



# **Construction Specification for Civil Works**

## **C222 – Precast Box Culverts**

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## GENERAL

### C222.01 SCOPE

This Specification covers the installation of precast concrete box culverts and should be read in conjunction with *C220 – Stormwater Drainage*.

**Associated Specifications**

The work to be executed under this Specification consists of:

**Extent of Work**

- (a) preparation of foundations;
- (b) provision of bedding;
- (c) construction of base slabs;
- (d) installation of precast U-shaped culvert units;
- (e) headwalls and wingwalls;
- (f) backfilling against structures;
- (g) provision and removal of coffer dams; and
- (h) excavation of inlet and outlet channels.

Requirements for quality control and testing, including maximum lot sizes and minimum test frequencies, are cited in *CQC-Quality Control Requirements Sub-Annexure B2*.

**Quality**

### C222.02 DEFINITIONS

**The Works** – Defined as follows:

**The Works**

- **Developer Infrastructure Works** - work includes subdivisions and any public infrastructure work associated with an approved Development in the TRC local government area requiring a construction certificate.
- **Contracted Works** – infrastructure work undertaken by a Principal Contractor or subcontractor formally appointed by TRC and supervised by TRC.
- **Internal Works** - infrastructure work undertaken by TRC's day labour workforce.

**Constructor** – Defined as the organisation responsible for construction of the Works and the Principal Contractor as defined in the *Work Health and Safety Act 2011*.

**Constructor**

**TRC Representative** – Defined as follows:

**TRC Representative**

- **Developer Infrastructure Works** – Nominated TRC officer(s) for the approved Development.
- **For Contracted Works** – the Superintendent.
- **For Internal Works** – TRC Asset Owner

**Constructor's Representative** – Defined as follows:

**Constructor's Representative**

- **Contracted Works** – the Principal Contractor's nominated representative as per the relevant contract.
- **Internal Works** – TRC officer responsible for delivery.

**Developer's Representative**– Defined as the person or organisation appointed by the Developer to administer the Constructor responsible for the delivery of **Developer Infrastructure Works**.

**Developer's Representative**

### **C222.03 REFERENCE DOCUMENTS**

Documents referenced in this Specification are listed in full below whilst being cited in the text in the abbreviated form or code indicated.

**Documents  
Standards Test  
Methods**

Where not otherwise specified in the relevant Tamworth Regional Council (TRC) Construction Specifications or the approved design drawings, the Constructor shall use the latest versions of the Reference documentation, including amendments and supplements, listed in the TRC Construction Specifications at the time of the Works approval.

**Currency**

#### **(a) Tamworth Regional Council (TRC) Specifications**

*C213 – Earthworks.*

*C220 - Stormwater Drainage*

*C224 - Open Drains, including Kerb and Gutter.*

*C242 - Flexible Pavements.*

*C271 - Concrete Works.*

*CQC - Quality Control Requirements*

#### **(b) Australian Standards**

References in this Specification or on the approved design drawings to Australian Standards are noted by their prefix AS or AS/NZS.

AS 1597.1 - Precast reinforced concrete box culverts - Small culverts.

AS 1597.2 - Precast reinforced concrete box culverts - Large culverts.

AS/NZS ISO 9002 Quality Systems - Model for Quality Assurance in Production, Installation and Servicing.

#### **(c) Other Publications**

AUSTROADS - Guide to Geotextiles.

## MATERIALS

### C222.04 CULVERT UNITS AND LINK SLABS

The supply and testing of precast reinforced concrete U-shaped culvert units and link slabs for the Works shall be in accordance with AS 1597.1 for small culverts not exceeding 1200mm width and 900mm depth and AS 1597.2 for large culverts from 1500mm span and up to and including 4200mm span and 4200mm height with the following alterations or additional requirements:

**Supply**

- (a) Proof load testing shall be arranged by the Constructor in batches as specified in either AS 1597.1 or AS 1597.2 as appropriate.
- (b) Lifting holes, galvanised lifting points or steel lifting eyes shall be provided in the precast U-shaped culvert units and link slabs.
- (c) The end units shall have factory installed starter bars for headwall and wingwall construction.
- (d) Delivery and unloading shall be the Constructor's responsibility.

