

# Management of State Heritage Significant Bridges

*P. B. Manamperi - Bridge Strategy Manager, RTA, NSW.*

## SYNOPSIS

The RTA NSW manages 31 timber truss bridges and two timber beam bridges that are assessed as being of State heritage significance. These bridges were designed to carry a traffic loading significantly lower than the current traffic. While these bridges have served NSW well for around 100 years their continued service requires proactive management.

This paper discusses

- How each of the elements that comprise the Bridge contributes to its overall significance.
- Analysis of form and fabric of each element and determination what constitute significant form and fabric
- Structural capacity of each element to carry current loads and
- Development of a heritage sympathetic approach to rehabilitation and strengthening for the Hinton Bridge to the required level and minimise the future maintenance costs.

## 1 TIMBER TRUSSES IN NSW

In the period between 1850 and 1920, 422 timber truss bridges were built in NSW. This led travellers to refer to NSW as the “timber truss state” (MBK report).

From the different types of truss bridges that were originally constructed, the following remain in service.

Truss Type	Number Built	Number remaining
Old Public Works Department (PWD)	147	2
McDonald	91	5
Allan	105	30
DeBurgh	20	10
Dare	44	26
Others	15	-
Total	422	73

*Table 1: Timber truss bridges in NSW*

## 2 MANAGEMENT OF STATE HERITAGE SIGNIFICANT TIMBER BRIDGES

The Roads and Traffic Authority of New South Wales (RTA) is constantly under pressure to replace or significantly upgrade many of the remaining timber bridges on NSW roads because, they do not meet current width and loading standards, because of local community pressures for improved access and/or because of the large maintenance burden the bridges impose.

Many of these bridges, especially those employing truss designs, are of heritage significance, as is illustrated by the recent listing of a number of bridges on the *State Heritage Register*.

Most of the remaining timber road bridges in NSW are nearing the end of their service lives, so decisions need to be made about how best to manage them, with due consideration for both their heritage significance and of current and future road transport needs.

The RTA produced the “Timber bridge management” brochure that provides clear direction and actions for the management of all of the RTA’s timber bridges, taking account of all the competing factors affecting their future, especially the heritage, safety and access issues.

In developing its strategy the RTA has carried out four relevant studies of the heritage significance of all the States' timber truss road bridges and the RTA controlled timber beam bridges. The issues examined in these studies, which yielded much valuable heritage information, included:

- The design evolution of all timber truss and timber beam road bridges in NSW, and
- The historical background and economic circumstances associated with timber bridge developments from the mid 19th century to the early 20th century.

Most of these bridges do not meet current RTA bridge design standards for width and load carrying capacity.

The supply of timber to maintain the current stock of the RTA heritage bridges is no longer available. In order to not lose the remaining heritage significant timber truss bridges a new and acceptable strategy of sustainable retention needs to be developed. The strategy should retain the structures such that any changes have minimal impact on the traditional appearance of the bridges and as far as possible retain their fabric.

The strategy proposed for the strengthening and rehabilitation of the Hinton Bridge is an example of a heritage sympathetic solution that preserves a State Heritage significant Bridge under current loadings.



***Figure 1: Hinton Bridge***

### **3 HINTON BRIDGE**

Hinton Bridge (*figure 1*) spans the Paterson River on an unclassified local road. The Bridge is a 13 span timber beam and Allan timber truss bridge with a lift span and was completed in 1901. The overall length of the Bridge is 178.6 metres and its minimum width is 5.1 metres between kerbs at the lift span. It comprises a metal lift span (17.8 metres or 58 feet) and lift towers flanked by two Allan timber trusses, each of 28 metres (92 feet) in length. There are seven timber beam approach spans at the western (Morpeth) end and three at the eastern (Hinton) end. The Bridge deck is 14.3 metres (47 feet) above the high water line and the lift span, when raised, had a further 7.9 metres (26 feet) of clearance.

As the Bridge is in excess of 50 years old, it is classified as a “relic” under the provisions of the NSW *Heritage Act* 1977. During a study of the heritage significance of all remaining timber truss road bridges in NSW, the Bridge was assessed as being of state heritage significance (MBK 1999). The Bridge was placed on the NSW Heritage Council's, State Heritage Register (SHR) in 2000. Any proposal to conduct works other than routine maintenance and repairs on an item on the SHR requires approval from the Heritage Council in accordance with Section 60 of the NSW *Heritage Act* 1977 before works can be undertaken.

The Bridge is one of only seven timber truss bridge and lift span combinations remaining in NSW. The Bridge is significant for its historical associations with the development of the NSW road network at a general level, and more specifically for the development of the road network in the Hinton-Morpeth area. There are a number of significant bridges in the area and their form dominates and complements the landscape (*figure 1*).

