

Engineering Construction Specification C27 Drainage Structures

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This document is a modified version of AUS-SPEC 1354 Drainage Structures
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1 General

1.1 Responsibilities

1.1.1 General

Requirement: Provide drainage structures as documented including headwalls, wingwalls, pits, gully pits, inspection pits, junction boxes/pits, drop structures, inlet and outlet structures, energy dissipaters, batter drains and other supplementary structures as shown on the drawings.

Authority requirements: Where the structure is located within a road reserve, the contractor shall obtain a Road Occupancy Licence and a Road Opening Permit from the relevant road authority.

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*
- *C15 Subsoil and formation drains*
- *C23 Stormwater drainage (Construction)*
- *C25 Pipe drainage*
- *C26 Precast box culverts*
- *C28 Auxiliary concrete works*
- *Council's Standard Drawings*

1.3 Interpretation

1.3.1 Definitions

General: For the purposes of this worksection the following definitions apply:

- **Drainage structures:** Devices to control stormwater flowing into and through a stormwater drainage system including culverts, inlet and outlet structures, junction boxes, gully pits, drop structures, headwalls, wingwalls, energy dissipaters and ancillary hardware such as grates, frames and step irons as well as subsurface drainage pipes at pits, headwalls and wingwalls.

1.4 Tolerances

1.4.1 General

Requirement:

- Horizontal position: ± 25 mm.
- Inlet and outlet invert levels: ± 10 mm of documented levels.
- Finished level of access cover: Flush with the finished level of the surrounding area ± 3 mm.

1.5 Submissions

1.5.1 Materials

Product conformity: Submit manufacturer's certificate of conformance for the precast drainage structures 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 in conformance with AS 3996 Appendix B for access covers.

1.5.2 Execution details

Precast drainage structures: If proposing to substitute precast units for in situ units, submit details of proposed proprietary items.

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). Provide schedules showing itemised full construction value of each conduit run as well as conduit material type, class and size and pit type (precast or insitu). Refer to HOLD POINTS.

1.6 Inspections

1.6.1 Notice

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

- Foundation:
 - At completion of excavation and compaction.
 - Rock foundation to wingwalls and headwalls. Excavation of rock to levels.
 - Rock foundation to gully pits and sumps. Excavation of rock for pits and sumps.
- Precast units: Installation of precast units.
- Formwork inspections (including steel) for insitu concrete drainage structures
- Subsoil outlets
- Backfilling: Before backfilling of in situ concrete drainage structures.

2 Materials

2.1 In situ concrete

2.1.1 General

In situ concrete: To the *C28 Auxiliary concrete works* worksection for the concrete and reinforcement for in situ drainage structures.

2.2 Precast drainage structures

2.2.1 General

Requirement: Provide proprietary precast drainage structures as documented.

Handling, delivery and storage: Handle precast units to the manufacturer's recommendations.

Knockouts: Do not provide standard precast pit base units with thinned wall sections on all 4 sides. Provide base units and other riser units to suit the design configuration of the particular pit with preformed knockouts only where required.

2.2.2 Durability

Exposure classification: As shown in the drawings

Concrete cover: To AS 3600.

2.2.3 Strength

Minimum compressive strength: As shown in the drawings

2.2.4 Marking

Identification marking: At the time of manufacture, clearly mark each precast unit with the following information:

- Date of manufacture.
- Manufacturer's name or registered mark and the location of manufacture.
- Maximum mass of unit in kg.
- Batch number.
- Inspection status.

Height of letters: 75 mm.

Location of marking: Easily visible but hidden once the unit is installed.

2.3 Cement mortar

2.3.1 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.

2.4 Fill material

2.4.1 Material

General: To AS 1597.2 clause 1.4.2.7.

2.5 Access covers and frames

2.5.1 Specification

Access covers and frames: To AS 3996 and as documented in the Access covers and frames schedule and as shown in the drawings.

Proprietary items: To the manufacturer's recommendations.

3 Execution

3.1 Establishment

3.1.1 Locating drainage structures

Alignment to road: Construct headwalls and pits parallel to the road centreline and wingwalls at 135° to the headwall or as documented.

Non-parallel culverts: If the culvert is not perpendicular to the road centreline, splay the wingwalls and headwalls so that the front edge of the wing bisects the angle between the centreline of the culvert and the headwall.

