

Code of Practice

Design of large box culverts

1. General

BTN016 Design of large box culverts states VicRoads' requirements for the design of culverts and link slabs from 1500mm span to 4200mm span and 4200 mm in height. This BTN does not cover the design or manufacture of the box culverts covered by AS1597.1 and VicRoads Standard Specification 619.

Bridge Technical Notes are a Code of Practice. Compliance with Bridge Technical Notes is mandatory.

BTN016 is to be read in conjunction with:

- AS1597.2 Precast reinforced concrete box culverts Part 2: Large culverts (exceeding 1200 mm span or 1200 mm height and up to and including 4200 mm span and 4200 mm height)
- Standard Specification 610
- Standard Specification 611
- Standard Specification 620
- Standard Specification 626.

Other than as stated in this document and relevant VicRoads standard specifications, the provisions of AS1597.2 and AS5100:2017 shall apply. Where this document differs from AS1597.2 and AS5100:2017, its requirements override those of AS1597.2 and AS5100:2017.

Designers should note that culvert units may be designed for the passage of water, vehicles, pedestrians or animals and that these should be designed with appropriate clearances, finishes and lighting if required.

2. Materials

2.1. Concrete

Concrete shall be in accordance with VicRoads Standard Specification 610.

The minimum concrete grade shall be VR400/40.

2.2. Durability

The minimum exposure classification for standard culvert units shall be B1.

Precast culvert units designed for use in livestock underpasses shall be designed for exposure classification C1.

2.3. Cover

The minimum cover shall be as specified in AS5100.5 as read in conjunction with Standard Specification 610 for the appropriate exposure classification.

Tolerance on cover shall be as specified in AS1597.2 Table 2.7.

2.4. Steel Reinforcement

Steel reinforcement shall be in accordance with VicRoads Standard Specification, Section 611.

2.5. Foundation material

Foundation material properties used for the design of U-shaped and one-piece culverts for a particular site shall be determined from a suitable geotechnical investigation.

If a geotechnical investigation has not been completed or the design is intended to cover standard culvert units, the foundation material shall be assumed to be a soft clay.

3. Design

Designs shall be completed by a suitably experienced engineer pre-qualified in accordance with VicRoads' Pre-qualification scheme and subject to proof-engineering by an engineer who is pre-qualified at Proof-Engineering level in accordance with VicRoads' Pre-qualification scheme.

Design shall be in accordance with AS1597.2 and AS5100 Bridge design. No reference shall be made to AS3600.

3.1. Design life

Culvert units shall have a design life of 100 years.

3.2. Design loads

Culvert units shall be designed using the requirements and design loads specified in AS 1597.2, Section 3 except that the W80, A160 and M1600 traffic loads specified in AS5100.2 (including dynamic load allowance) and as described below, shall be used.

3.3. Live loads W80, A160 and M1600

Culvert units shall be designed for the W80, A160 Axle Load and M1600 moving traffic load, detailed in AS5100.2. The

dynamic load allowance factor as specified in AS5100 with appropriate load factors shall be used for these loads. The methods described in AS 1597.2 Cl3.3 is to be used to determine vertical and horizontal pressures due to these loads.

3.4. Site-specific loads

Culvert units shall be designed for site-specific loads such as barrier loading on end walls, wingwall loads and settlement of foundations.

3.5. Handling

Provision shall be made for lifting and handling the culvert units in accordance with AS5100.

Lifting devices and methods of handling shall be determined by the designer.

3.6. Construction loads

Construction loads on culverts shall be in accordance with VicRoads Standard Specification 626 Cl626.10 or as specified.

3.7. Strength

The theoretical design strength ϕR_u shall be determined in accordance with AS5100.5. The critical section for shear shall be as shown in AS1597.2 Figure 3.2.

3.8. Serviceability

Serviceability parameters shall be calculated in accordance with AS 5100.5. However, the minimum distribution reinforcement shall be in accordance with AS 1597.2 Cl3.5.

3.9. Reinforcement detailing

Reinforcement detailing shall be in accordance with AS5100.5 as modified by Standard Specification 611.

3.10. Hydraulic requirements

If culverts are designed for conveying water, the culvert walls shall present a smooth continuous surface to the water flow to prevent entrapment of debris.

3.11. Settlement

If one-piece culvert units are used, their bases shall be connected by shear keys designed to prevent differential settlement between adjacent units.

Shear keys in the base slab of culverts carrying water shall be sealed to prevent leakage.

4. Load testing for design

Proposals for verification of product compliance that rely on the provisions stated in AS1597.2 Appendix B (informative) shall be submitted to the Superintendent for acceptance stating full details of the basis for the proposal. The Superintendent may request further information if required.

5. Documentation

The following information shall be supplied to VicRoads:

- two complete sets of final drawings.
- the method of culvert installation as it affects the design of the units.

5.1. Design calculations

A copy of all design calculations shall be supplied for VicRoads record purposes if requested by the Superintendent.

5.2. Test load results

Further to 4. Above, if load-testing is used as a basis for design, the results of all load-testing shall be made available to VicRoads if requested by the Superintendent. In this case, records shall be provided of routine sampling and testing in accordance with AS1597.2.

5.3. Drawings

The following information shall be shown on drawings for construction:

- fully dimensioned details
- reinforcement details and tolerances
- installation details for multi-cell culverts
- concrete exposure classification.
- grade of materials including the relevant Australian standard to be used in the manufacture of the units
- assumed foundation soil type.
- foundation serviceability and ultimate limit state design-bearing pressures
- traffic design loads including Dynamic Load Allowance
- assumed dead load
- any other live load
- soil factors
- fill depth over the culvert units
- provisions for lifting of the culvert units
- culvert unit volume and mass.

6. Culvert classes

It should be noted that the culvert classes specified in AS1597.2 are for a fill height range. The minimum design requirement for culverts for VicRoads use is Class 2-A. Units shall be marked in accordance with AS1597.2 Clause 2.15

**Principal Bridge Engineer
VicRoads**

For further information please contact:

Principal Bridge Engineer
Level 3, 60 Denmark Street
Kew Victoria 3101
Email: landDSrequests@roads.vic.gov.au

Bridge Technical Notes are subject to periodic review and may be superseded.