Approach Slabs

BTN 011
Version 2.0 25 May 2022

1 Scope and Application

Bridge Technical Note BTN 011 – Approach Slabs – states the Department of Transport's (DoT) requirements for the design of approach slabs on bridges, underpasses, and culverts.

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

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

2 Definitions

Approach Slab (relieving slab, run-on slab or transition slab) describes the reinforced concrete slab which supports the road pavement for a smooth transition from approach and departure embankments to and off a structure.

Conventional Bridges have movement joints located within the bridge extent between the abutments and are designed to isolate the approach slabs from bridge movements.

Integral and Semi-integral Bridges have no movement joints located within the bridge extent between the abutments.

Underpasses are structures of passages under road, railway, trail, or similar obstruction to facilitate vehicles, pedestrian, or livestock movement.

Pipe Culverts are circular pipe(s) or arche(s) structures with single or multiple cells that allows water to flow under a road, railway, trail, or similar obstruction from one side to the other with a minimum single span or diameter ≥ 1.8 m or have a single or combined waterway/open area ≥ 3 m^2.

Box Culverts are square/rectangular structures with single or multiple cells that allows water to flow under a road, railway, trail, or similar obstruction from one side to the other with a minimum single span or diameter ≥ 1.8 m or have a single or combined waterway/open area ≥ 3 m^2.

3 General

3.1 Purpose

Approach slabs serve to prevent the forming of a step due to settlement and consolidation of adjacent embankment fills and the underlying material and from the effects of ratcheting that will occur with integral and semi-integral structures. The smooth transition provided by approach slabs reduces the dynamic vehicle effects on structures, enhances road safety and comfort of vehicle occupants.

3.2 Criteria for Use

Approach slabs must be provided at both ends (i.e. both abutments outer leg walls) of structures, except that they may be omitted in the following circumstances:

- Road structures with AADT ≤ 300 vehicles per day and the approach estimated average grade change is less than 1% over the design life of the structures.
- Standalone pedestrian, cyclist and shared use path bridges.
- Pipe culverts.

Approach slabs must be provided on both ends of box culverts and underpasses where the cover between the top of structure and the finish road pavement is less than 0.5 m at any location and where the structure height is more than 3 m (i.e from the bottom of the base slab to the very top of the culvert/underpass).

Where existing structures have approach slabs, then any widening or modifications to the structure must incorporate approach slabs of the same length as the existing.

Where existing structures do not have approach slabs, approach slabs are not be required for the new widening or modifications if the above criteria are satisfied.

Where existing structures do not have approach slabs, and signs of settlement are prevalent or the average grade change of the approach exceeds 1% or geotechnical assessment determines approach slabs

to be required, approach slabs must be provided for both existing and new widening or modifications.

Approach slabs must not be used as foundations for bridge approach barriers as settlements of the approach slab can lead to deformation of the barrier or reduction of effective barrier height below the required minimum. An exception may be made for barriers over reinforced soil structures (RSS), where the barrier moment/friction slab may also serve as an approach slab. The combined slab must be designed to AS5100, including loads in AS5100.2 Clause 12.3, be stable in traffic collisions and meet the grade criterion for approach slabs stated in Section 4. Alternatively, barrier moment/friction slabs and approach slabs must be separated.

4 Design

4.1 Length and Width

The minimum length of an approach slab measured parallel to the structure centreline must be:

- 4.0m/cosine of the skew angle for conventional bridges, box culverts and underpasses.
- For integral and semi-integral bridge, Table 1 below must be applied.

Table 1: Minimum approach slab length for square (zero skew) integral and semi-integral bridges. The approach slab lengths specified in Table 1 are measured perpendicular to abutment centreline.

