

**SPECIFICATIONS FOR THE FABRICATION
OF PRECAST REINFORCED CONCRETE BOX CULVERTS**

1045. 1. **DESCRIPTION**

The work will include:

- (a) The supply of materials and the fabrication of precast reinforced concrete box culvert units as shown or described, or reasonably inferable from the plans and specifications.
- (b) The supply of all strand, anchorages and other incidental materials required for stressing.

1045. 3. **SUPPLY OF MATERIALS**

3.1 Concrete

Concrete shall have a minimum ultimate compressive strength of 31.0 MPa at 28 d.

Maximum nominal size of coarse aggregate shall be 20 mm. The coarse aggregate shall be uniformly graded and not more than 1% shall pass a 75 um sieve.

Coarse aggregate shall consist of crushed stone or gravel or a combination thereof, having hard, strong, durable particles free from elongated particles, dust, shale, earth, vegetable matter or other injurious substances.

The fine aggregate shall be graded uniformly and not more than 3% shall pass a 75 um sieve.

Fine aggregate shall consist of sand, stone, screenings or other inert materials with similar characteristics, or a combination thereof, having clean, hard, strong, durable, uncoated grains and free from injurious amounts of dust, lumps, shale, alkali, organic matter, loam or other deleterious substances.

When the aggregates are subjected to five cycles of the Sulphate Soundness Test, ASTM Designation C88 (latest edition), the mass percentage of loss shall not be more than 10% when sodium sulphate is used, or 15% when magnesium sulphate is used.

Concrete shall have between 3% and 5% entrained air. All admixtures will be subject to the Engineer's approval.

Cement shall be in accordance with ASTM Designation C150 (latest edition).

3.2 Prestressing Steel

The high strength polyvinyl chloride covered strand shall be in accordance with: (i) the size and ultimate strength as shown on the plans, (ii) ASTM Designation A416 (latest edition) and the following:

3.2.1 Tagging

The size of strand, coil number, heat number and the mark of the manufacturer shall be marked on a tag securely attached to each reel or reeless pack. This tag shall identify also the strand with its own stress-strain curve.

1045. 3. SUPPLY OF MATERIALS (Cont'd)

3.2.2 Stress-Strain Curve

One stress-strain curve shall be provided by the manufacturer for each reel or reeless pack.

3.2.3 Testing

All prestressing steel to be used in the culverts shall be subject to the approval of the Engineer.

Should the Engineer consider it necessary, this approval, in addition to the requirements of Section 12 of ASTM Designation A416 (latest edition), will be based on tests carried out by the Contractor at his expense in a testing laboratory subject to the approval of the Engineer. The Contractor shall test not less than three specimens which are truly representative of the strands to be used in the culverts. The results of these tests shall be supplied to the Engineer. The Engineer may require the Contractor to supply additional representative specimens to the Department for independent testing.

Physical properties of the strand shall be based on the total metallic area of the individual wires.

3.3 Anchorages

End anchorages for the post-tensioned strands, including all additional steel reinforcement that may be required, shall be designed by the Contractor and the anchorages shall be capable of sustaining, without appreciable slip, the loads which will be applied. Such anchorages will be subject to the approval of the Engineer.

3.4 Polyvinyl Coating

The thickness of the polyvinyl chloride coating shall be 1.5 mm.

3.5 Reinforcing Steel

Reinforcing steel shall be in accordance with ASTM Designation A615M (latest edition).

3.6 Incidental Material

Incidental material will be subject to the approval of the Engineer.

1045. 7. CONSTRUCTION METHODS

7.1 Tolerances

Cross-sectional dimensions, including the locations of the holes for post-tensioning strands, shall not vary from those shown on the plans by more than 3 mm.

7.2 Forms

The faces of the forms shall be smooth to impart a good finish to the concrete and particular care shall be taken to ensure the verticality and rigidity of the end forms producing surfaces which will be in contact with each other after erection. The faces of the forms shall be treated with a release agent to ensure that stripping can be carried out without damage to the concrete.

All material that is to be embedded in the concrete shall not come in contact with the release agent.

1045. 7. CONSTRUCTION METHODS (Cont'd)

7.3 Reinforcing Steel

Reinforcing steel shall be placed in the positions shown on the plans, and shall be retained in such positions by means of bar accessories and wires during and after the depositing of concrete. Bar accessories shall be completely galvanized or shall be made from non-rusting material.

Reinforcing steel shall be kept free of all foreign material in order to ensure a positive bond between the concrete and steel. The Contractor shall remove all material which has accumulated on the steel before concrete is placed.

Intersecting bars shall be tied positively at each intersection.

7.4 Depositing of Concrete

Concrete shall be deposited carefully and well worked by vibrating so that it shall fill the forms and make complete contact with all reinforcing bars.

Concrete shall be deposited in such frequent locations in the forms that there shall be no necessity for moving large quantities of concrete from place to place in the forms. The concrete shall be placed in layers not exceeding 600 mm in depth and each layer shall be vibrated into place by methods which will not segregate the ingredients.

The Contractor shall provide and use different personnel on the depositing equipment and on the vibrating equipment to ensure that every batch of concrete is properly worked into place as deposited.

Buckets, chutes or other equipment used to deposit concrete in the units shall be positioned as close to the top of the forms as possible in order to keep free falling of the concrete to a minimum.

