

DIVISION 4 - DRAINAGE WORKS

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SPECIFICATION SECTION 04100 – PRECAST R.C. PIPE CULVERTS AND BOX CULVERTS

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SPECIFICATION SECTION 04100 – PRECAST R.C. PIPE AND BOX CULVERTS

1. DESCRIPTION

This Specification Section prescribes the requirements for the construction of Precast Reinforced Concrete Pipe Culverts and Box Culverts set on bedding and/or bearings as shown on the Drawings and subject to the approval of the Engineer.

Inlet and outlet structures, headwalls and associated erosion and scour protection Works are included in other Specification Sections.

2. MATERIAL REQUIREMENTS

2.1 Reference Standards

The most recent edition of the following Standards shall be applied to Works covered by this Specification Section.

Vietnamese Standard:

TCVN 9116-2012: Reinforced Concrete Box Culvert

22TCN 159-1986: Reinforced Concrete Pipe Culvert

TCVN 9113-2012: Drainage Concrete Pipe

International Standard:

ASTMC76M: Reinforced Concrete Culvert, Storm Drain and Sewer Pipes (Metric)

ASTM C990: Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

2.2 Bedding

- a) Granular material for bedding shall be in accordance with Paragraph 4.2, Table 4 of Vietnamese Standard TCVN 7570-2006 and subject to the approval of the Engineer.
- b) Lean concrete for bedding shall be class C10 bedding or blinding concrete in accordance with the requirements of Specification Section 07100 Concrete and Concrete Structures.

2.3 Concrete

Concrete used for all structural work described in this Specification Section shall be of the classes indicated on the Drawings and shall conform with the requirements specified in Specification Section 07100 Concrete and Concrete Structures. All finished surfaces of concrete, which are not permanently covered shall; have a smooth fair finish, be even and free from waves, be finished true to line/levels and contours (if applicable), be free of blow holes, be free of honeycombing and air bubbles and the like. Any holes left by bolts used to position the formwork shall be filled in with epoxy grout flush with the surrounding surfaces.

2.4 Reinforcing Steel for Concrete

All reinforcing steel used in the Works shall conform with the requirements specified in Specification Section 07500 Reinforcing Steel.

2.5 Reinforced Concrete Culverts

- a) Reinforced Concrete Culverts shall be precast reinforced concrete class C25 and shall conform with Specification Section 07100 Concrete and Concrete Structures. Pipes shall be laid with male/female joints and reinforcement in all pipes shall consist of spiral steel cages with longitudinal bars all as indicated on the Drawings unless otherwise approved by the Engineer.
- b) No precast concrete products shall be cast until the Engineer has approved the manufacturing plant and the equipment therein. The Contractor shall ensure that no damaged precast concrete items are taken to Site or installed on Site. Damage is deemed to include, inter alia, honeycombing, chips, cracks and blemishes in appearance. In the event the precast concrete items are damaged they shall be removed from the Site and never used in the Works. No repairs or patching will be accepted by the Engineer whether the damage occurs on the Site or before or after delivery to Site.
- c) The Engineer shall periodically inspect the precast concrete manufacturing plants to ensure compliance with the approved method statements for manufacturing. The Contractor will supply material samples for laboratory testing to ensure quality compliance and will make the necessary arrangements to facilitate the inspections by the Engineer.

Such inspections shall include the inspection of reinforced precast concrete items. All precast items shall be marked with a unique reference and no item shall be delivered to the construction Site without approval from the Engineer.

- d) Unless otherwise indicated on the Drawings or required by the Engineer, all joints for Reinforced Concrete Culverts shall use joint sealants and be flexible all in accordance with ASTM C990. The push fit joints are also accepted if they are approved by the Engineer.
- e) The tests for loading capacity to the Culvert shall conform with subsection 2.1 of this Specification Section.

2.6 Bearings

Bearings to support the pipes shall be of the numbers and types indicated on the Drawings and subject to the approval of the Engineer. They shall be of precast reinforced concrete of concrete class C20 and shall conform with Specification Section 07100 Concrete and Concrete Structures. Bearings shall be inspected and approved as specified in subsection 2.5 b) of this Specification Section.

In order to maintain the quality of the precast concrete items the Contractor shall cast these in a factory off the Site. No precast concrete products shall be cast until the Engineer has approved the factory and the equipment therein. The Contractor shall ensure that no damaged precast concrete items are taken to Site. Damage is deemed to include, inter alia, honeycombing, chips and cracks. In the event the precast concrete items are damaged they shall be removed from the Site and not used in the Works. No repairs or patching will be accepted by the Engineer whether the damage occurs before or after delivery to Site.

