

SPECIFICATION FOR PIPE CULVERT CONSTRUCTION

1. SCOPE

Pipe culverts shall be constructed in accordance with this specification and in conformity with the lines, levels and cross-sections shown on the drawings. The work shall include: the construction of trenches; the supply and placement of bedding; the supply and laying of pipes; the jointing of the pipes; the construction of headwalls, wing-walls, aprons, drops, and intakes and outlet structures where specified; the construction of connecting and outlet drains; backfill of trenches and reinstatement as specified, the supply of all materials, labour, plant, transport and tools required for the proper completion of the work and testing.

Where pipes are less than 350mm in diameter and laid in a narrow trench, they shall, unless otherwise specified, be laid in accordance with the following standards appropriate for the pipe type: AS/NZS 3725:2007 *Design for installation of buried concrete pipes* and AS/NZS 2566: *Buried flexible pipelines*. For PVC pipes use; AS/NZS2032 2006 *Installation of PVC pipe systems* for PVC pipes. For all polyethylene (PE) pipes use AS/NZS2033 2008 *Installation of polyethylene pipe systems*.

Where pipe culverts are to be constructed in any natural river, stream, or waterway in such a way that the passage of fish would be impeded, Part 6 of the *Freshwater Fisheries Regulations 1983* must be complied with.

2. MATERIALS

2.1 Pipe Types

The pipes shall conform to the requirements for the class, type of joints, diameter and length shown on the drawings and defined in the job specification, and shall be one of the following types:

2.1.1 Concrete pipes:

- (a) Concrete pipes shall comply in all respects with the requirements specified in AS/NZS 4058:2007 *Precast concrete pipes (pressure and non-pressure)* and designed and installed to NZS/AS 3725 2007: *Design for installation of buried concrete pipes*;

2.1.2 Corrugated steel or aluminium pipes of any of the following types:

- (a) Aluminium and steel structures (or conduits) complying with AS/NZS 2041 1998: *Buried Corrugated Metal Structures*, and AS/NZS2041.4:2010 *Buried Corrugated structures - Helically formed sinusoidal pipes*.

Aluminium pipes complying with relevant clauses in AS/NZS 2041 as above together with AASHTO M219: *Aluminium Alloy Structural Plate for Field Bolted Conduits* and AASHTO *Standard Specifications for Highway Bridges*, Section 12.

- (b) Nestable corrugated steel pipes complying with AS/NZS 2041: 1998 *Buried Corrugated Metal Structures*, and AS/NZS 2041.4:2010 *Buried Corrugated structures - Helically formed sinusoidal pipes*.
 - (c) Helical lock-seam corrugated aluminium pipes complying with relevant clauses in NZS 4406:1986 as above together with AASHTO M196: *Standard Specification for Corrugated Aluminium Pipe for Sewers and Drains* and AASHTO M197 *Standard Specification for Aluminium Alloy Sheet for Corrugated Aluminium Pipes*.
 - (d) Helical lock-seam corrugated steel pipes complying with relevant clauses in AS2041 as above together with NZS4406 1986: *Helical lock seam corrugated steel pipes design & installation*.
- 2.1.3 PVC pipes and fittings to Class SN4 or SN6 as defined in AS/NZS 1260 2009: *PVC pipes and fittings for drain, waste and vent applications*, and UPVC Pipes and Fittings to AS 1254 2010: *UPVC pipes and fittings for storm and surface water applications* designed and installed to AS/NZS 2566.1:1998 *Buried flexible pipelines* and AS/NZS2566.2/2002 *Buried flexible pipelines*.
- 2.1.4 Polyethylene pipes manufactured to AS/NZS 4130 2009: *Polyethylene (PE) pipe systems for pressure applications* and installed to AS/NZS2566.1 1998: *Buried flexible pipelines* and AS/NZS 2566.2: 2002 *Buried flexible pipelines*.
- 2.1.5 Glass reinforced plastic pipes manufactured to AS 3571: 2009 *Glass reinforced thermo plastic (GRP) systems based on unsaturated Polyester (UP) resin – Pressure and non-pressure drainage and sewage* and designed and installed to AS/NZS 2566: *Buried flexible pipelines* (parts 1 and 2).
- 2.1.6 Perforated polyethylene pipes manufactured to Type 1 or Type 2 defined in AS 2439:2007 *Perforated plastics drainage and effluent pipe and associated fittings* and installed to AS/NZS 2566: *Buried flexible pipelines* (Parts 1 and 2).
- 2.1.7 Polyethylene and polypropylene black or black jacket twin wall or plain wall pipes manufactures to NZS/AS 5065:2005 *Polyethylene and polypropylene pipes and fittings for drainage and sewerage application*