Dissipaters: Construct with centreline on axis to the culvert.

3.1.2 Preparation

Foundation: Dewater and wash clean of contaminants before placing concrete.

3.2 Excavation

3.2.1 Foundation

Requirement: Excavate and compact the foundation to the *C23 Stormwater drainage (Construction)* worksection.

Wingwalls and headwalls: If rock is encountered at the bottom of excavations for wingwalls and headwalls, the documented depth of cut-off walls in uniform rock over the full width of the foundations may be reduced.

- Minimum depth of cut-off walls into sound rock: 150 mm.

Gully pits and sumps: If the full depth of the excavation is in sound rock, construct a neatly formed pit of the required dimensions and omit the concrete lining except to the wall adjacent and parallel to the road.

Subsoil drainage: Provide subsoil drains for the pits and headwalls to the *C15 Subsoil and formation drains* worksection.

Mass concrete bedding: Dampen the surface of the foundation and place a layer of concrete not less than 50 mm thick over the excavated surface and finish to a smooth, even surface.

3.3 Installation

3.3.1 General

Timing: Install drainage structures not later than 14 days after the installation of associated pipes, box culverts or open drains.

Trash racks: If documented, construct trash racks with access for machine removal of accumulated debris.

3.3.2 Joints and seals

Isolation joints: Provide joints where a drainage structures abut another structure or concrete pavements.

- Joint width: 10 mm wide
- Material: Preformed jointing filler to manufacturer's recommendations.

Sealing: Seal joints and connection points against the ingress of water and other kinds of material with cement mortar.

3.3.3 Rung ladders and step irons

Pits and junction boxes over 600 mm deep: Install an individual rung ladder or step iron on one internal wall for the full depth of the structure to AS 1657 and as follows:

- The top of the uppermost rung: ≤ 600 mm below the top of the pit.
- The top of the bottom rung: ≥ 300 mm and ≤ 500 mm above the invert of the pit.
- Rung spacings: $300 \text{ mm} \pm 50 \text{ mm}$.

Installation: Fix step irons using one of the following methods:

- Within the formwork before placing the concrete for the pit walls.
- Provide blockout formers to make recesses in the concrete to receive the arms of the step irons.

- Drill holes using a rotary masonry bit in the pit wall after placing concrete. Do not use percussion tools to drill holes.

Fixing into recesses or holes: Fix step irons using epoxy resin. Protect step irons from movement until the epoxy resin has reached the specified strength.

3.3.4 Bulkheads

Requirement: If the gradient of the stormwater drainage pipe lines is more than 5%, construct concrete bulkheads to the documented spacings and details.

3.4 Headwalls and wingwalls

3.4.1 General

Batter retention: Construct the wingwalls to retain the batters as documented.

3.4.2 Precast units

Requirement: Provide headwalls and wingwalls as documented.

3.4.3 Weepholes

Backfill material: To the *C23 Stormwater drainage (Construction)* worksection.

Location: Provide weepholes as documented and place backfill material as follows:

- Height: > 450 mm above the bottom of the weephole.
- Plan area: > 600 mm along the wall and 300 mm out from the wall located centrally about the weephole.
- Enclose the backfill material with geotextile filter fabric in conformance with Austroads AGPT04G.

Alternative to geotextile: Cover the face area of the structure with an equivalent area of geocomposite.

Type: As shown in the drawings

3.5 Pits and junction boxes

3.5.1 General

Existing pits: Modify existing pits only if modification documented.

3.5.2 Precast units

Requirement: Provide precast pit and junction boxes as documented.

3.5.3 In situ concrete units

Requirement: Construct all new pits to accept access covers, gully grates and frames as documented and as follows:

- Concrete: Conform to the following:
Strength: > 32 MPa.
Aggregate size: > 12 mm.

Inlet and outlet pipes: Cast ends of inlet and outlet pipes into the pit walls.

Access cover and pit: Locate so that removal of the cover is not obstructed by a wall, kerb or other fixed item.

3.5.4 Access covers and frames

Proprietary access covers: To manufacturer's recommendations, including any infill requirements for the covers.

Matching covers and frames: Do not switch covers and frames.

Cleaning: Remove excavated or other material from between cover and frame.