		Depth of abutment* (m)					
		≤4	6	7	8	9	10
Length of structure (m)*	≤10	4.0	4.0	4.0	4.0	4.0	4.0
	25	4.0	4.5	4.7	5.0	5.2	5.5
	30	4.0	4.7	5.0	5.3	5.7	6.0
	40	4.0	5.0	5.5	6.0	6.5	7.0
	50	4.0	5.3	6.0	6.7	7.3	8.0
	60	4.0	5.7	6.5	7.3	8.2	9.0
	70	4.0	6.0	7.0	8.0	9.0	10.0

* For spill through abutment, depth of abutment is measured from the finish road surface to the underside of the abutment crosshead. For vertical wall abutment, depth of abutment is measured from the finish road surface to the underside of the abutment wall (refer to Appendix A of this document for detailed sketches for more information). Linear interpolation must be used for determination of intermediate values. For skew bridge, the approach slab length must be the length specified in Table 1 divided by cosine of skew angle of the bridge.

In addition to the requirements for minimum approach slab length detailed in Table 1, when the geotechnical assessment indicates that the average grade change is greater than 1% then the minimum approach slab shall be lengthened to ensure that the maximum average grade change is 1% over the design life of the structures.

Where the depth of an integral or semi-integral bridge abutment is greater than 10m, specific advice must be obtained from a DoT pre-qualified Geotechnical Engineer which is to include the required design approach slab length and estimated average grade change to ensure that the maximum average grade change of 1% is not exceeded over the design life of the structures The specific advice must be submitted and approved by DoT Chief Engineer-Roads. Notwithstanding the Geotechnical Engineer's advice, the minimum approach lengths specified in Table 1 are not to be reduced.

The edges of the approach slab must be parallel to the edges of the roadway. The end of the approach slab must be parallel to the bridge abutment or outer wall of the underpass or culvert, as appropriate.

Approach slabs must be provided for the full width of the bridge, including pedestrian and/or cyclist paths that are located outside the roadway.

4.2 Design and Detailing

4.2.1 General

Approach slabs design must allow for future resurfacing of the road due to settlement and consolidation of the embankment.

For structural design, it must be assumed that approach slabs are simply-supported with span length of 0.9 x actual length.

Approach slabs must be connected to the structure with a reinforcement detail that combines vertical and horizontal fixity at the support. The connection must have sufficient rotational capacity to prevent spalling of the slab or support and cracking of the bridge deck or culvert and underpass in case settlement of the slab occurs. The capacity of the connection must not be less than the:

- the frictional resistance of the approach slab; and
- longitudinal vehicular/seismic forces on the approach slab.

If approach slabs have two-way cross-fall, Designers must detail the support to allow the slab to rotate about a single hinge line.

If the bridge deck joint is fixed to the approach slab, it must have capacity for horizontal and vertical rotation and vertical movement (uplift) compatible with the expected settlement of the approach slab.

Designers must provide adequate lateral clearances from other parts of the structure (e.g. from wing walls) to allow for relative horizontal movements and settlement of approach slabs.

The gap between an approach slab and the adjacent wing wall must be sealed to prevent entry of surface drainage water.

A bedding layer consisting of a minimum 100mm of compacted crushed rock in accordance to project specific requirement must be used under approach slabs. For integral and semi-integral bridges, an alternative of a minimum of 50 mm compacted sand or a smooth low-friction membrane must be adopted under approach slabs to facilitate thermal movements of the structure and approach slabs.

An edge beam or additional reinforcement must be provided to stiffen the transverse free edges of the approach slab.

4.2.2 Additional Requirements for Integral/Semi-Integral Bridges, Underpasses, and Culverts

The approach slab must be embedded within the pavement to facilitate resurfacing of the road after any settlement occurs but must not restricting thermal movements.

Horizontal movements of the structure and the approach slabs must be accommodated by a contraction joint in the pavement at the end of the approach slab away from the structure. The joint must be designed to minimise water penetration, be durable and low-maintenance.

A sub-surface drain may be installed at the ends of approach slabs to prevent water penetration into the underlying pavement and subsequent settlement of the approach slab

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Document Control

This document is subject to periodic review and may be superseded. The revision date is listed in the BTN.

Note that for projects tendered prior to the revision date of this document, there are no retrospective implications of this document unless agreed otherwise with DoT.

