

PART 1 - GENERAL

- | | | |
|--------------------------------|-----|--|
| <u>1.1 WORK INCLUDED</u> | .1 | This section specifies requirements for constructing cast-in-place concrete and precast concrete for rigid frame culverts. Work includes supply and installation of formwork, reinforcement, concrete and accessories. |
| | | |
| <u>1.2 RELATED SECTION</u> | .1 | Section 33 42 16 - Precast Rigid Frame Culverts. |
| | | |
| <u>1.3 REFERENCE STANDARDS</u> | .1 | ASTM C171-07, Standard Specification for Sheet Materials for Curing Concrete. |
| | .2 | ASTM C260-10a, Standard Specification for Air-Entraining Admixtures for Concrete |
| | .3 | ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete. |
| | .4 | ASTM C494/C494M-11, Standard Specification for Chemical Admixtures for Concrete. |
| | .5 | AASHTO M182-05, Burlap Cloth Made from Jute or Kenaf. |
| | .6 | CAN/CSA-A3000-08, Cementitious Materials Compendium. |
| | .7 | CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test Standard Practice for Concrete. |
| | .8 | CSA S269.1-M92(R2008), Falsework for Construction Purposes. |
| | .9 | CSA S269.3-M92(R2008), Concrete Formwork. |
| | .10 | CSA G30.18-M92(R2007), Billet- Steel Bars for Concrete Reinforcement. |
| | | |
| <u>1.4 SUBMITTALS</u> | .1 | Submit shop drawings and samples in accordance with Section 01 33 00 for items listed in Supplementary Specification. |
-

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Portland Cement: to CSA Standard A3000, Type GU, Normal and CSA A23.1, Table 6, Type GU.
 - .2 Blended Hydraulic Cement: CSA Standard A3000 and CSA A23.1, Table 7. Ternary blended cements may be used with the concurrence of the Departmental Representative.
 - .3 Aggregates: to CSA-A23.1. For exposure Classes C-XL, C-1, C-2, C-3, C-4 and F-1, supply certification that the concrete mixtures have been evaluated for alkali-aggregate reaction and that measures have been taken to improve the reaction.
 - .4 Water: to CSA-A23.1, Table 9.
 - .5 Admixtures:
 - .1 Air Entraining: to ASTM C260.
 - .2 Chemical: to ASTM C494/C494M or C1017 for flowing Concrete.
 - .6 Supplementary Cementing Materials:
 - .1 Low Calcium Fly Ash (Class F): to CSA A3000 and CSA 23.1, Table 8. Provide certification for the fly ash used in the concrete.
 - .7 Reinforcement:
 - .1 Bars: to CSA G30.18, billet steel, grade 400, deformed.
 - .2 Welded Steel Wire Fabric: to CSA G30.5.
 - .3 Bar Supports and Spacers: to CSA- A23.1.
 - .8 Formwork:
 - .1 Forms: to CSA-A23.1, plywood and lumber, clean and free of loose knots, splits or metal.
 - .2 Form Ties: to CSA-A23.1, removable or snap-off metal ties, fixed or adjustable length. Form ties, tie wire, spacers or other embedded fixtures shall not be positioned closer than 20 mm of the surface. For severe environments, the dimension shall be as shown on the project drawings.
 - .3 Release Agent: non-staining natural organic chemicals of sprayable consistency which prevent adhesion of concrete to forms.
 - .4 Design: to CSA S269.3.
 - .9 Curing Compound: to CSA A23.1, white. Refer to AASHTO M182; ASTM C171; ASTM 309.
 - .10 Non-shrink Grout: pre-mixed, dry pack or pourable, containing non-metallic aggregate, plasticizing

- | | |
|----------------------------------|--|
| <u>2.1 MATERIALS</u>
(Cont'd) | .10 Non-shrink Grout:(Cont'd)
agents and cement, minimum compressive strength of 45 MPa at 28 days. |
| <u>2.2 CONCRETE MIX</u> | <ul style="list-style-type: none">.1 Concrete shall be class of exposure C-1, with minimum compressive strength of 35 MPa at 28 days..2 Mix proportions to provide workable concrete having required durability and strength..3 Air entraining admixtures: to obtain Air Content Category as defined in CSA A23.1, Tables 1, 2 and 4..4 Slump: to CAN/CSA A23.1, Section 4.3.2.3..5 Compressive strength at 28 days: for mixtures containing supplementary cementing materials, other ages may be appropriate as determined by the Departmental Representative. Evaluate strength in accordance with CSA A23.1..6 Water/cement ratio: to CSA A23.1, Tables 1, 2 and 4 as required for exposure conditions..7 Ready mix plant must conform to CSA and possess a current active membership in the Atlantic Provinces Ready Mix Concrete Association. |

