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**2.4 CULVERTS**

2.4.1 GENERAL

2.4.1.1 **Description**

This specification covers the installation of pipe culverts less than 1500 mm equivalent diameter.

Abbreviations for the various types of culverts when indicated on the plans or used in the specifications are as follows:

C.S.P.	Corrugated Steel Pipe
C.S.P. Arch	Corrugated Steel Pipe Arch
R.C.P.	Reinforced Concrete Pipe
R.G.R.C.P.	Rubber Gasket Reinforced Concrete Pipe
P.P.	Polyethylene Pipe
C.A.P.	Corrugated Aluminum Pipe
C.A.P. Arch	Corrugated Aluminum Pipe Arch
C.M.P.	Corrugated Metal Pipe (General Term for Corrugated Steel and Aluminum Pipe)

2.4.2 MATERIALS

2.4.2.1 **Culvert Material**

The Contractor shall supply pipe culvert material in accordance with Specification 5.23, Supply of Corrugated Metal Pipe and Pipe Arches by Contractor, Specification 5.24, Supply of Polyethylene Pipe by Contractor and Specification 5.16, Reinforced Concrete Pipe and Related Junctions, Fittings and Materials as applicable.

2.4.2.2 **Gravel Material for Culverts**

When the Contract stipulates, the Contractor shall produce gravel material for culvert backfill in accordance with Specification 3.2, Aggregate Production and Stockpiling for the designation and class of materials specified. The Contractor shall supply aggregate in accordance with Specification 5.2, Supply of Aggregate.

2.4.3 CONSTRUCTION

2.4.3.1 **Excavation and Preparation of Base**

Excavation for the culvert base shall be to a depth of not less than 0.3 m below the invert grade, and shall be of sufficient width to permit assembly of the pipe and the operation of compaction equipment on either side of the pipe. All soft, yielding, or unsuitable material at this level shall be removed to a depth as directed by the Consultant, and replaced with gravel or other acceptable material to provide a firm foundation of uniform density throughout the entire length of the pipe.

On completion of excavation for the culvert base and the removal and replacement of any soft, yielding or unsuitable material the Contractor shall compact the exposed surface to uniform density. The Contractor shall then construct the culvert bed to the established elevation using gravel material or other material acceptable to the Consultant. The culvert bed shall be compacted in accordance with Specification 2.3,

Grading. The width of the culvert bed shall be 3 times the culvert diameter.

When the culvert installation is in rock, excavation for the culvert base shall be carried out to a depth of not less than 0.2 m below the invert grade. The width of the culvert bed shall be a minimum of 1.5 times the diameter of the pipe.

Where gravel bedding or backfill is used, impervious, compacted clay cut-offs shall be constructed at both ends of the culvert as shown on drawing CB6-2.4M1.

### 2.4.3.2 **Installation**

#### 2.4.3.2.1 General

The culvert shall be installed on the prepared base, true to the designed lines and grades unless otherwise established by the Consultant. Separate sections shall be securely joined together in accordance with the manufacturer's instructions. Coupler bands shall be used for metal and polyethylene pipe and unless otherwise specified, rubber gasket type joints shall be prepared and made between sections of reinforced concrete pipe. At all coupling and joint areas and at areas of concrete pipe that have external bells, depressions shall be constructed in the culvert bed so that the pipe is uniformly supported along its entire length.

The Contractor shall use due care when installing pipe to avoid damaging the pipe. Damaged pipe shall be removed and replaced by the Contractor at his expense.

#### 2.4.3.2.2 Installation of Corrugated Metal Pipe and Pipe Arches

When required, elbows shall be installed to accommodate sharp changes in gradient or direction of the pipe.

Pipe shall be carefully handled to prevent damage to the protective coating. Any damage to coatings shall be repaired by the Contractor at his own expense in accordance with CAN 3-G401.

#### 2.4.3.2.3 Installation of Reinforced Concrete Pipe

Reinforced Concrete Pipe shall be placed beginning at the downstream or lower end of the culvert. The pipes shall be placed with the bell or grooved ends facing upstream.

Pipe shall be joined using either a wedge and block or mechanical pipe pullers to bring the pipe to the homed position. Joints shall not be deflected beyond the manufacturer's recommended maximum.

End sections shall be anchored to adjacent sections by tie bars, where provided. Lifting holes and holes for engaging bars shall be filled with mortar and finished flush with the pipe surface.