2.7 Mortar

Mortared joints shall only be used if required by the Engineer or so indicated on the Drawings. If or when required mortar for pipe joints and collars shall comply with Specification Section 12100 Cement Mortar.

3. CONSTRUCTION REQUIREMENTS

3.1 Shop Drawings and Schedule

3.1.1 Shop Drawings

The Contractor shall prepare shop drawings and method statements showing his proposed construction details for the Culverts indicated on the Drawings or as directed by the Engineer. The shop drawings and method statements shall be submitted to the Engineer for his approval prior to the start of any construction work on the Culverts, including the start of any precast work.

3.1.2 Work Scheduling

- a) Precasting and construction of the Culverts shall not begin until the Engineer has approved the Contractor's shop drawings and method statements. The Contractor shall allow sufficient time in his Program for the submission and approval of his shop drawings and method statements and for any revision and resubmission of such documents that may be required to incorporate the comments of the Engineer.
- b) All necessary temporary Drainage Works or diversions of existing Drainage Works shall be in place and operating prior to the construction of the Culverts in their place.
- c) Subgrade preparation or work on the pavement structure, either in the roadway or the shoulder areas shall not begin until the culverts, headwalls and other minor structures below the subgrade level are complete along that particular section of the roadway.

3.2 Installation of Culverts

3.2.1 Site Preparation

The Contractor shall carry out any excavation and preparation of trenches for culverts that may be required in accordance with the provisions of Specification Section 03200 Structural Excavation. The Contractor shall be responsible for all dewatering and temporary support works of the trenches and all other necessary Temporary Works that may be required during the construction.

The Contractor shall place supports and/or bedding materials in accordance with the Drawings or as required by the Engineer; all in accordance with applicable Specification Sections.

3.2.2 Culvert Laying

- a) The Contractor shall excavate Culvert trenches to the required line and level. Bedding shall be placed to provide a uniform and continuous

support under the entire length of the Culvert bearings.

- b) The width of any trenches shall be considered to be the distance between the vertical planes through the outer limit of the bedding on each side of the culvert as shown on the Drawings. The Engineer, at his discretion, may allow extra trench widths, but the Contractor shall receive no additional payment for the wider trench excavation.
- c) Where side slopes are used on trenches the slopes used shall be selected to suit the stability of the soil. Any over excavation of culvert trenches shall be backfilled and compacted using approved embankment materials, subject to the approval of the Engineer, at the Contractor's expense.
- d) Water shall be removed from trenches by sump pumping or other approved methods.
- e) Materials shall be handled in such a manner as to ensure delivery to the point of installation in the sound undamaged condition. Bearings, Pipe or Box Culverts delivered to the Site shall be inspected by the Engineer before placing and/or laying. Any defective bearings, Pipe or Box Culverts shall be rejected and replaced by the Contractor at his own expense. No bearing, Pipe or Box Culverts shall be laid when the trench conditions are unsuitable for such work.
- f) The pipe bearings, Pipe or Box Culverts shall be laid to the grades and alignment as indicated on the Drawings or as directed by the Engineer.
- g) All Pipe or Box Culverts shall be laid and fitted together such that the joint sealant forms a full and effective seal around the full circumference of the Pipe or the Box Culverts. Joint sealants shall be placed such that any joints or overlaps in the sealant are at the top of the Pipe or the Box Culverts.
- i) All bearings and Pipe or Box Culverts in place shall be approved before being covered up.
- j) The Contractor shall backfill and compact the soil and granular materials around and over the bearings and Pipe or Box Culverts, as shown on the Drawings, to the density of 95% of the maximum dry density determined according to Vietnamese Standard 22TCN 333-06, Method 2D using approved materials in accordance with Specification Section 03200 Structural Excavation. Oversized material shall be removed.
- k) The Contractor shall backfill the Culvert to the level of the bottom of K98

subgrade layer.

- l) Where pipes, bearings or box culverts have not been laid in a trench the fill shall be extended for a minimum distance of one and a half pipe diameters from the centre line of the Pipe or the width of the Box Culverts measured from the centre line of the box culverts.
- m) The backfill shall be brought up evenly on both sides of the haunches for the entire Culvert length. The Contractor shall take particular care to ensure backfill is properly compacted around and beneath the pipes.
- n) Heavy earth moving and compacting equipment shall not operate closer than one and a half pipe diameters or the width of the Box Culverts from the centre line of the Pipe or the Box Culverts until such time that the cover to the top of the Culverts is at least 50 cm. Notwithstanding these conditions the Contractor shall be responsible for and shall rectify any damages which may result from either backfilling or compacting to the Culvert or placing and compacting road construction materials over the Culvert.

