Country Bridge Solutions

Modular bridge overarching guide

Edition 1, Version 1.0

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Foreword:

Roads and Maritime Services has prepared this document as an introduction to the Country Bridge Solutions modular bridge system. It provides an overview of the system and its key features, and introduces its key supporting guide documents.
# 1 Common terms used in the CBS system

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AADT</td>
<td>Annual Average Daily Traffic, determined by measuring the number of axle pairs crossing at a specific site per year and dividing this number by 365</td>
</tr>
<tr>
<td>Alignment</td>
<td>The geometrical form of the centreline of a carriageway in both the horizontal and vertical directions</td>
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<tr>
<td>AS5100</td>
<td>Australian standard for bridge design that sets out the requirements for the design, using limit states principles, of bridges and other structures</td>
</tr>
<tr>
<td>Australian standard</td>
<td>Standards prepared, adopted or approved by Standards Australia</td>
</tr>
<tr>
<td>Carriageway</td>
<td>That portion of a road or bridge used by vehicles, including shoulders.</td>
</tr>
<tr>
<td>CBS</td>
<td>Country Bridge Solutions</td>
</tr>
<tr>
<td>Certification</td>
<td>Document issued by the designer certifying that reasonable professional skill and care has been used in the preparation of the design, with a view to securing that it has been checked for compliance with the relevant standards, and has been accurately translated into construction drawings.</td>
</tr>
<tr>
<td>Contractor</td>
<td>Organisation or individual that has been engaged to construct the bridge</td>
</tr>
<tr>
<td>Cross fall</td>
<td>The carriageway slope at right angles to the alignment, expressed as a percentage</td>
</tr>
<tr>
<td>Deck Module</td>
<td>CBS prestressed concrete double-T superstructure element</td>
</tr>
<tr>
<td>Design criteria</td>
<td>The particular requirements specified by Australian standards and other technical documents that the design must satisfy</td>
</tr>
<tr>
<td>Designer</td>
<td>Organisation responsible for the design and certification of the bridge</td>
</tr>
<tr>
<td>Low performance level traffic barrier</td>
<td>Twin rail steel traffic barrier designed to meet low performance level criteria in accordance with AS5100</td>
</tr>
<tr>
<td>SM1600</td>
<td>Traffic loading model defined in AS5100, Part 2: Design loads</td>
</tr>
<tr>
<td>T44</td>
<td>Traffic loading model defined in AUSTROADS Bridge Design Code 1996, Part 2: Design loads</td>
</tr>
<tr>
<td>Span</td>
<td>The horizontal distance between supports of a member</td>
</tr>
<tr>
<td>Timber beam bridge</td>
<td>Bridge in which the principal means of spanning between piers is longitudinal timber members, typically round undressed hardwood</td>
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</table>
2 Background

When a bridge is closed or is load limited, the impact on regional communities and the local economy can be significant.

Local councils, as road authorities, face the growing challenge of maintaining and eventually replacing ageing bridges on Regional and Local roads.

The NSW Government is developing Country Bridge Solutions (CBS) to help councils meet this challenge. CBS will:

- Provide regional and rural councils with simple and easy to build bridge solutions developed by expert bridge engineers
- Deliver cost savings through the use of standardised bridge components
- Use existing council resources and regional manufacturing capability to replace and build bridges
- Assist council staff during investigation, design, construction and maintenance through the provision of technical guides
- Promote regional economic growth through local employment opportunities

3 CBS prestressed concrete modular bridge system

What is CBS?

CBS is a modular bridge system developed by Roads and Maritime Services (Roads and Maritime) to assist councils in replacing bridges on regional and local road networks. The system delivers an innovative and reliable standard bridge design and construction sequence consistent with both Australian Standards and Roads and Maritime technical documents.