#### 2.4.3.2.4 Installation of Polyethylene Pipe

The culvert bed shall be shaped to the curvature of the pipe to a depth of 75 mm using a template.

Blocking shall not be used to bring the pipe to grade. The pipe shall be placed on the prepared base to the lines and grades as established by the Consultant, with the separate sections securely joined with the applicable welds and gasket joints as specified in Specification 5.24, Supply of Polyethylene Pipe.

Temporary hold downs shall be used to maintain the position of the pipe during installation.

Sections of pipe with a minimum length of 6 m shall be used on each end of each culvert.

#### 2.4.3.2.5 Installation of Downdrains

When required, downdrain pipes shall be installed as shown on the drawings, at the locations as shown on the plans or designated by the Consultant. A trench shall be excavated to the established depth and grade required for the installation of the downdrain pipe and connecting elbows, and its bottom surface shall provide a uniform, firm foundation throughout the length of the installation, with sufficient width to permit satisfactory jointing and thorough compaction of the backfill material around the pipe.

#### 2.4.3.2.6 Extension of Existing Culverts

Extensions to existing culverts will be considered as new installations. Where an existing culvert is to be extended, the removal, salvage and reinstallation of the existing sloped end sections may be required as shown on the drawings or as directed by the Consultant.

Where the existing pipe was manufactured to imperial dimensions and the new pipe is manufactured to metric dimensions and a mismatch occurs at the joint, the Contractor shall caulk the joint with oakum to obtain a water resistant joint.

### 2.4.3.3 **Backfilling**

#### 2.4.3.3.1 General

Backfill under the haunches and immediately adjacent to the pipe extending from the culvert base up to an elevation of 30 percent of the vertical height of the pipe shall be comprised of select gravel or soil material, as directed by the Consultant. Backfill immediately adjacent to the pipe above this level shall be comprised of select soil material. All backfill material shall be free from frozen lumps and organic material. Backfill within 300 mm of the pipe wall shall be free from stones of diameter larger than 80 mm.

All backfill material shall be placed in layers not exceeding 0.15 m in depth. Each layer shall be thoroughly compacted at optimum moisture content by means of pneumatic or other mechanical tamping equipment. Backfill and compaction layers shall be brought up simultaneously and evenly on both sides of the pipe filling all corrugations and ensuring firm contact with the entire bottom surface of the pipe. This compaction procedure shall be continued until the backfill reaches a minimum elevation of 0.3 m above the top of the pipe, or greater if necessary to carry the weight of construction equipment without damage to the pipe.

Backfilling of the remainder of the culvert excavation, beyond the immediate region of the pipe, shall be carried out in accordance with Specification 2.3, Grading. Compacting equipment shall be operated parallel to the longitudinal axis of the culvert, until sufficient fill has been placed to proceed with construction of the embankment in the normal manner.

The remaining construction of the grade embankment over the installation may then proceed in accordance with Specification 2.3, Grading.

#### 2.4.3.3.2 Backfilling Polyethylene Pipe

The minimum height of fill above the top of the pipe is 0.6 m rather than the 0.3 m indicated on drawing CB6-2.4M1 and stated in Section 2.4.3.3.1.

Immediately after backfill is completed, the Contractor shall saw cut the sloped ends at a ratio of 4:1 as shown on drawing CB6-2.4M9.

#### 2.4.3.4 **Hand-Laid Riprap**

Immediately following completion of culvert installation, hand-laid riprap shall be placed in accordance with Specification 2.5, Riprap.

#### 2.4.3.5 **Removal**

##### 2.4.3.5.1 Removal, Salvage and Reinstallation of Existing Culverts

Where removal and salvage of existing culverts or drainage structures from the roadbed, ditches, or other waterways is specified, the Contractor shall carefully excavate, remove and store the material at locations suitable to the Consultant. Salvaged materials shall be reinstalled in accordance with these specifications.

##### 2.4.3.5.2 Removal and Disposal of Existing Culverts

Where removal and disposal of existing culverts or drainage structures from the roadbed, ditches, or other waterways is specified, the Contractor shall remove and dispose of the material at locations suitable to the Consultant.

##### 2.4.3.5.3 Culvert Installation and Removal on Roadways in Service

Where culvert installation or removal must take place on roadways which must remain in service during construction, the Contractor shall carry out his installation or removal by either building and maintaining a detour or by working on one half of the roadway while maintaining flagperson controlled and adequately signed traffic flow on the other half. Prior to any disruption of the roadway, the Contractor shall submit to the Consultant details of his installation procedures and traffic control measures and obtain written approval from the Consultant prior to proceeding with the Work.