3.5.5 Bulkheads

Location: If the pipe gradient of the line > 5%, construct concrete bulkheads on stormwater drainage pipe lines. Unless otherwise shown in the drawings, concrete bulkheads shall be constructed at intervals of 7.5 metres or at every third joint for reinforced concrete pipes of 2.44 metres length. Concrete bulkheads @ 7.5m spacing where grade exceeds 5% is excessive? trench stops where the grade is in between 10 to 15 percent and bulkheads where it is greater than 15%?

Dimensions: The axis of the bulkhead shall be vertical with a minimum top width of 150 mm. The top of the bulkhead shall extend to within 300 mm of the finished surface level or to the subgrade level where the pipeline is within a road pavement. Bulkheads shall extend into trench walls and base by a minimum of 300mm.

Drainage: On each side of the pipe at the level of the trench invert, 100 mm diameter pipes shall pass through the bulkhead to allow free draining of the trench. Such pipes shall be filled with fibreglass wool or other approved filter material or a capped 1.5 metre length of sub-soil drainage line.

3.6 Backfilling and compaction

3.6.1 Backfilling

Requirement: Do not backfill against in situ concrete drainage structures less than 14 days after placing concrete or before the compressive strength is more than 15 MPa.

Backfilling: Place selected fill against the full height of the vertical faces of structures for a horizontal distance equal to one-third the height of the structure, or as documented. Selected backfill shall consist of a granular material in accordance with the requirements of the specification for *C06 Earthworks (Roadways)*.

Sequence: Start backfilling and compaction at the drainage structure wall. Prevent excessive surcharge loading against vertical surfaces during the backfilling.

Balance: Backfill on both sides of the structure alternately in layers to avoid unbalanced forces on the structure.

Horizontal terraces: If the sides of the excavation are steeper than 4H:1V, cut benches in the form of horizontal terraces at least 600 mm in width, before placing backfill.

3.6.2 Compaction

Compaction: To the *C23 Stormwater drainage (Construction)* worksection.

3.7 Completion

3.7.1 General

Requirement: Remove and replace drainage structures if required for any of the following reasons:

- Not within the tolerances.
- Settlement after installation.

4 Annexure

4.1 Annexure – Summary of hold and witness points

Reference No:	Clause and description	Type*	Submission/Inspection details	Submission/Notice times	Process held
C27-HP01	SUBMISSIONS Products and materials Product conformity	H	Manufacturers certificates for conformance for precast units.	10 days before delivery	Delivery of drainage structures. Execution.
C27-HP02	SUBMISSIONS Execution details Precast drainage structures	H	Substitution of precast units for in situ units. Submit details of proprietary items.	10 days before commencing installation	Substitution of precast units. Precast drainage structures
C27-HP03	INSPECTIONS Notice Foundation	H	Completed excavation and compaction of foundations	1 day	commencement of drainage structure and foundations. For development inspections book through "MyInspect".
C27-WP04	INSPECTIONS Notice Foundation	W	Rock foundation to wingwalls and headwalls	1 day	Excavation of rock for wingwalls and headwalls.
C27-WP05	INSPECTIONS Notice Foundation	W	Rock foundation to gully pits and sumps	1 day	Excavation of rock for pits and sumps.
C27-WP06	INSPECTIONS Notice Precast units	W	Installation of precast units	5 days	Precast drainage structures
C27-HP07	INSPECTIONS Notice Backfilling	H	Before backfilling of in situ concrete drainage structures	1 day prior to backfilling progressively	Document and survey measure. For development inspections book through "MyInspect".
C27-HP08	SUBMISSIONS Work as	H	Submit certified drawings and schedules	2 weeks after completion of	Prior to sealing of road

Reference No:	Clause and description	Type*	Submission/Inspection details	Submission/Notice times	Process held
	Executed Drawings and Drainage Assets Attribute Schedules			works	

4.2 Annexure - Referenced documents

The following documents are incorporated into this worksection by reference:

AS 1597			Precast reinforced concrete box culverts
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 1657	2018		Fixed platforms, walkways, stairways and ladders - Design, construction and installation
AS 3600	2018		Concrete structures
AS 3972	2010		General purpose and blended cements
AS 3996	2006		Access covers and grates
Austrroads AGPT			Guide to pavement technology
Austrroads AGPT04G	2009		Geotextiles and geogrids