BTN 010

January 2018

Code of Practice
Integral and semi-integral bridges

1. Scope and application

BTN010 Integral and semi-integral bridges states VicRoads' requirements for the design of integral and semi-integral bridges.

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

The contents of this document are based on the UK Design Manual for Roads and Bridges advice note BA42/96 together with the recommendations of the United States PCI Committee and the results of research and observation of integral bridges built in the United States and the United Kingdom. If BA 42/96 refers to European or UK standards as a source of design requirements and material properties or other parameters, the equivalent requirements, material properties and other parameters shall be obtained from AS 5100:2017 and other Victorian and/or Australian standards as appropriate.

2. Terminology

The terms integral bridge and jointless bridge are sometimes interchanged. However, the following meanings apply in this document:

Integral Bridges feature a fully continuous moment connection between the superstructure and substructure at the abutments eliminating the need for joints or bearings to accommodate rotations and displacements at the ends of the deck.

Semi-integral Bridges form do not have deck joints but incorporates bearings at the supports. This form may be adopted when ground conditions are not suitable for a fully integral bridge.

In both cases, horizontal forces in the superstructure are transmitted to the abutment fill by a diaphragm that is continuous with the superstructure.

Jointless Bridge describes a bridge with a continuous deck (i.e. without deck joints) over the intermediate piers but which has movement joints and bearings at the abutments.

In multi-span integral or semi-integral bridges, the deck is made continuous between abutments and there are no joints in the deck at intermediate piers. Intermediate pier to deck connections may be fully continuous or the deck may be supported on bearings.

3. General

3.1. Basis for selection

Clause 5 of AS 5100.4:2017 requires that the number of deck joints in a bridge is minimised. The aims of this requirement are to improve ride-quality and to eliminate the need for potentially hazardous and costly inspection and repair of joints over the life of the bridge. Both the integral and the semi-integral forms of construction eliminate the need for movement joints and shall be considered in the first instance for use in all new bridges that meet the requirements of Clause 4 of this document.

The decision to adopt the integral form of construction must be based on a thorough consideration of structural, geotechnical and backfill options.

3.2. Advantages

Integral bridges have the following advantages:

- Improved structural reliability and redundancy
- Improved long-term serviceability
- Improved ride-quality and noise reduction
- Potential for reduced initial cost
- Reduced maintenance requirement leading to the elimination of the hazards associated with bearing and joint inspection and their maintenance*
- Reduced traffic disruption derived from elimination of maintenance requirement
- Lower whole-of-life cost and
- Improvement of bridge appearance through elimination of staining caused by water leakage through joints.

3.3. Safety in design

*The Victorian Occupational Health Act 2004 places general duties on VicRoads to provide a safe workplace and a specific duty on Designers to ensure that the structures they design are safe and without risk to the health of persons using them as a workplace so far as is reasonably practicable. For this reason the integral bridge form of construction is the most preferable form where it is suitable.

3.4. Restrictions on use

The integral and semi-integral forms of bridge construction may be used on single and multi-span bridges subject to the restrictions on span, skew and the range of thermal movement at the abutments specified in Clause 4.

3.5. Foundation type

The choice of foundation type for an integral bridge abutment will depend on the ground conditions and considerations of soil-structure interaction. Piled foundations may not be suitable for use in very stiff soils and rocks as these ground conditions restrict flexure in the piles arising from cyclical thermally-induced movements of the superstructure. A framed abutment may be more appropriate in the case of very stiff soils and rocks.

4. Design limitations and requirements

4.1. Maximum overall length

The maximum overall length shall not exceed 70 metres.

This limit is aimed at controlling the maximum passive soil pressure arising from thermally-induced cyclical displacements at the abutments which will, in-turn limit the maximum stresses in the piles and, the magnitude of cracks between the approach slab and approach pavement.

4.2. Maximum thermal movement

The maximum range of thermally induced cyclic movement at each abutment shall not exceed ±20mm.

4.3. Structure geometry

Integral bridge design is permissible for straight and curved-in-plan bridges with a skew not greater than 30°.

Highly skewed and curved bridges may tend to rotate in plan as a result of the action of thermally-induced forces in the superstructure which, in turn, mobilise passive resistance at the abutments in the form of a couple. This may lead to proportional increases in the horizontal loads on piled foundations.

4.4. Serviceability limit state

Tensile stresses shall be evaluated at critical locations to ensure that crack-widths remain within specified limits.

4.5. Approach slab

The minimum length of approach slab should be one and a half times the depth of the abutment below the soffit of the approach slab measured perpendicular to the fender wall but not less than 4m.

4.6. Inspection and maintenance

Choice of details and components must be made with the aim of maximising the life of components to first maintenance and minimising the need for subsequent maintenance operations. Irrespective of the choice of bridge form and details, consideration must be given to accessibility for inspection, maintenance and replacement of bridge components throughout the life of the bridge, particularly where the details include items such as elastomeric bearings, pads and joint-fillers.

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