

Code of Practice

Buried corrugated metal structures

1. General

BTN015 Buried corrugated metal structures (BCMS) states VicRoads' requirements for the design and construction of BCMS.

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

BTN015 is to be read in conjunction with:

- AS/NZS2041 Buried corrugated metal structures
- Standard Specification 632

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

This document also provides additional requirements for lining of BCMS.

2. Scope

For the purpose of this document, the term BCMS describes bolted plate corrugated steel pipes and arches manufactured and installed in accordance with AS2041.

Corrugated steel plate culverts shall not be installed in locations where part of the culvert is below the watertable for extended periods.

In aggressive environments such as saline soil conditions, aluminium BCMS may be used subject to VicRoads acceptance of the proposed material, manufacture, design and installation details, which shall be based on AS/NZS2041 modified to suit the properties of aluminium.

This document applies to all steel and aluminium BCMS having a clear height or width greater than 900mm.

3. Design

All BCMS shall be designed in accordance with AS/NZS 2041 Buried corrugated metal structures and AS5100 Bridge design as detailed below.

The minimum wall thickness shall be 5mm.

3.1. Design life

BCMS shall have a minimum design life of 100 years at which time the BCMS shall have sufficient residual strength to support the design dead and live loads.

The design life for each component shall be determined by recognised analytical methods taking into account appropriate corrosion rates for exposure to the atmosphere, soil, and groundwater determined by site investigation. In addition, the designer shall make allowance for any chemicals carried by stream flow or spillage, and expected runoff resulting from future changes in upstream land use.

The calculated design life of BCMS is a function of the following:

- base metal thickness in excess of thickness required for load bearing
- use of a hot-dip galvanized coating (in accordance with AS/NZS4680 for bolted steel plate structures).

If necessary, the designer can achieve extra design by a number of options including:

- additional sacrificial base metal thickness
- a secondary polymer coating applied to the galvanized steel face
- by lining the invert with concrete.

The calculated design life of aluminium BCMS shall be determined by the designer in a similar manner to that for steel BCMS.

3.2. Site investigation

Designs for BCMS shall be based on an assessment of aggressiveness of the surrounding ground, groundwater, general embankment fill, backfill material, and any contained water, effluent and abrasive materials to be carried by the structure.

3.3. Invert protection

In addition to the above requirements for design of BCMS, the invert of all new structures carrying water shall be protected from the effects of abrasion and corrosion by means of a reinforced concrete lining.

A period of at least 14 days shall elapse between backfilling around the structure and casting of the concrete invert lining to

ensure that settlement does not disrupt the bond between the concrete and the corrugations as the concrete is gaining strength. The designer shall detail the concrete lining to take account of predicted long term settlement of the structure.

3.4. Concrete lining details

The minimum thickness of concrete lining shall be 130mm above the crest of corrugations. The minimum height of lining shall be normal water level plus 300mm or one third height of the structure, whichever is greater. Top edges of concrete lining shall slope towards the centreline of the structure to prevent ponding of water against the wall of the structure. At both ends of the structure the concrete invert lining shall terminate with a 900mm deep reinforced concrete cut-off wall. The cut-off wall depth shall be measured below the finished invert level, and the wall shall be detailed to connect to the reinforced concrete headwall if this is present.

Concrete for the lining shall be special class performance concrete having a grade not less than VR 330/32 as specified in VicRoads Standard Specification 610.

The concrete lining shall be reinforced with a steel fabric having a minimum steel area of 500mm²/m in both directions and mesh dimensions not greater than 200mm and bar size not less than 8mm. Cover to the mesh at the edges of the concrete lining shall be not less than 50mm and not more than 100mm. Minimum cover shall be 50mm to all other faces, including to the crest of the BCMS corrugations.

Concrete lining shall be placed, compacted, and cured in accordance with VicRoads Standard Specification 610 and shall be screeded to a uniform grade and profile and then wood float-finished with 10mm deep tooled transverse joints at 3m spacing.

Refer to Figure 1 for typical concrete lining details.

For steel BCMS, reinforcement in the concrete lining shall be lapped and welded for electrical conductivity and supported by steel bars welded or bolted to the structure at 1.0m maximum spacing in both directions.

