Engineering Construction Specification

C26 Precast box culverts

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This document is a modified version of AUS-SPEC 1353 Precast box culverts October 2018 version

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1 General

1.1 Responsibilities

1.1.1 General

General: Provide precast box culvert units including construction of base slabs, as documented. This specification should be read in conjunction with the specification for *C23 Stormwater drainage (Construction)*.
Documented is defined in *C01 General requirements (Construction)* as meaning contained in the contract documents.
Performance Requirements: As shown in the drawings
Design
Design life of culvert: 120 years useful life (This does not refer to ARI for hydraulic design).

1.2 Cross references

1.2.1 General

Requirement: This worksection is not a self-contained specification. In addition to the requirements of this worksection, conform to the following:

- *C01 General requirements (Construction)*
- *C02 Quality management (Construction)*
- *C03 Control of traffic*
- *C06 Earthworks (Road reserve)*
- *C08 Flexible pavement base and subbase*
- *C15 Subsoil and formation drains*
- *C23 Stormwater drainage (Construction)*
- *C24 Open drains*
- *C27 Drainage structures*
- *C28 Auxiliary concrete works*

1.3 Standards

1.3.1 General

Small culverts: To AS 1597.1.
Large culverts: To AS 1597.2.

1.4 Interpretation

1.4.1 Definitions

General: For the purposes of this worksection the definitions given in AS 1597.1, AS 1597.2, as appropriate, and the following apply:

- Cofferdam: A structure, usually temporary, built to support the surrounding ground or to exclude water and soil sufficiently to permit work to proceed safely without excessive pumping.
- Large culvert unit: Culvert unit with a span exceeding 1200 mm up to 4200 mm and a height from 1200 mm up to 4200 mm.
- Small culvert unit: Culvert unit with a span up to 1200 mm and a height up to 1200 mm.

1.5 Tolerances

1.5.1 General

Inlet and outlet invert levels: ± 10 mm from documented levels.
Cast in situ base slabs: Conform to the following:

- Invert levels: ± 10 mm.
- Grade: 1:500.
- Plan position: ± 50 mm.
- Surface irregularities: < 5 mm step in surface.
- Flatness: Maximum 8 mm deviations from a 3 m straightedge laid in any direction on a plane surface.

1.6 Submissions

1.6.1 Execution details

Construction of cofferdams: Submit details of the coffer dam, formwork required, and proposed clearances.
Diversion and disposal of water: Submit details for managing water flows 1 week before starting diversion works.
Obtain a Fisheries Permit if required.
Execution details: Refer to HOLD POINTS

1.6.2 Products and materials

Product conformity: Submit manufacturer's certificate of conformance to AS 1597.1 and AS 1597.2, as appropriate, for the box culverts before dispatch to site. Identify the item, source and record the inspection and test records that verify conformity.
Manufacturer's data and installation recommendations: Submit to AS 1597.1 Appendix A and AS 1597.2 Appendix A, as appropriate.
Drawings: Manufacturers drawings
Documents
Submit the following:
Work as executed drawings: Include stormwater system information sheets and works. Provide certified work as executed drawings showing plans, longsections, pit schedules with reduced levels of conduit invert at upstream and downstream end of each conduit run (between pits or structures). Provide schedules showing itemised full construction value of each conduit run as well as conduit material type, class and size. Refer to HOLD POINTS.

1.7 Inspections

1.7.1 Notice

General: Give notice so that inspection may be made of the following:

- Handling, delivery and storage: Precast box culvert on delivery to site.
- Removal of cofferdams: Timber and bracing and cofferdam removal.
- Diversion and disposal of water: Diversion works.
- Cast in situ base slab: Completed bedding.
- Precast base slab: Completed bedding.
- Cast in situ base slab: Minimum compressive strength.

- Placement precast units: Completed jointing between units.
- Side zones and overlay fill: Backfill sequence.

2 Materials

2.1 Precast box culverts

2.1.1 General

Requirement: Proprietary precast box culvert to the size and load class documented and conforming to AS 1597.1 and AS 1597.2, as appropriate.
Joint type: Butt joint.
Marking: Apply marking on each culvert, conforming to the following:

- Small culverts: To AS 1597.1.
- Large culverts: To AS 1597.2.

2.1.2 Handling, delivery and storage

Handling and storage: Handle and load store precast box culverts to prevent damage to the units.
Delivery inspection: Inspect batches of precast box culverts for dimensional accuracy and defects. Ensure minimum curing time of 28 days is achieved.

2.2 Cement mortar

2.2.1 Materials

Cement: To AS 3972.
Water: Clean and free from any deleterious matter.
Sand: Fine aggregate with a low clay content and free from efflorescing salts, selected for colour and grading.
Proportions (water:cement:sand): 0.4:1:3 by mass.

2.3 Fill material

2.3.1 Material

General: To AS 1597.1 clause 1.4.2.7 and AS 1597.2 clause 1.4.2.7, as appropriate.