PART 3 - EXECUTION

- | | |
|--------------------|---|
| <u>3.1 GENERAL</u> | <ul style="list-style-type: none">.1 Do concrete Work to CSA-A23.1 and as herein specified..2 Use ready-mixed concrete unless on-site mixing approved..3 Do not change concrete mix without prior approval of Departmental Representative. Changes in material supply will require submission of a new mix design for review..4 If on-site mixing is approved, equipment to be capable of accurately proportioning ingredients to produce required concrete. |
|--------------------|---|
-

3.2 FORMWORK AND
FALSEWORK

- .1 Construct formwork and falsework to CSA-A23.1 and CSA S269.1.
- .2 Construct formwork to produce finished concrete to required shape, dimensions, and levels indicated within tolerances required by CSA-A23.1. Provide close fitting joints to prevent leakage of mortar, and form ties and bracing sufficient to withstand pressure of plastic concrete without deflection.
- .3 Falsework to be of sufficient strength to support total load of formwork, concrete, reinforcing steel, workers and equipment.
- .4 Use approved form release agent.
- .5 Formwork removal shall be in accordance with CSA A23.1.
- .6 Fill form tie holes with non- shrink mortar and finish to texture of adjacent concrete.

3.3 PLACING

- .1 Place concrete to CSA A23.1, Section 7.
- .2 Place concrete on dampen base.
- .3 Convey concrete from mixer to forms by methods that will maintain specified slump and prevent segregation.
- .4 Do not drop concrete more than 1.5 metres vertically unless it can be shown that the concrete will not segregate. Deposit concrete in final position in forms to avoid lateral movement.
- .5 Place concrete in continuous operation, starting from lowest point in form, in lifts not greater than 500 mm.
- .6 Vibrate or tamp each layer to obtain dense homogeneous structure free of cold joints, fill planes, voids and honeycombing. For vertical installation vibrate at least 150 mm into previously placed layers. Concrete to be well bonded to all reinforcing steel, anchors, waterstops and other embedded parts.

3.4 JOINTS

- .1 Make joints in accordance with CSA-A23.1, Section 7.3.
-

- | | | |
|----------------------------------|----|---|
| <u>3.5 FINISHING</u> | .1 | Finish concrete in accordance with CSA A23.1, Section 7.5. |
|
 | | |
| <u>3.6 CURING AND PROTECTION</u> | .1 | Provide curing and protection to CSA A23.1, Section 7.4. The temperature of the concrete as placed to be within the limits of Table 14. |
| | .2 | Do not place concrete on frozen base. Remove all snow, ice and frost from area prior to placing concrete. Do not place concrete on, or against, any surface that will lower the temperature of the concrete in place below the minimum value shown in Table 14. |
| | .3 | When air temperature may drop below 5C or when there is a probability that it will drop below 5C within 24 hours of placing, raise temperature of base, reinforcing steel, embedded parts and forms above 5C prior to placing concrete. In addition, before placement have available all materials and equipment needed for adequate protection and curing. |
| | .4 | When air temperature is at or above 27C, or when there is a probability of its rising to 27C during the placing period, provide facilities for protection of concrete in place from effects of hot and/or drying weather conditions. Under severe drying conditions, protect formwork reinforcement and concreting equipment from direct rays of sun, or cool by fogging. |
| | .5 | After placing is completed, maintain minimum curing conditions for the concrete in accordance with CSA-A23.1, Section 7.4. |
|
 | | |
| <u>3.7 CONCRETE QUALITY</u> | .1 | Departmental Representative may require inspection or testing of concrete in accordance with CSA-A23.1, using CSA certified concrete laboratory. |
|
 | | |
| <u>3.8 DEFECTIVE WORK</u> | .1 | Remediate all structural defects in unexposed concrete such as spalling, low points and delaminating where defect could cause long term deterioration of the structure. |
| | .2 | Remediate all structural defects and all aesthetic defects in exposed concrete. Aesthetic defects include honeycombing, blemishes, embedded debris from tie holes and the like. |
-

3.8 DEFECTIVE
WORK

(Cont'd)

.3 Submit method and obtain approval of Departmental
Representative prior to proceeding with remediation
of all structural and aesthetic defects.