7 No splices of reinforcement shall be made, except as shown on the plans, or as specified, or as authorized by the Consultant.

### **3.4 Concrete Placement**

- .1 Remove water from forms. Do not permit water to flow over or to rise on concrete within twenty-four (24) hours of placing concrete.
- .2 Remove sawdust, mud, debris or other foreign substances from equipment, formwork and reinforcing steel.
- .3 Before placing concrete, certify to the Consultant that all formwork, reinforcing steel and anchor bolts for the concrete to be placed, have been carefully inspected by the Contractor. Ensure the structural safety of the formwork and conformity with the Contract Documents regarding size, placing and cleanliness of formwork and reinforcing steel.
- .4 Obtain Consultant's approval prior to placing concrete. Provide at least twenty-four (24) hours notice of scheduled delivery prior to placement. Provide a minimum of four (4) hours notice prior to placement of concrete in slabs or closing forms in walls to allow review of the reinforcement. This will be strictly enforced. Concrete arriving on site prior to review may be rejected.
- .5 Concrete shall be delivered as close as possible to the point of placing, in a thoroughly mixed and uniform mass and shall be discharged with a satisfactory degree of uniformity. Complete the placing of concrete within one and a half (1½) hours after the introduction of the mixing water to the cement and aggregates. Do not add water to the mix after the concrete has left the plant.
- .6 Concrete shall arrive at the site having a temperature of not less than 16°C nor greater than 32°C.
- .7 Convey concrete from the mixer to the place of final deposit by methods which will prevent separation or loss of the ingredients. (See also items 3.5).
- .8 Place concrete as nearly as practicable in its ultimate position in order to avoid rehandling or flowing. Do not flow, push or drag concrete into place. Place concrete uniformly as rapidly as possible after leaving the mixer.

## CAST-IN-PLACE CONCRETE

**GUELPH TRANSIT OPERATIONS & MAINTENANCE  
WATSON ROAD FACILITY  
WATER RECLAMATION PROJECT**

**SECTION 03300  
PAGE 8 OF 10  
JUNE 2013**

- .9 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .10 Place concrete in a single continuous complete operation so that each unit shall be monolithic without joints.
- .11 Unless otherwise directed by the Consultant, consolidate concrete during placing by means of vibrators. The frequency of vibration shall not be less than 6,000 cycles per minute. Vibrate thin walls or other thin reinforced concrete members with small diameter vibrators or by outside pneumatic or electric vibrators. Keep the vibrators off the reinforcement. Do not over vibrate so as to cause separation of the concrete materials. Work concrete around the reinforcement and into the corners of forms to prevent voids and honeycombing. Vibrate concrete as it is placed.
- .12 While placing concrete, Contractor shall ensure that all forms remain plumb and true.
- .13 Horizontal surfaces of concrete on which waterproofing is to be subsequently placed shall be accurately screeded. They shall then be floated with wooden floats and given a very light steel trowelling to produce a uniformly smooth surface free of irregularities or projections that might damage the membrane.

### **3.5 Chuting**

- .1 Concrete may be conveyed by chuting only on special authority from the Consultant. In no case will permission be granted for the addition of water to concrete mixers for the purpose of facilitating the placing of concrete chutes.
- .2 When concrete is conveyed by chuting, the plant shall be of such size and design as to insure a practically continuous flow in the chute. The chutes shall be of metal or metal lined. The angle of the chute with the horizontal and the shape of the chute shall be such as to allow the concrete to slide without separation of the ingredients. The delivery end of the chute shall be as close as possible to the point of deposit. When the operation is intermittent, the chute shall discharge into a hopper. The chute shall be thoroughly flushed with water before and after each run and the water used for this purpose shall be discharged outside the forms. Chutes shall be properly baffled or hooded at the discharging end to prevent separation of the aggregates.

### **3.6 Tolerances**

- .1 Cast-in-place concrete: to CAN3-A23.1-00, unless noted otherwise on the drawings.



## CAST-IN-PLACE CONCRETE

### **3.7 Inserts and Accessories**

- .1 Install embedded items as indicated on the drawings.

### **3.8 Removal of Forms**

- .1 Removal of forms and of shorings shall not be started until the concrete has attained sufficient strength to safely support its own weight and the weight of any and all superimposed construction loads, and in no case shall any forms or shores be disturbed or removed until so authorized by the Consultant.
- .2 All formwork shall be removed from the site by the Contractor after all concrete work is complete, and the entire site left in a neat and clean condition.

### **3.9 Curing**

- .1 Accelerated curing shall be in accordance with CSA-A23.4.
- .2 Concrete shall be moist-cured for a minimum of 3 days from time of casting.
- .3 If steam curing is used, it shall be applied after initial set has taken place, and shall be continued until the concrete strength has reached 25 Mpa. In this case, no further moist curing shall be required.
- .4 The ambient air temperature shall rise at a rate not to exceed 20°C per hour to a maximum temperature of 70°C. The ambient temperature shall not be allowed to fall at a rate exceeding 20°C/hour.
- .5 The members shall not be subject to freezing temperature until reaching its design strength of 30 Mpa.

### **3.10 Concrete Surface Finish**

- .1 All surfaces shall be finished as follows:
  - (a) Preparatory work on surfaces to be finished shall be in accordance with section 24 General of CSA Standard CAN3-A23.1-00.
  - (b) Immediately following the removal of forms, all fins and irregular projects shall be removed from all surfaces. All lines that are not true must be corrected by chipping, grinding or patching as necessary. Parging to correct irregularities will not be permitted. On all surfaces, the cavities produced by form ties, and all other holes, honeycomb areas, broken corners or edges and other defects, shall be thoroughly chipped out, cleaned and after having been kept saturated with water for a period of not less than thirty (30) minutes, shall be carefully pointed and trued by trowel

## CAST-IN-PLACE CONCRETE

**GUELPH TRANSIT OPERATIONS & MAINTENANCE  
WATSON ROAD FACILITY  
WATER RECLAMATION PROJECT**

**SECTION 03300  
PAGE 10 OF 10  
JUNE 2013**

---

with mortar. Mortar used in pointing shall be not more than one (1) hour old. All mortar patches shall be cured as specified under "Curing". All expansion joints, in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges. The small surface voids formed by air bubbles must be filled by rubbing a thin grout composed of clean fine sand and cement into the moistened surface. When the patching and filling have adequately hardened, a carborundum stone shall be used to finish the surface to a smooth, uniform and closed texture. Any voids opened during the grinding process shall be re-filled.

### **3.11 Floor Slabs**

- .1 The grades of the slabs shall be set by screeding, darbying, or bull floating to within a tolerance of 5mm + or - as measured by a 3 m screed. Surface to be suitable for an overlay.
- .2 Finishing of slabs shall be done by skilled personnel qualified for this type of work.
- .3 Sawcut floor slab in accordance with existing cut pattern.
- .4 Protect finished slabs against damage.

End of 03300