The Supplier shall implement and maintain a Quality System in accordance with ISO 9002 to ensure materials, manufacture and proof load testing conform to the appropriate Standards.

**Suppliers Quality System**

Shop drawings are to be received and approved by the Constructor prior to the commencement of fabrication for the precast concrete U-shaped culvert units and link slabs. Any errors identified following fabrication shall be rectified by the Constructor before incorporating in the Works. All costs associated with rectification of precast concrete U-shaped culvert units and link slabs shall be borne by the Constructor.

**Constructor approval of the shop drawings**

### HOLD POINT

A conformance certificate, to AS 1597.1 or AS 1597.2, for the precast U-shaped culvert units and link slabs units shall be submitted to the TRC Representative and/or Developer's Representative (for Developer Infrastructure Works) for approval at least three (3) working days prior to despatch.

**Hold Point**

**PROCESS HELD:** Delivery of precast concrete U-shaped culvert units and link slabs.

Each precast unit shall be marked at time of manufacture with:

- (a) Type and size.
- (b) Casting date.
- (c) Manufacturer's name.
- (d) Inspection pass and date.

### C222.05 CONCRETE

The concrete and reinforcement for cast-in-situ base slabs shall comply with C271 – Concrete Works.

**Concrete Quality**

### C222.06 SELECTED BACKFILL

The quality of selected backfill shall comply with the requirements in AS 1597.2.

**Backfill Quality**

### C222.07 ORDINARY BACKFILL

Ordinary backfill is material obtained from culvert excavations, cuttings and/or borrow areas which is in accordance with the requirements for the upper 1m of embankment construction as detailed in C213 - Earthworks.

**Ordinary Backfill Quality**

## CONSTRUCTION

### C222.08 COFFER DAMS

At some sites, it may be expedient for the Constructor to construct a coffer dam. All costs associated with the construction of coffer dams shall be borne by the Constructor.

**Constructor's Costs**

Coffer dams shall be sufficiently watertight to prevent damage of the concrete by percolation or seepage through the sides, and shall be taken sufficiently below the level of the foundations to prevent loosening of the foundation materials by water rising through the bottom of the excavation. Coffers shall be adequately braced and shall be so constructed that removal will not weaken or damage the structure.

**Construction**

A coffer dam may be constructed to the actual size of the reinforced concrete invert slab and used as side forms for the concrete. The details of the coffer dam and formwork, and the clearances proposed shall be subject to the approval of the TRC Representative and/or Developer's Representative (for Developer Infrastructure Works), but the Constructor shall be responsible for the successful construction of the work.

**Constructor's Responsibility**

Coffer dams which have tilted or have moved laterally during sinking, shall be righted or enlarged to provide the clearances specified. This work will be at the Constructor's expense.

**Specified Clearances**

No timber or bracing shall be left in the concrete or in the backfill of the finished structure. Coffers, including temporary piles, shall be removed at least to the level of the invert after completion of the structure.

**Removal**

### C222.09 EXCAVATION

Excavation shall be carried out in accordance with the provisions in C220 – *Stormwater Drainage*.

**Specification**

The trench width shall be the width of the base slab plus 150mm minimum each side.

**Trench Width**

### C222.10 FOUNDATIONS

Rock foundations shall be neatly excavated to the underside of the mass concrete or selected fill bedding shown on the approved design drawings. All minor fissures shall be thoroughly cleaned out and refilled with concrete, mortar or grout. All loose material shall be removed.

**Rock Foundations**

Where rock is encountered over part of the foundation only, or lies within 300mm below the underside of the mass concrete or selected fill, all material shall be removed to a depth of 300mm below the mass concrete or selected fill for the full width of the foundation over the length where the rock is encountered. This additional excavation shall be backfilled with ordinary backfill material.

**Additional Excavation**

Over-excavation or uneven surfaces shall be corrected with mass concrete so as to provide a uniform surface at least 50mm above the highest points of rock.

**Uniform Surface**

Earth foundations shall be finished to line and level to the underside of bedding shown on the approved design drawings. Care shall be taken to avoid disturbing material below this level.