The depositing of concrete in every unit shall be a single, continuous, complete operation so that each unit shall be monolithic without joints.

Before any concrete is deposited, the interior of the forms shall be cleaned of all chips, earth, shavings, sawdust, rubbish or other foreign substances.

7.5 Testing of Concrete

The Contractor shall at his own expense, take a sufficient number of cylinders from each separately mixed batch of concrete to be placed in a unit, to establish that each batch has achieved a minimum compressive strength of 31.0 MPa. The minimum compressive strength will be deemed to have been obtained when the average compressive strength of three cylinders from an individual batch equals or exceeds 31.0 MPa. The cylinders shall be molded and initially field cured in accordance with ASTM Designation C 31 (latest edition) and finally cured and tested in accordance with ASTM Designation C 39 (latest edition). A slump, air test and concrete temperature shall be obtained for each set of cylinders. The results of all these tests shall be submitted to the Engineer.

All test cylinders shall be cured under the same conditions as the unit until the steam curing or moist curing of the unit has been completed.

1045. 7. CONSTRUCTION METHODS (Cont'd)

7.5 Testing of Concrete (Cont'd)

The Engineer, at his own discretion and at the Department's expense, may make any other tests deemed necessary on the concrete, on the components of the concrete, as well as on any finished or partially finished unit. The Contractor shall allow the Engineer unhindered access to the concrete, concrete components and units and also to assist the Engineer in carrying out any tests.

7.6 Concrete Finish

Immediately after the removal of the forms, all defects in the concrete shall be brought to the Engineer's attention and they shall be repaired as directed by the Engineer, providing the defects are not extensive enough to cause rejection of the unit.

All objectionable fins, projections, offsets, and other surface imperfections shall be removed totally to the Engineer's satisfaction by approved means.

Honeycomb, if any, shall be repaired as soon as the forms are removed, subject to the approval of the Engineer. When approved by the Engineer, repairs shall be accomplished by removing all aggregate that is loose or that is not bonded thoroughly to the surrounding concrete, washing the sound concrete with clean water and using a wire brush to remove all loose particles. An approved epoxy resin shall be applied to the dried areas to be patched immediately before applying a cement-sand grout of the same quality and mix as that used in the concrete, except that all aggregates retained on a 2.36 mm sieve are to be eliminated. Patched areas shall be rubbed flush with the surrounding surface after the cement-sand grout has hardened.

Finally, the concrete surface shall be wetted down thoroughly and all air pockets and other surface cavities shall be filled carefully with approved cement mortar. When sufficiently dry, the surface shall be rubbed down to leave a smooth and uniform finish. Cement washes of any kind will not be allowed.

7.7 Curing

Concrete shall be either moist cured for a minimum of 72 h from the time of casting or steam cured until the concrete has reached a strength (f'_{ci}) as shown on the plans or as specified by the Engineer.

If steam curing is used, the steam shall be applied after the initial set has taken place. Initial set will be deemed to have taken place 4 h after the completion of concrete placing.

During steam curing, the ambient air temperature shall rise at a rate not to exceed 20° C per h to a maximum temperature of 70° C.

Once curing has been completed, the temperature of the concrete shall not be allowed to fall at a rate exceeding 20° C per h. The units shall not be subject to freezing temperatures until they have reached the design strength of 31.0 MPa.

1045. 7. CONSTRUCTION METHODS (Cont'd)

7.8 Handling, Storage and Loading

Lifting devices shall be cast into the concrete at the locations shown on the plans. Where more than one strand is called for, the individual strands shall be separated and splayed out sufficiently to ensure adequate bond and load transfer to the main body of concrete. The lifting devices shown on the drawings are only minimum requirements. The Contractor shall satisfy himself as to the adequacy of the lifting devices.

The Precast Contractor shall not release any unit to another Contractor until the concrete design strength has been achieved. The Precast Contractor may have to store the units, strands, anchorages and other incidental materials, free of charge, past the Contract completion date, depending on the progress of the Bridge Contractor.

The Bridge Contractor will give the Precast Contractor 48 h notice of his intention to pick up the precast units. The Precast Contractor shall load the precast units onto the Bridge Contractor's hauling equipment and shall co-operate with the Bridge Contractor as to the loading procedures. The point of loading shall be in the City of Winnipeg.

1045. 9. METHOD OF MEASUREMENT

- a) The supply of precast reinforced concrete box culverts will be measured on a unit basis and the number to be paid for will be the total number of units fabricated and accepted by the Engineer.
- b) The supply of cables and anchorages for stressing and the supply of other incidental materials will be paid for on a Lump Sum Basis and no measurements will be taken for this work.

1045. 11. BASIS OF PAYMENT

- a) Supply of precast reinforced concrete box culverts will be paid for at the Contract Unit Price for "Supply of Precast Reinforced Concrete Box Culverts", measured as specified herein, which price will be payment in full for performing all operations herein described and all other items incidental to the work included in this Specification.
- b) The supply of cables and anchorages for stressing and the supply of other incidental materials will be paid for at the Contract Lump Sum Price for "Supply of Miscellaneous Material" measured as specified herein, which price will be payment in full for performing all operations herein described and all other items incidental to the work included in this Specification.