(and Amendments) and installed to *AS/NZS 2566: Buried flexible Pipelines (Parts 1 and 2)*.

The Contractor shall produce evidence of the pipes' compliance with one of the above clauses if requested by the Engineer.

2.2 Elastomeric Sealed Joints

Rubber rings used in flexible joints shall comply with *AS 1646 Elastomeric Seals for waterworks purposes (parts 1, 2 and 3)* and shall be of a type approved by the pipe manufacturer for use with the particular joint.

2.4 Mortar

Mortar shall consist of one part of cement to two parts of fine, clean, sharp sand that complies with NZS 3103: 1991 *Specification for sands for mortars and plasters* measured in dry loose volume, and just sufficient water to make it workable. The mortar shall be mixed either by hand or in an approved mechanical mixer, as required. Any mortar which is not used within 30 minutes of mixing shall be discarded.

2.5 Timbering and Formwork

The Contractor shall be responsible for providing support to all excavations and for all falsework and formwork.

3. EXCAVATION

3.1 Clearing

The Contractor shall remove sufficient vegetation and topsoil to allow pipe laying to proceed without risk of contamination of bedding or backfilling.

3.2 Trenches

Where trenches are required, they shall be cut in such a manner as will ensure that the pipes will be laid true to the depths, grades and lines shown on the drawings.

The base of the trench shall not be excavated over the specified dimensions unless directed by the Engineer for the removal of unsuitable material.

Unless otherwise specified, trenches shall have a minimum gradient of not less than 1 in 80 and a minimum depth that will ensure that, when the pipes are laid, the distance between the top of the pipes and the finished surface level shall be not less than 1 metre in any place unless otherwise designed for less cover as approved by the Engineer.

3.3 Support for Excavations

The Contractor shall be responsible for providing support to all excavations and for falsework and formwork and shall conform with safety practices and codes of practice issued by the Department of Labour.

3.4 Inlet and Outlet Drains

Inlet and outlet drains shall be cut true to grade and line within the limits of the road reserve or such other limits as are shown on the drawings or directed by the Engineer. These drains shall have a bottom width equal to the external diameter of the pipe or the width of the concrete apron where applicable, and side slopes of one horizontal to two vertical in clay and one horizontal to four vertical in rock.

3.5 Handling of Excavated Material

To avoid any danger to stability of the trench or adjacent buried services excavated material shall be stacked a sufficient distance away from the edge of the excavation and the size of the spoil bank shall be limited.

Surplus excavated material shall be disposed of as specified in the specific contract documents or as directed by the Engineer.

3.6 Unsuitable Foundation Material

Where the Engineer considers that the foundation material below the pipes or structures is unsuitable, this material shall be removed to a depth of 600mm or any greater depth as specified by the Engineer. Unsuitable foundation material shall be replaced with approved material placed in layers of 150mm loose depth which shall then be compacted as specified in either the relevant standard or contract documents.

3.7 Saw Cutting of Existing Asphalt Surfaces

Existing asphalt surfaces shall be saw cut prior to excavation where pipes are being placed under existing roads.

4. DEWATERING

4.1 General

The Contractor shall keep the excavations free from water at all times and shall provide all such pumping plant and drainage systems as may be required for this purpose.

For small diameter rigid pipes upon release of the pumping the bedding material must be stable to ensure a uniform bedding is maintained. Pipe length is an important parameter if broken backs are to be avoided.

4.2 Sumps

Sumps formed for the purpose of dewatering shall be kept outside the line of the trench and away from foundations as far as possible. When finished with, they shall be backfilled and consolidated in layers with suitable fill or concrete.