3.3 Culvert Headwalls, Inlets, Outlets

Headwalls, inlets, outlets, scour protection and connections to manholes or catch pits (or catch basins) shall be constructed as shown on the Drawings and conform with the requirements of the Specification Section 04300 Catch Basins, Manholes, Inlets and Outlets, subject to the approval of the Engineer.

3.4 Joints, Fittings and Connections

Culverts shall be laid with joints complying with ASTM C990. Where Culverts are built into inlets, outlets, manholes or catch pits (or catch basins), the connections shall comply with details on the Drawings and the requirements of the relevant Specification Sections and be subject to the approval of the Engineer.

3.5 Tests

Tests for the concrete items shall comply with the requirements of the relevant Specification Sections. Each layer of the backfill to the Culverts shall be tested in accordance with the requirements of subsection 3.5 Backfilling of Specification Section 03200 Structural Excavation.

Tests for the loading capacity to the Culverts shall conform with the reference Standards stipulated in subsection 2.1 of this Specification Section.

3.6 Cleaning Culverts

All Culverts shall be cleaned of loose debris, soil and all foreign materials before they are put into use. The Contractor shall obtain the Engineer's approval before putting any Culverts into use.

3.7 Rectifying and Maintenance

3.7.1 Rectifying Unsatisfactory Work

All materials and workmanship used in the construction of Culverts shall be subject to the inspection and approval of the Engineer. Where appropriate the Engineer will issue instructions for any remedial works found necessary as a result of unsatisfactory works by the Contractor. The Contractor will carry out such remedial works at his own expense. The Works will not be approved until such time as they have been completed to the satisfaction of the Engineer.

3.7.2 Maintaining Accepted Work

The Contractor shall be responsible for the routine maintenance, cleaning and care of the Culvert works until the issue of the Taking-Over Certificate..

4. MEASUREMENT AND PAYMENT

4.1 Method of Measurement

- a) The Precast Reinforced Concrete Pipe and Box Culverts quantities shall be measured for payment according to the number of linear meters (m) between two ends of the completed culverts. This quantity shall be measured as the actual placed length of the pipe or box culvert of the specified diameter or size as applicable. The cost of all excavation, soil and granular backfill, bedding, bearings, blinding stone and jointing shall be included in the unit rates for the Precast Reinforced Concrete Pipe and Box Culverts.
- b) The Precast Reinforced Concrete Pipe Culverts and Box Culverts provisions, material requirements and construction requirements identified in this Specification Section shall be measured for payment in pay items 04100-04, 04100-08 and 04100-11.
- c) Any Precast Reinforced Concrete Pipe Culverts and Box Culverts Works not specifically indentified in this Specification Section but which are

necessary for the performance of the Works shall be deemed to be included in pay items 04100-04, 04100-08 and 04100-11.

- e) The measurement shall include all necessary Temporary Works including any such works required for the diversion of existing drainage during construction of the new Culvert and any modifications to the drainage required as a result of the Temporary Works and the construction of the new Works.
- f) Headwalls, inlets, outlets, manholes or catch basins and any connections shall be constructed, measured and paid for in accordance with the provisions identified in Specification Section 04300 Catch Basins, Manholes, Inlets and Outlets.
- g) Mortared stonework in slope protection shall be measured for payment in Specification Section 12400 Slope Protection
- h) The cost of other works is deemed incidental to constructing the Culverts or drain works. The cost is included in the unit rates for the Culverts for the various construction materials used.
- j) The diameters indicated in the pay item descriptions are internal diameters.

4.2 Basis of Payment

The work under this Specification Section shall be paid for in accordance with the applicable unit prices as indicated in the Bill of Quantities and given below. Payment shall be full compensation for performing the requirements of the Contract for the items of work as specified including; furnishing and placing all the materials, all necessary joint materials for concrete pipes and box culverts and for furnishing all labour, materials, tests, tools, equipment and any incidentals to complete the Works as shown on the Drawings and as required in accordance with this Specification Section.

<u>Pay Item</u>	<u>Description</u>	<u>Unit</u>
04100	Precast R.C. Pipe and Box Culverts	
04100-04	Precast R.C. Pipe Culvert, $\Phi 750$	m
04100-08	Precast R.C. Pipe Culvert, $\Phi 1500$	m
04100-11	Precast R.C. Box Culvert, (0.75 x 0.75)	m