#### **3.1 Abutments**

Abutment A (Morpeth side) comprises vertical timber driven piles sheeted with horizontal timbers. Above the piles on abutment is a timber headstock. This is a standard design used in the majority of timber road bridges (both truss and beam designs) constructed in NSW.

Abutment B on the Hinton side is constructed in concrete in 1901.

#### **3.2 Timber Piers**

Piers 1 to 6 at the Morpeth end and Piers 11 and 12 at the Hinton end support the timber girder approach spans. Piers 7 and 10 support one end of each of the truss spans. The piers are of standard timber pier design used in the majority of road bridges (both truss and beam designs) constructed in NSW, generally comprising driven timber piles, timber cross bracing, timber headstocks and lower horizontal timber members.

#### **3.3 Iron Piers**

The piers supporting the lift span and the ends of the two truss spans (piers 8 and 9) comprise twin wrought iron /cast iron cylinders, connected by plate diaphragms with an elliptical opening.

### **3.4 Lift Span**

The lift span is a vertical type and consists of a steel Warren type truss on each side. Built-up steel cross girders are supported on the bottom chord of the truss at the panel points. These cross girders support timber stringers topped with timber decking and longitudinal sheeting. Lateral bracing of the span against wind forces is achieved by bracing the bottom chords together, in the plane of the deck, in an 'X' pattern that covers two panels using wrought iron straps with turnbuckles.

The four towers consist of a wrought iron lattice column system. Lattice girders brace the four towers both longitudinally and transversely. The counterweights that were located on the transverse Bridge axis side of the lifting towers were removed in 1949.

### **3.5 Approaches**

Spans 1 to 7 at the Morpeth end and spans 11 to 13 at the Hinton end, form the approach spans. Each span was designed with five timber girders, the outer girders being square and the inner girders of round section. The majority of the spans now have round girders also at the edge location. The edge girders were square cross sections for aesthetic reasons only. The spans are supported on round timber corbels over the approach span piers.

### **3.6 Decking**

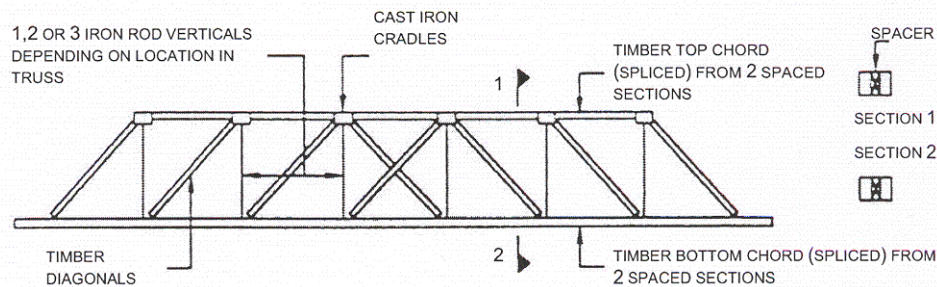
The entire Bridge is decked with 50 millimetre thick longitudinal sheeting supported on transverse timber decking. The transverse decking comprises timber planking laid perpendicular to the stringers in the truss spans and the girders in the approach spans in accordance with the original configuration. The transverse decking is approximately 125 millimetres thick. The original bridge was designed with transverse decking only. However, to overcome maintenance (durability) and strength problems longitudinal sheeting has been introduced on transverse decking. The use of longitudinal sheeting significantly improves the distribution of wheel loads to the supporting decking. The entire surface of the deck has been flush sealed to provide a better travelling surface and to improve its waterproofing qualities by reducing the effects of rapid moisture changes. Timber kerbing is situated along the edges of the deck in the 150 x 150 millimetre kerb design.

### **3.7 Railing**

Behind the timber kerbs on both edges of the deck, at the truss spans and approach spans, is traditional timber ordinance railing, approximately 1.1 metres high. The existing timber railing has no structural capacity and represents no real barrier, except to pedestrians or travelling stock. The ordinance railing terminates with timber end posts at each end of the Bridge structure. At the lift span the railing comprises a steel tubular system, fixed to the top surface of the top chord of the main trusses.

### 3.8 Truss spans

Spans 8 and 10 comprise timber trusses. The truss type employed in this Bridge is the Allan design (see Figure 2).



**Figure 2: Profile of an Allan truss illustrating the elements described in the text.**

The bottom chord of each truss consists of a pair of timber elements spaced 152mm apart to allow wrought iron suspension rods to pass through. The individual timber members are referred to as flitches. There are two splices in the bottom chord and these occur at the same location on the individual timber flitches unlike later Allan truss designs that have staggered spliced connections.