5. BEDDING LAYING AND JOINTING PIPES

5.1 Bedding

Unless otherwise detailed in the specific contract documents or to an appropriate standard as approved by the Engineer, all bedding material shall satisfy the requirements in AS/NZS 3725:2007 *Design for installation of buried concrete pipes* and AS/NZS 2566 *Buried flexible pipelines* (Parts 1 and 2).

Irrespective of the method of bedding used, the bedding adjacent to the pipe joints shall be recessed as necessary to ensure that the whole of the barrel length of the pipe makes uniform contact with the prepared bedding.

5.2 Laying and Jointing Pipes

All pipes shall be laid in accordance with the relevant standards, the manufacturer's instructions and good trade practice.

Pipe jointing shall be carried out in such a manner that the finished joints are watertight and present a smooth invert surface.

For concrete pipes, the spigot and the inside of the socket of pipes shall be clean before jointing. Rubber rings for flexible joints shall be free of dust, grease or dirt. The rubber rings shall be mounted evenly on the extreme end of the spigot and the pipe lined up truly concentric with the pipes already laid. The spigot shall then be forced into the socket leaving a gap between the socket shoulders and the spigot of between 5 and 10mm, or as recommended by the manufacturer, care being taken to maintain the pipes concentric. The rubber ring shall be equidistant from the end of the socket all round and at least 20mm from the back of the socket chamber when the joint is complete.

5.3 Field Testing

For concrete pipes, where testing is specified, pipelines shall be tested with an applied hydrostatic head of 2m applied and carried out in accordance with the requirements of the Concrete Pipe Association of Australasia: *Field Testing of Concrete Pipelines and Joints Section 1*.

For PVC and PE pipes, where testing is specified, pipelines shall be tested as non-pressure pipelines as set out in AS/NZS 2566.2:2002 section 6.4 with an applied hydrostatic head of 2.0m.

5.4 Lifting Holes

Most concrete pipes manufactured in New Zealand are lifted using an appropriately fitted lifting anchor. However, where a concrete pipe has lifting holes these shall be closed with a mortar, as specified in Clause 2.4 of this specification, before backfilling.

6. BACKFILLING

6.1 Commencement of Backfilling

Prior to commencement of backfilling the bedding material must comply with Clause 5.1 of this specification. For each installation type, backfilling requirements shall be carried out as specified in the specific contract documents or to an appropriate standard as approved by the Engineer.

6.2 Placement and Compaction

Backfilling shall be built up in layers placed and compacted evenly on both sides of the pipes in order to effect balanced loading. Full use shall be made of mechanised hand operated compaction tools on each side of the pipe and within a height of 1.5m above the pipe. Heavy construction equipment and sheep's foot rollers shall not be operated over or near the culvert until the amount of filling required by the job specification has been placed and compacted as specified, around and over the pipes.

Compaction requirements for the fill materials defined in Clause 6.3 in this specification are specified below:

- *Selected fill* and *Ordinary fill* unless specified otherwise, shall be compacted to at least 90% of the maximum dry density at optimum moisture content, as determined by NZS 4402:1986 *Methods of testing soils for civil engineering purposes* Test 4.1.1 in layers not exceeding 150mm thick unless field trials show, to the satisfaction of the Engineer, that the specified compaction is obtained with thicker layers.
- *Loose fill* unless specified otherwise, shall be compacted (if necessary) to a minimum of 70% and a maximum of 80% of the maximum dry density at optimum moisture content, as determined by NZS 4402 1986 Test 4.1.1 in layers not exceeding 200mm thick unless field trials show, to the satisfaction of the Engineer, that the specified compaction is obtained with thicker layers.

6.3 Fill Material

Three types of fill material referred to in the contract documents and drawings, are specified as follows:

- (a) *Selected fill* shall be any material that does not qualify as either Type W or Type U material as defined in TNZ F/1: 1997 *Specification for Earthworks Construction* and meets the requirements of the appropriate installation specification.
- (b) *Ordinary fill and loose fill* shall be any material that does not qualify as either Type W or Type U material as defined in TNZ F/1: 1997 *Specification for Earthworks Construction* and meets the requirements of the appropriate installation specification. Ordinary fill placed within 1.5m of the finished surface shall be material suitable for use as a subgrade.