2.4 In situ concrete

2.4.1 General

In situ concrete base slabs: To the *C28 Auxiliary concrete works* worksection.

2.5 Drainage structures

2.5.1 General

Requirement: To the *C27 Drainage structures* worksection.

3 Execution

3.1 Cofferdams

3.1.1 General

Requirement: Construct a cofferdam as required by the site specific conditions to allow dewatering of the construction area and diversion of the water course.

3.1.2 Construction of cofferdams

General: Construct cofferdams as follows:

- Sufficiently watertight to prevent damage to in situ concrete structures, by percolation or seepage through the sides.
- Founded sufficiently below the culvert foundation level to prevent loosening of the foundation materials by water rising through the bottom of the excavation.
- Braced to prevent weakness or damage to the structure on removal of the cofferdam.

Clearances: Adjust cofferdams that have tilted or moved laterally to maintain the documented clearances. This adjustment will be at contractor's expense.

3.2 Establishment

3.2.1 Diversion and disposal of water

Requirement: Divert and/or dispose of water from the construction area as required, without causing damage to any portion of the works or surrounding properties.

3.3 Excavation

3.3.1 General

Requirement: To the *C23 Stormwater drainage (Construction)* worksection.
Trench width: As documented or the width of the base slab plus 150 mm minimum each side.
Line and level: Excavate earth and rock foundations to line and level of the underside of the bedding. Do not disturb material below this level.
Unsuitable material: Remove and dispose of inadequate foundation material and replace with ordinary fill.
Batter slopes: Evenly transitioned over 10 m length from the edge of the wingwall to match culvert wingwall slopes.

3.3.2 Rock foundations

Preparation: Thoroughly clean out all minor fissures and refill with concrete, mortar or grout. Remove all loose material.
Surface correction: Provide mass concrete to form a uniform bearing surface at least 50 mm above the highest points of rock to correct over-excavation or uneven surfaces.
Partial rock foundation: If rock is encountered over part of the foundation prepare as follows:

- Excavate the whole of the foundation to a depth of 300 mm below the level of the bottom of the base concrete slab.
- Replace and compact this additional excavation with ordinary fill to provide uniform bearing conditions.

3.3.3 Excavate existing stream bed

Joining: Excavate inlet and outlet channels as documented and extend to the existing stream bed to the *C24 Open drains* worksection.

3.4 Bedding

3.4.1 Cast in situ base slabs

General: Select bedding from the following alternatives:

- Mass concrete bedding.
- CRB20-2 bedding as follows:

  CRB20-2 material: To *C08 Flexible pavement base and subbase*.

  Lightly bound and compacted: To *C23 Stormwater drainage (Construction)*.

  Place to the line and level of the underside of the base slab.

  Level tolerance: ± 10 mm.

  Finish: Screed to a smooth surface finish.

  Strength: Same compressive strength as for the base slab.

  Thickness: Not less than 50mm over any point of the foundation.

  Dimensions: As shown on the drawings.

  Place to the line and level of the underside of the base slab: ± 10 mm in level and ± 5 mm in line.

3.4.2 Precast base slabs

Foundation support as follows:

- Small culverts: Select backfill to AS 1597.1.
- Large culverts: Select backfill to AS 1597.2.
- Compacted depth: > 100 mm.

3.5 Installation

3.5.1 General

Inlet and outlet invert levels: As documented with a smooth, uniform gradient throughout each culvert length.

Installation: Conform to the following:

- Small culvert units: To AS 1597.1 Section 4.
- Large culvert units: To AS 1597.2 Section 6.

3.5.2 Cast in situ base slabs

Requirement: Construct cast in situ base slabs to the documented dimensions.

Traffic: Prevent construction or public traffic access over the base slab for 7 days after of placement.

Recesses: Form recesses to accommodate the walls of the precast crown units in the base slab to the documented dimensions.

Minimum comprehensive strength: 20 MPa before installation of precast crown units.

3.5.3 Placement of precast units

Temporary plug: If required, seal the ends of the culvert with a temporary plug to exclude water, sand or other deleterious materials.

Mortar bed in recess: Install precast crown units on a cement mortar bed in the base slab recess. Pack any gaps between the side walls and the sides of the recess with cement mortar.
Lifting holes and butt joints between the ends of units: Seal with cement mortar or grout of a consistency to make sure void is filled.
Grout type: As shown in the drawings

Slabs on U-shaped units or link slabs between crown units: Before placing slabs, clean the support bearing area and cover with a cement mortar bed, minimum 5 mm thick.
Lifting hooks: Cut lifting hooks and coat the exposed steel to prevent corrosion.
Coating material: Zinc rich paint

Multi-cell:box culverts: Provide a 15 mm gap between adjacent cells. Fill gap with cement mortar or grout.
Curing of joints: Protect all mortar joints from the sun and cure for more than 48 hours before placing backfill.
Joint covering: Cover the external surfaces of joints between precast crown units, both laterally and longitudinally for the full length, with minimum 250 mm wide strips of non-woven geotextile of minimum mass 270 grams/m^2 to AUSTROADS AGPT04G.