##### 2.4.3.5.4 Grouting Abandoned Culverts

When directed and/or at the locations shown on the mosaic plan and profiles, the Contractor shall completely fill existing culverts with a permanent cementitious fill material with a minimum compressive strength of 0.5 MPa to prevent future collapse of the culverts.

The filling of the culverts shall be carried out using methods and materials approved by the Engineer. The Contractor shall take precautions during filling operations to ensure that no blow outs or disruptions of the existing roadway occur.

When a replacement culvert is being installed, the replacement culvert shall be in operation before grouting of the abandoned culvert begins.

#### 2.4.4 MEASUREMENT AND PAYMENT

##### 2.4.4.1 **Excavation for Removal of Existing Culverts**

Measurement and payment for excavation for the removal of existing culverts, including the excavation of existing base or surfacing courses, will be in accordance with Specification 2.3, Grading.

##### 2.4.4.2 **Removal, Salvage and Reinstallation of Existing Culverts**

Measurement for the removal, salvage and reinstallation of existing culverts and drainage structures including sloped ends, will be made in metres based on the total invert length of pipe removed and reinstalled.

Payment will be made at the unit price bid per metre for "Culverts - Remove, Salvage and Reinstall" for the various types and sizes of culvert specified. This payment will be full compensation for removing and salvaging the pipe, preparing the culvert bed, reinstalling the pipe, backfilling and the supply and placement of hand-laid riprap.

When a culvert is identified by the Consultant to be salvaged and the culvert is damaged by the Contractor during the removal operations due to his negligence, the Contractor shall replace the damaged culvert at his own expense.

##### 2.4.4.3 **Removal and Disposal of Existing Culverts**

Measurement for the removal and disposal of existing culverts and drainage structures will be made in metres based on total invert length of pipe removed.

Payment will be made at the unit price bid per metre for "Culverts - Remove and Dispose" for the various types and sizes of culvert specified. This payment will be full compensation for removing and disposing of all the culvert pipe material.

##### 2.4.4.4 **Excavation for Culvert Installation**

Measurement and payment for excavation for culvert installation will be in accordance with Specification 2.3, Grading. Where the Contractor chooses to construct embankments before installing culverts, there will be no payment for subsequent excavation of these embankment materials.

##### 2.4.4.5 **Supply and Installation of Culverts**

Measurement for the supply and installation of culverts, and downdrains will be made in metres based on the total invert length of pipe installed, including elbows and sloped end sections.

Payment will be made at the unit price bid per metre for "Culverts - Supply and Install" for the various types and sizes of culvert specified. This payment will be full compensation for supplying all culvert pipe materials including couplers and appurtenances, preparing the culvert bed, installing the pipe, backfilling and the supply and placement of hand-laid riprap.

No separate payment will be made for the installation of oakum in joints. Payment for this work will be included in the unit price bid for supplying and installing the culverts.

2.4.4.6 **Gravel Material For Culverts**

Measurement of gravel material for culverts will be made in cubic metres. Payment will be made at the unit price bid per cubic metre for "Granular Backfill - Culverts." This payment will be full compensation for processing, hauling and placing the gravel material.

Payment for the supply of aggregate used for gravel material for culverts will be made in accordance with Specification 5.2, Supply of Aggregate.

Acceptable material obtained from within the highway right-of-way or from borrow locations will not be classified and paid for as "Granular Backfill - Culverts", but it will be classified and paid for as "Common Excavation" or "Borrow Excavation" and "Overhaul" in accordance with Specification 2.3, Grading.

2.4.4.7 **Culvert Installation and Removal on Roadways in Service**

No separate payment will be made for the staging of construction required for installation or removal of a culvert in a roadway in service. The cost of this work will be considered incidental to the Work.

Where the construction of detours is required, the construction and subsequent removal of detours will be measured and paid for at the applicable unit prices bid for the work involved. Maintenance of detours will be at the Contractor's expense.

2.4.4.8 **Grouting of Abandoned Culverts**

The Contractor shall provide a means of measuring the volume of material used to fill the culverts.

Payment will be made at the unit price bid per cubic metre for "Grouting of Abandoned Culverts". This price will include the costs of supply of all materials, equipment and labour for filling the pipes and all work incidental to the completed work.