**Line and Level**

All soft, yielding or unsuitable material shall be removed and replaced with ordinary backfill material as directed by the TRC Representative and backfilled in accordance with C220 – *Stormwater Drainage*.

**Unsuitable Material**

**C222.11 BEDDING**

**(a) Cast-In-Situ Base Slabs**

No bedding material shall be placed until the foundations have been inspected and approved by the TRC Representative.

*Inspection*

**HOLD POINT**

Inspection and approval of the foundations by the TRC Representative at least three (3) working days prior to the placement of the bedding.

**Hold Point**

**PROCESS HELD:** Placement of the bedding.

Bedding shall be either mass concrete or lightly bound DGB20 in accordance with *C242 – Flexible Pavements*, whichever is shown on the approved design drawings.

*Type*

Mass concrete bedding shall be minimum 20MPa compressive strength and shall not be less than 50mm thick over any point in the foundation. It shall be laid to the line and level of the underside of the base slab to a tolerance of  $\pm 10$ mm in level and  $\pm 5$ mm in line. The bedding shall be finished to a smooth surface.

*Mass Concrete*

**HOLD POINT**

Submission of test results and conformance survey of the bedding for the approval of the TRC Representative at least three (3) working days prior to construction of the cast in-situ base slabs.

**Hold Point**

**PROCESS HELD:** Construction of the cast in-situ base slabs.

**(b) Precast Base Slabs**

Precast base slabs and one-piece culvert Precast U-shaped culvert units are not permissible.

*Precast Concrete Base Slabs*

**C222.12 CAST IN-SITU BASE SLABS**

Cast-in-situ base slabs shall be constructed to the dimensions shown on the approved design drawings and in accordance with the requirements of *C271 – Concrete Works*. The invert levels shall be within -10mm to +10mm of the design level, grade 5mm in 2.5m (1 in 500) and plan position  $\pm 50$ mm.

*Construction*

Recesses to accommodate the walls of the precast U-shaped culverts shall be formed in the base slab to the dimensions shown on the approved design drawings. The Constructor is responsible for checking recess dimensions to ensure the precast U-shaped culvert units fit within the recesses.

*Recesses for Walls*

Expansion joints in base slabs shall only be provided at the interface between two adjacent units (i.e.: precast U-shaped culvert units must not span across the joint).

*Expansion Joints*

**HOLD POINT**

Inspection and approval of the formworks and reinforcement of the base slab by the TRC Representative at least three (3) days prior to the placement of concrete.

**Hold Point**

**PROCESS HELD:** Placement of concrete in the base slabs.



**C222.13 INSTALLATION OF PRECAST UNITS**

Precast U-shaped culvert units shall not be installed until the base slab has attained a minimum compressive strength of 20MPa.

**Minimum Strength**

Precast U-shaped culvert units shall be placed on a bed of mortar in the recesses in the base slab. Any gaps between the side walls and the sides of the recesses shall be packed with cement mortar. Lifting holes between precast units shall be packed or sealed with cement mortar or grout.

**Mortar Bed in Recess**

Alternatively, precast U-shaped culvert units can be placed on shims with flowable grout used to fill the void under the leg of the precast U-shaped culvert unit. The shim height to suit the minimum thickness for the flowable grout.

**Flowable Grout in Recess**

Before placement of top slabs on precast U-shaped culvert units or link slabs on adjacent precast U-shaped culvert units, the bearing areas of the supports shall be thoroughly cleaned and covered with a bed of mortar of minimum thickness 5mm after placement of the precast unit.

**Mortar Bed on Supports**

Steel lifting hooks shall be cut flush with the surface of the concrete, cleaned to bright metal and coated with two coats of coal tar epoxy. Alternatively, they shall be cut off 12mm below the surface of the precast unit and the recess sealed with epoxy mortar.

**Lifting Hooks**

In the case of multi-cell culverts, a nominal 10mm gap shall be provided between adjacent cells both longitudinally and laterally. This gap between adjacent precast U-shaped culvert unit shall be cover with bituthene tape in accordance with TRC Standard Drawing SW018.