3.6 Backfill

3.6.1 General

Removal of formwork: Remove all bracing and formwork before backfilling.
Subsoil drain: Provide a subsoil drain enclosed in a seamless tubular filter fabric at the outer walls of the precast crown sections and at wingwalls as documented and to the *C15 Subsoil and formation drains* worksection.
Horizontal terraces: If the sides of the excavation are steeper than 4H:1V, cut benches in the form of horizontal terraces at least 1 m in width before placing backfill.
Wingwalls: Do not backfill against wingwalls less than 21 days after placing concrete.

3.6.2 Side zones and overlay zone fill

Backfilling: Place select fill in the side zones of box culverts and wingwalls, and 300 mm deep in the overlay zone of box culverts.
Compaction: Compact in layers with a maximum compacted thickness of 150 mm.
Sequence: Start backfilling and compaction at the box culvert wall. Place backfill equally balanced on both sides of the box culvert with a maximum 600 mm level difference.

3.6.3 Trench and embankment fill

Backfilling: Backfill the remainder of the excavation or embankment to the *C06 Earthworks (Road reserve)* worksection.

3.7 Completion

3.7.1 General

Requirement: Remove and replace precast box culverts if required for any of the following reasons:

- Not within the tolerances.
- Settlement after installation.
- Damaged during backfilling, compaction or subsequent operations.

Flushing: Flush clean all culverts from end to end and maintain in working order until completion of the works.

3.7.2 Removal of cofferdams

Timber and bracing: Remove from the concrete and the backfill of the completed structure.
Cofferdams: Remove, including temporary piles, at least to the culvert invert level after completion of the structure. Prevent material associated with the cofferdam or dewatering from entering the culvert.

3.7.3 Construction loading on culverts

Requirement: Prevent the passage of construction vehicles and plant over the box culvert until 28 days after the placing the concrete base slab or until the compressive strength of the concrete base slab has reached 32 MPa.
Loading restrictions: To AS 1597.1 clause 4.7 and AS 1597.2 clause 5.7, as appropriate.

4 Annexures

4.1 Annexure – Summary of hold and witness points

Reference No:	Clause and description	Type*	Submission/Inspection details	Submission/Notice times	Process held
C26-HP01	SUBMISSIONS Products and materials Product conformity	H	Certificate of conformance for dimensional accuracy and defects	10 days before delivery	Delivery of precast box culverts
C26-HP02	SUBMISSIONS Execution details Construction of cofferdams	H	Details of proposed cofferdams and compliance with requirements	10 days before commencement.	Construction of cofferdam
C26-WP03	INSPECTIONS Notice Handling, delivery and storage	W	Precast box culvert on delivery to site. Check dimensions and any defects	5 days before installation	Precast material supply
C26-WP04	INSPECTION Notice Diversion and disposal of water	W	Diversion works	Proceeding	Cofferdam construction establishment
C26-HP05	INSPECTIONS Notice Cast in situ base slab	H	Completed bedding	5 days before installation of base slab	Installation of base slab. For development inspections book through "MyInspect".
C26-HP06	INSPECTIONS Notice Precast base slab	H	Completed bedding	5 days before installation of base slab	Installation of base slab. For development inspections book through "MyInspect".
C26-WP07	INSPECTIONS Notice Cast in situ base slab	W	Minimum compressive strength	1 day	Cast in situ base slab
C26-WP08	INSPECTIONS Notice Placement	W	Completed jointing between units	1 day	Precast base slabs

Reference No:	Clause and description	Type*	Submission/Inspection details	Submission/Notice times	Process held
	precast units				
C26-WP09	INSPECTIONS Notice Side zones and overlay fill	W	Backfill sequence	1 day	Backfill
C26-WP10	INSPECTIONS Notice Removal of cofferdams	W	Timber and bracing and cofferdam removal	3 days	Cofferdams removal
C26-HP11	SUBMISSION Work as Executed Drawings and Asset Attribute Data.	H	Submit certified drawings and schedules	2 weeks after completion of works	Payment
C26-HP12	SUBMISSION CCTV Inspection	H	CCTV inspection footage and reports.	5 days after CCTV Inspection	Payment.

4.2 Annexure - Referenced documents

The following documents are incorporated into this worksection by reference:

AS 1597		Precast reinforced concrete box culverts
AS 1597.1	2010	Small culverts (not exceeding 1200 mm width and 900 mm depth)
AS 1597.2	2013	Large culverts (exceeding 1200 mm span or 1200 mm height and up to and including 4200 mm span and 4200 mm height)
AS 3972	2010	General purpose and blended cements
Austroads AGPT		Guide to pavement technology
Austroads AGPT04G	2009	Geotextiles and geogrids