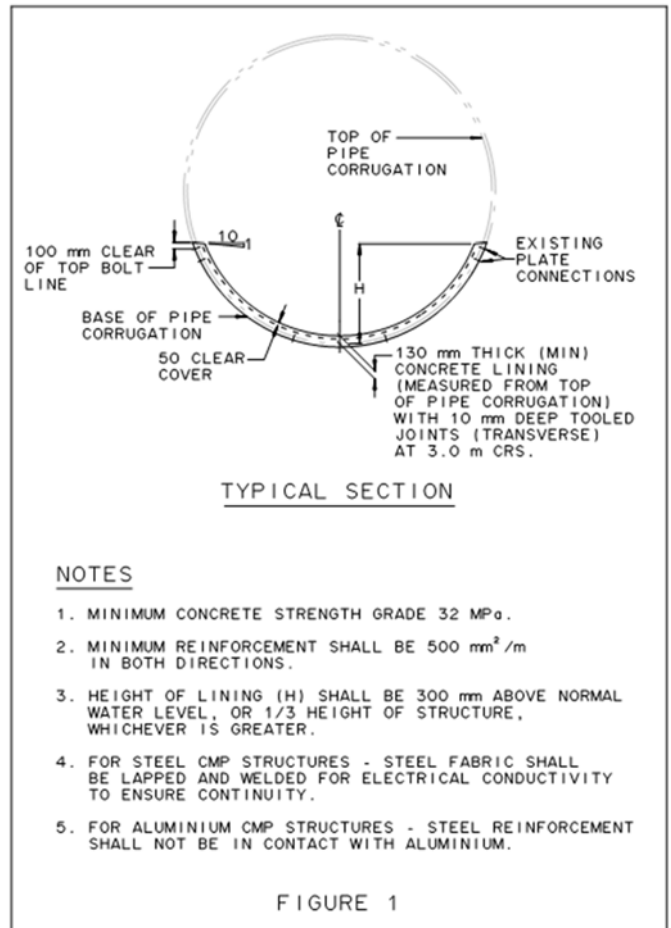
For aluminium BCMS, there shall be no conductive connection between steel reinforcement and the aluminium structure.

4. Existing structures

Subject to consideration of safe access, existing BCMS with a clear height or width greater than 1500mm may be protected by means of a reinforced concrete lining as described below.

4.1. Inspection

Inspection and maintenance of BCMS shall be conducted in accordance with a safe system of working determined by a risk assessment of each individual culvert. Access to BCMS may require installation of a temporary support system.



4.2. Preparation of existing BCMS for concrete lining

The following invert preparation is recommended prior to concrete lining of an existing BCMS:

- temporarily divert water flow
- remove sediment in culvert
- pressure wash to remove sediment and debris
- abrasive sweep blast area to be lined to equivalent to class 1 finish to AS 1627 – Part 9
- for steel BCMS, paint penetrating primer 50 microns DFT over area to be lined using Xymax MonoLock PP, Wasser MC- Prebond, Zinga or other approved equivalent
- for aluminium BCMS, paint with an approved bitumastic or coal tar epoxy coating.

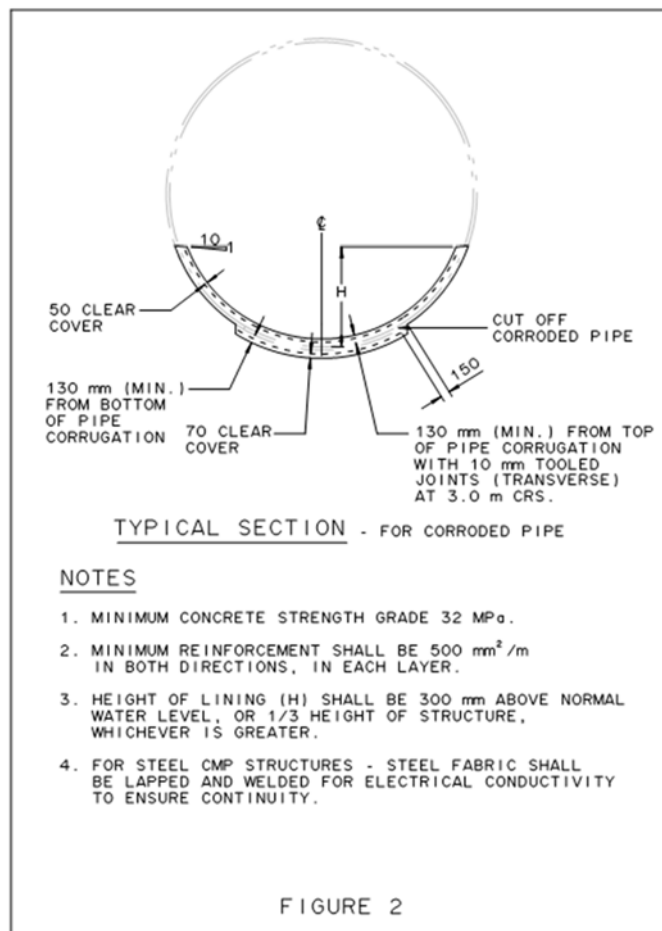
4.3. Full depth corrosion

Where corrosion has penetrated the full depth of steel plate and areas of steel are either perforated or missing, the BCMS must be inspected by an experienced engineer in accordance with the Road Structures Inspection Manual.

The extent and sequence of repairs to the corrugated metal shall be determined by an engineer who is experienced in the design and refurbishment of BCMS and is pre-qualified in accordance with the VicRoads Pre-qualification scheme.

Prior to the commencement of repairs, the requirement for temporary supports is to be determined by a suitably qualified and experienced temporary works design engineer. The temporary works shall be subject to proof-engineering by an engineer who is pre-qualified at Proof Engineering level in accordance with the VicRoads Pre-qualification scheme.

Where directed by the engineer, damaged areas shall be cut back to sound metal and concrete lined as shown in Figure 2.



Concrete lining shall be staged so that the length of plate removed does not de-stabilise the culvert and result in its collapse. Sections of plate adjacent to newly placed lining concrete shall not be removed until the concrete has achieved sufficient strength to support the loads that may arise in the temporary condition and, in no circumstances, before the lining concrete is 5 days old.

Reinforcement shall be spliced between adjacent sections of concrete lining

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