Revision	Description	Effective Date	Approved by
1.0	Original Revision	January 2018	Principal Bridge Engineer
2.0	Revision of Section 3 and 4 • Criteria for calculating approach slab length. • Minimum approach slab lengths for integral and semi-integral bridges. • Approach slab requirements for culverts.	25 May 2022	Chief Engineer - Roads

Appendix A

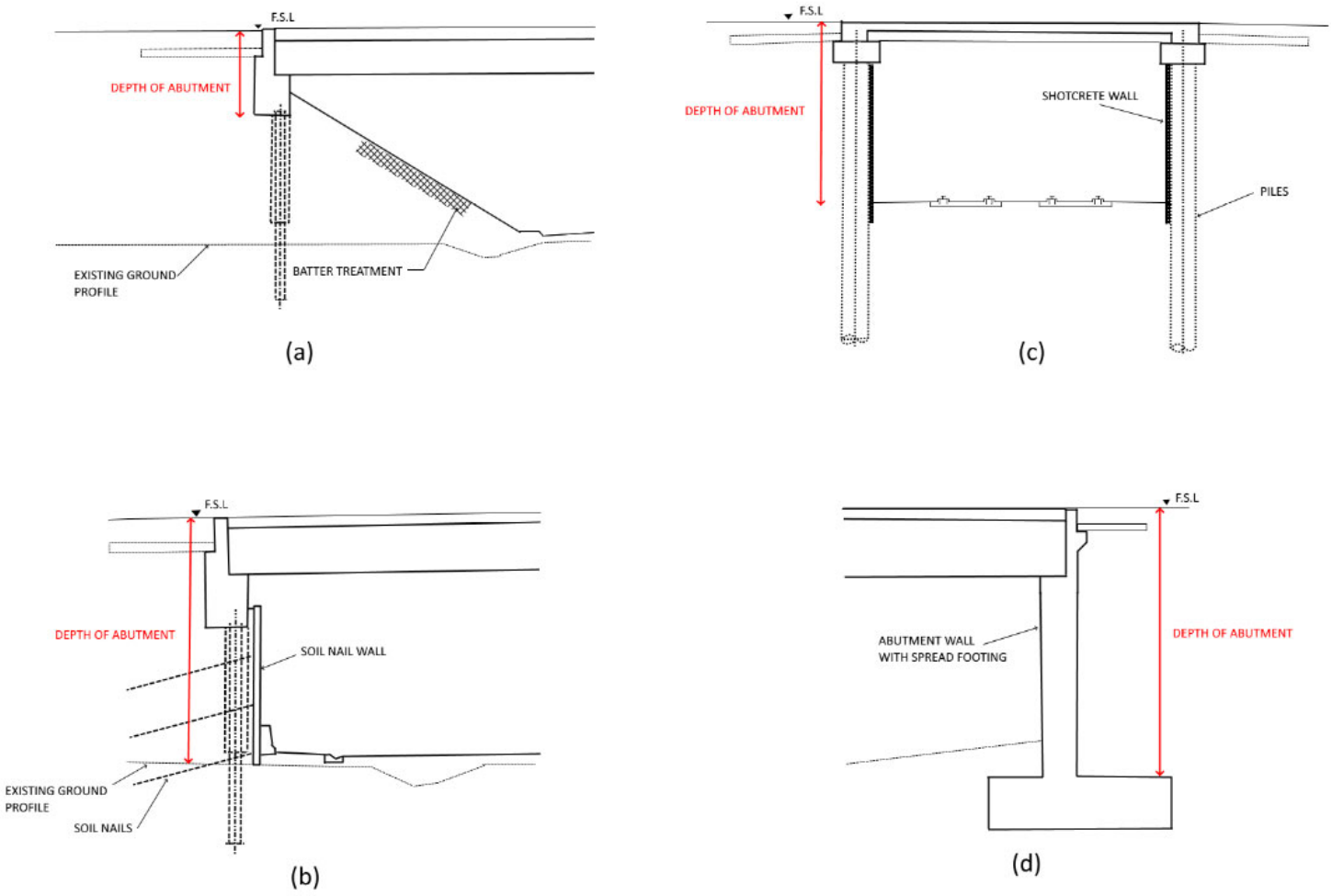

Figure A1 – Depth of Abutment: (a) Spill through abutment; (b), (c) and (d) Vertical wall abutment