Conceived for the replacement of ageing timber beam road bridges in regional NSW, the CBS system has two key strengths:

1. It provides a suite of standardised solutions that can be constructed under various site conditions with minimal variation to the design of the bridge components.
2. Its designs are supported by a set of best practice guides that clearly explain the processes that need to be followed throughout the entire asset life cycle in order to ensure a high quality, durable, safe and fit-for-purpose bridge solution for each site.
Key features of CBS include:

- A suite of standard bridge drawings for a modular bridge solution.
- Guidance on solution selection, site investigation, detailed design, construction, operation and maintenance management provided in a set of four best practice guides.
- A fully certified bridge deck system, incorporating prestressed concrete double-T deck modules.
- Standardised substructure components that can be easily adapted to suit a range of site conditions.
- Three standard bridge configurations to suit different future traffic demands and site constraints, including a two-lane and a single-lane ‘stitched’ solution, as well as a simplified ‘butted’ solution for remote sites with very low expected heavy vehicle traffic volumes.

Why CBS?
The CBS system provides councils with:

1. High quality, durable and easy to build structural solutions developed by technical experts in bridge infrastructure and explained in guides written in plain language.
2. New bridges designed to current Australian bridge design standard traffic loading.
3. Opportunity to improve access for heavy vehicles and agricultural equipment through an enhanced standard carriageway width.
4. Opportunities to use local labour resources and regional manufacturing capability.
5. Transportability of precast components on standard General Access trucks.
6. Minimised on-site concrete requirements, especially for remote lightly trafficked sites.
7. Low performance level barriers suitable for submergence.
8. “Cradle to grave” guidance on bridge asset management.
9. Reduced maintenance requirements resulting from a 100 year design life.
10. Increased capacity of regional transport networks to the benefit of community and commerce.

Responsibilities
Roads and Maritime has standard drawings for the components of a modular bridge solution, as well as guides covering solution selection, site investigation, detailed design, construction, operation and maintenance management.

Though not an exhaustive list, the responsibilities of the council, should they choose to use CBS, include the following:

- Produce or procure a set of detailed drawings for each site, incorporating the standard deck modular system and adapting the substructure components to the site conditions.
- Certify the final bridge design for the site.
- Meet all WHS obligations during investigation, design, construction and maintenance operations.
- Meet all environment and heritage obligations during investigation, design, construction and maintenance operations.
3.1 System Description

The CBS system is designed for application in its entirety and comprises an assembly of precast concrete modular components, certified by experienced bridge engineers. The designs maximise the use of pre-casting and bring innovation to installation methods for bearings and pier headstocks.

The CBS system has been designed to AS5100:2004 Bridge Design, including SM1600 traffic loading, except that the reduced capacity single lane configuration (Type 3) has been designed for T44 traffic loading in accordance with the AUSTROADS Bridge Design Code (1996).

The standard design drawings of CBS bridges, regardless of configuration, have two sets:

- Components (superstructure) which are fully detailed and which must be used in strict adherence to the design criteria and notes shown on the drawings to retain certification

- Components (substructure) which are provided as non-certified templates. These should be detailed according to site requirements and contain design criteria and suggested notes for use by the design engineer.

The system has been designed with three simply supported spans. Standard span lengths of 8m, 10m and 12m are available. Within these parameters, there are three bridge span configurations available:

**Type 1: Two Lanes ‘stitched’ (8.5m carriageway)**

Comprises four prestressed concrete double-T modules placed side-by-side and stitched together with cast-in-situ concrete closure strips. This provides an 8.5m carriageway width with a two-way cross fall, to carry two lanes of traffic. It has a 150mm high kerb with an 800mm high low performance level steel traffic barrier. (Figure 3.4 Type 1 shown below).

![Figure 3-1: Two lane "stitched" bridge](image-url)
Type 2: Single Lane ‘stitched’ (4.2m carriageway)
Comprises two prestressed concrete double-T modules placed side-by-side and stitched together with a single central cast-in-situ concrete closure strip. This provides a 4.2m carriageway width with either two-way or one-way cross fall, to carry only one lane of traffic. It also has a 150mm high kerb with an 800mm high low performance level steel traffic barrier.

![Typical Section](image1)

Figure 3-2: Single lane ‘stitched’ bridge (Note: Cross fall as required)

Type 3: Single Lane ‘butted’ (4.2m carriageway)
Comprises two prestressed concrete double-T modules placed side-by-side with a central longitudinal deck joint in place of a cast-in-situ concrete closure strip. This also provides a 4.2m carriageway width for one lane of traffic, but is suitable only for remote locations where high quality concrete is difficult to bring to site, and where the expected volumes of heavy vehicle traffic will be very low.