7. ANCILLARY CONCRETE

7.1 Structures

Ancillary concrete structures required to complete the pipe installation including: headwalls; wingwalls; sumps; sump tops; aprons; drops; and intakes shall be reinforced and constructed as shown on the drawings. No portion of any metal tie permanently embedded in the concrete shall be left within 40mm of any concrete face. Unless otherwise specified, all exposed concrete faces shall be F3 as defined in NZS 3114:1987 *Specification for concrete surface finishes*.

Ancillary concrete structures shall comply with the durability requirements specified in NZS 3101: Part 1: 2006 *Concrete Structures Standard*.

7.2 Joints

The jointing of ancillary concrete structures to pipes and other structures shall be in accordance with the relevant standards, the manufacturer's instructions, good trade practice and meet the required performance.

7.3 Concrete and Steel Reinforcement

All concrete work shall be in accordance with NZS 3109 1997 *Concrete Construction*. Concrete for headwalls and other ancillary concrete shall have a minimum compressive strength of 25 MPa at 28 days. Steel reinforcement for concrete shall be in accordance with the current version NZS3109:1997 *Concrete Construction* and AS/NZS 4671:2001 *Steel Reinforcing Materials*.

7.4 Timbering and Formwork

The Contractor shall be responsible for providing support to all excavations and for all falsework and formwork for concrete structures.

8. MAINTENANCE

The work area shall be left in a neat and tidy condition on the completion of the work.

The Contractor shall maintain the culverts and incidental works including the inlet and outlet drains until the end of the maintenance period. He shall make good any subsidence which occurs in the earthworks above the culvert.

9. BASIS OF PAYMENT

The basis of payment shall be in accordance with the specific contract documents. If the basis of payment has not been specified in the contract documents then the following Clauses shall apply:

9.1 General

The scheduled unit rates shall be deemed to include for all materials, labour, plant, miscellaneous items, board, supervision, contingencies, conveyance of

plant, sampling and testing required, and incidental work, plus general overhead, administration, profit, quality assurance and maintenance.

9.2 Basic Excavation

Payment will be made at the unit rate per cubic metre on the total volume of earthworks excavated as specified to install the culverts. For payment purposes the volume of excavation shall be measured in the solid. The volume shall be calculated from the natural surface of the ground or if in cuts from the subgrade level and specified cross-section dimensions. The volume of excavation for inlet and outlet channels shall be based on specified cross-section dimensions. The volume of excavation for concrete structures shall be based on the net plan dimensions of the concrete to be placed below ground level. The unit schedule rate shall be in full compensation for: clearing; excavating; the removal and disposal of surplus or unsuitable material; the supply, placing, compaction and testing of approved backfilling; removal and stacking of existing pipe culverts and shall include for any temporary drainage control, timbering, etc, necessary to properly install the culvert.

9.3 Rock Excavation

Payment for excavation in rock will be made as an extra in addition to payment under basic excavation. Payment will be made on the total volume as either Type R1 or Type R2 as defined in TNZ F/1: 1997 *Specification for Earthworks Construction*. Measurement of the volume will be made in the solid within the limits specified for basic excavation. There will be separate additional unit rates for both Type R1 and Type R2 material which shall be in full compensation for the increased cost of excavating and handling these materials.

9.4 Supply and Install Pipes Including Bedding

Payment will be made under the appropriate schedule item on the total length of each type, class and diameter of culvert pipe, installed as specified. The unit schedule rate in each case shall be in full compensation for: shaping the foundation; provision of the bedding (except when concrete bedding is required); the supply and installation of the culvert pipe; jointing, backfill to levels shown on the drawings and testing where specified.

9.5 Ancillary Concrete

Payment will be made on the total volume measured in cubic metres of concrete used for the construction of ancillary concrete (excepting bedding) forming part of the culvert installation. For payment purposes, the volume shall be the net quantity in accordance with the drawings. The unit schedule rate shall be in full compensation for supplying and constructing the structures as specified, including the provision of reinforcement and formwork.