**Gap Between Cells**

All mortar joints shall be protected from the sun and cured in an approved manner for not less than 48 hours.

**Curing of Joints**

All external surfaces of joints between precast U-shaped culvert units, both laterally and longitudinally, shall be covered full length, and minimum 250mm width, with strips of non-woven geotextile of minimum mass 270g/m<sup>2</sup> in accordance with AUSTRROADS Guide to Geotextiles.

**Joint Covering**

**WITNESS POINT**

Inspection and approval of culvert and joints by the TRC Representative at least three (3) days prior to the placement of backfill. Evidence that the culverts have been laid within the specified tolerances shall be made available to the TRC Representative on request.

**Witness Point**

**PROCESS HELD:** Commencement of backfilling.

**C222.14 BACKFILL**

All bracing and formwork shall be removed prior to backfilling.

**Removal of Formwork**

All formwork Z bar conduit holes shall be grouted prior to backfill to ensure no egress of fines through conduits.

**Grouting of Z bar conduit holes**

Selected backfill shall be placed in the side zones of the box culverts and wingwalls, and to a depth of 300mm in the overlay zone of the culverts, in layers with a maximum compacted thickness of 150mm in accordance with the backfilling and compaction requirements of AS 1597.2. The remainder of the excavation shall be backfilled with ordinary embankment fill in accordance with C213 - Earthworks.

**Selected Fill**

No backfill shall be placed against headwalls and wingwalls until 21 days after casting or concrete has reached 75% of its compressive strength..

**Headwalls & Wingwalls**

Backfill layers shall be placed simultaneously on both sides of the culvert with a maximum 600mm level difference to avoid differential loading. Backfilling and compaction shall commence at the wall and proceed away from it. The Constructor is to ensure backfill does not puncture the non-woven geotextile that spans the gaps between adjacent precast units.

**Sequence**

The Constructor is to ensure backfill does not puncture the non-woven geotextile that spans the gaps between adjacent culverts. Damage to non-woven geotextile shall be rectified by the Constructor. All costs associated with the rectification shall be borne by the Constructor.

**Damage to Non-woven Geotextile**

Where the slopes bounding the excavation are steeper than 4:1, they shall be cut in the form of successive horizontal terraces of at least 1m width before the backfill is placed.

**Horizontal Terraces**

### **C222.15 EXCAVATION OF INLET AND OUTLET CHANNELS**

Excavation of inlet and outlet channels shall be carried out as shown on the approved design drawings and shall extend to join the existing stream bed in a regular manner as detailed in *C224 – Open Drains including Kerb and Gutter*.

**Extent**

### **C222.16 CONSTRUCTION LOADING ON CULVERTS**

Construction vehicles and plant shall not pass over the culvert until 28 days after the casting of the base slab or until the cylinder compressive strength of the base slab concrete has reached 75% of its compressive strength.

**Traffic Over Culvert**

Construction vehicle loads on culverts for various design fill heights shall be in accordance with AS 1597.2 and the culvert shop drawings.

**Loading Restrictions**

## **LIMITS AND TOLERANCES**

### **C222.17 SUMMARY OF LIMITS AND TOLERANCES**

The limits and tolerances applicable to the various clauses in this Specification are summarised in Table C222.1 below:

| <b>Item</b> | <b>Activity</b>                 | <b>Limits/Tolerances</b> | <b>Spec Clauses</b> |
|-------------|---------------------------------|--------------------------|---------------------|
| <b>1</b>    | <b>Mass Concrete Correction</b> |                          |                     |
|             | a) Over highest point of rock   | 50mm                     | C222.10             |
| <b>2</b>    | <b>Mass Concrete Bedding</b>    |                          |                     |
|             | a) Level                        | ± 10mm                   | C222.11             |
|             | b) Line                         | ± 5mm                    | C222.11             |
| <b>3</b>    | <b>Culvert Location</b>         |                          |                     |
|             | a) Invert Level                 | ±10mm                    | C222.12             |
|             | b) Grade                        | 5mm in 2.5m (1 in 500)   | C222.12             |
|             | c) Plan Position                | ±50mm                    | C222.12             |

**Table C222.1 - Summary of Limits and Tolerances**

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