![Typical Section](image2)

Figure 3-3: Single lane ‘butted’ bridge (remote low volume roads)
Figure 3.4 Type 1: Two lanes

4 CBS guides

The CBS system delivery process can be divided into four stages. In order to assist councils through the necessary critical steps, a guide has been produced for each stage, as follows:

- Suitability and Investigation
- Design
- Construction
- Operation and Maintenance

The guides have been devised to:

- Assure councils that the CBS system is appropriate to their needs
- Ensure that safety and quality assurance requirements are met throughout
- Progress through the work in a logical and methodical manner for a successful implementation and management of a complete bridge system.

The system has been developed based on industry best practice to cater for users with limited experience or expertise in bridge replacement work. Every bridge replacement project is unique, but the guides provide information appropriate for most small bridge sites for which CBS is suitable.

The figure below illustrates how each of the four guides combine with the CBS standard drawings and council’s requirements to deliver a bridge asset:
4.1 CBS Guide Overview

SUITABILITY AND INVESTIGATION
"Identification of design criteria for design of bridge structure"

- Examination of the current structure and surrounds
- Assessing the site for CBS suitability
- Collecting data for design
- Selection of appropriate CBS configuration.

DESIGN
"Design and documentation of bridge structure for construction"

- Scoping the design to comply with the CBS design criteria
- Designing the bridge and specific elements
- Documenting the design
- Technical data for standard elements

OPERATION and MAINTENANCE
"Long term management of bridge structure"

- Process of maintenance and operation
- Inspection and maintenance strategy
- Methodology for inspection and maintenance

CONSTRUCTION
"Planning and construction of bridge to design documentations"

- Planning the bridge work
- Setting up and mobilising the construction site
- Constructing the bridge
- Handling of precast components
- Completing site works and de-establishing
4.2 Where CBS system can be applied

Efforts have been made to develop a suite of solutions to suit a broad range of site conditions. Particular care has been taken to accommodate those conditions in which the majority of existing timber beam bridges will be found. However, the need to standardise has meant that not all situations can be accommodated.

The following checklist appears in the Suitability and Investigation Guide, and is used to determine whether CBS should be considered for a particular site.

<table>
<thead>
<tr>
<th>Standard criteria</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>No more than two traffic lanes on road approaching bridge?</td>
<td></td>
<td><img src="image" alt="Box" /></td>
</tr>
<tr>
<td>30-year projected AADT does not exceed 1000 vehicles a day?</td>
<td></td>
<td><img src="image" alt="Box" /></td>
</tr>
<tr>
<td>Proposed bridge alignment is straight, has a constant grade and no skew?</td>
<td></td>
<td><img src="image" alt="Box" /></td>
</tr>
<tr>
<td>Bridge deck height does not exceed 10m above ground or creek bed level?</td>
<td></td>
<td><img src="image" alt="Box" /></td>
</tr>
<tr>
<td>No individual span of the proposed bridge exceeds a length of 12m?</td>
<td></td>
<td><img src="image" alt="Box" /></td>
</tr>
<tr>
<td>Proposed bridge does not reduce waterway opening in comparison to the existing bridge waterway?</td>
<td></td>
<td><img src="image" alt="Box" /></td>
</tr>
<tr>
<td>A dedicated pedestrian bridge or cycleway is not required?</td>
<td></td>
<td><img src="image" alt="Box" /></td>
</tr>
<tr>
<td>The bridge site is not located within 1km of the shoreline of a large expanse of salt water?</td>
<td></td>
<td><img src="image" alt="Box" /></td>
</tr>
</tbody>
</table>

If the answer is yes for all of above then the CBS system is applicable.
5 References

The following publications were referred to in this guide:

- NSW Environmental Planning and Assessment Act (1979)
- AUSTROADS Bridge Design Code (1996)

5.1 CBS materials

- Country Bridges Solutions: Overarching guide
- Country Bridges Solutions: Suitability and Investigation guide
- Country Bridges Solutions: Design guide
- Country Bridges Solutions: Construction guide
- Country Bridges Solutions: Operation and Maintenance guide.