The top chord consists of twin timber members packed apart for lateral stability reasons. The two members have maximum spacing at midspan and at the ends they are in contact. The wrought iron suspension rods generally pass through the space between the timber members, however, at the ends where the flitches are in contact the rods pass through the drilled holes. The chords have staggered splices, utilising steel splice plates, and are connected at either end to the truss principals (the sloping end members) in a cast iron shoe that also fixes the double suspension rods. The principals comprise two timber members held apart by timber spacer blocks. The spacing between the two timber members widens from being in contact at the top to a maximum gap at the bottom chord connection. The existing top chords are spliced at midspan only, as per the original design.

A series of diagonal members, consisting of double timber pieces, packed apart similar to the principals, run from top chord to bottom chord. The centre panel contains an additional single timber diagonal passing through the double timber diagonal forming an 'X' shape. The top ends of these diagonals connect to the top chord in cast iron shoes. The bottom ends connect to the bottom chord through cast iron shoes.

All cross girders are timber elements. The internal cross girders on the Bridge are located at the panel points. All internal cross girders are supported directly on the bottom chord and pass between the double steel suspension rods. The end cross girders of the trusses at piers 8 and 9 are supported on the bottom chord just within the principal/bottom chord junction. The end cross girders at the other end of each truss are supported on the bottom chord beyond the principal/bottom chord junction. The road decking is bolted to six longitudinal timber beams called stringers that are supported on the cross girders.

#### 4 CRITERIA FOR ASSIGNING LEVELS OF SIGNIFICANCE TO BRIDGE ELEMENTS

While each of the elements that comprise the Bridge contributes to its overall significance, it is a useful management tool to separate the Bridge into its components and examine the heritage significance of each. This process allows for more informed analysis of what constitutes significant form and fabric, what fabric is of little significance and what form and fabric is intrusive.

Table 2 provides a guide to the grading of significance, of items or places of heritage value and is directly derived from the NSW Heritage Office Heritage Manual (revised 2001).

GRADING	JUSTIFICATION	STATUS
EXCEPTIONAL	Rare or outstanding element directly contributing to an item's local or State significance.	Fulfil criteria for local or State listing.
HIGH	High degree of original fabric. Demonstrates a key element of the item's significance. Alterations do not detract from significance.	Fulfil criteria for local or State listing.
MODERATE	Altered or modified elements. Elements with little heritage value, but which contribute to the overall significance of the item.	Fulfil criteria for local or State listing.
LOW	Alterations detract from significance. Difficult to interpret.	Does not fulfil criteria for local or State listing.
INTRUSIVE	Damaging to the item's heritage significance.	Does not fulfil criteria for local or State listing.

*Table 2: Guide to the grading of significance of items of heritage value*

Examination of components of the Bridge as per above criteria resulted in the following significance of each component:

Bridge Element	Grading of Heritage Significance
Abutments	MODERATE
Timber Piers	LOW
Iron Piers	HIGH
Lift Span	EXCEPTIONAL
Approaches	MODERATE
Decking	LOW
Railing	MODERATE
Truss spans	EXCEPTIONAL

*Table 3: Grading of Hinton Bridge elements*

## **5 Need for strengthening**

The structural analysis of the Hinton Bridge revealed that the bridge approach spans, truss spans and the lift span of the Bridge do not have sufficient capacity to safely carry current loads. The analysis identified the following Bridge elements as deficient to carry current loads.

- 1 Timber approach spans
- 2 Stringers and cross girders of the truss spans
- 3 Bottom chord of the truss spans
- 4 Diagonals of the truss spans
- 5 Traffic barriers

## **6 Upgrade Proposal**

To address the above deficiencies and some durability issues the RTA proposed to upgrade the Bridge to the required level and minimise the future maintenance costs. A principal focus of the latter is reduction of the need for timber.

The upgrade proposal aims to keep the Hinton Bridge operating as a road bridge with no load restriction thus ensuring the significance of the Bridge as a functioning road bridge remains intact.

The Proposal to upgrade includes the following:

- Installation of Stress Laminated Timber (SLT) decking on truss spans.
- Use of hollow steel cross girders to support the SLT decking
- Installation of steel laminates to the inside faces of the bottom chord to strengthen the bottom chord
- Increase the size of the timber diagonals and new steel shoes to suit.
- Installation of timber and reinforced concrete composite decking for approach spans
- Replacement of the existing timber abutment with a concrete construction
- Upgrade safety barriers to comply with current design standards.
- Construction of concrete sills at the base of all timber piers in such a manner that it does not project above the ground level.

The above Proposal attempts to keep the visual appearance of the bridge as close as possible to the original design and maintain the aesthetic appearance of the Bridge.

## **7 CONCLUSION**

The proposed works ensure the Hinton Bridge continues to operate as a functioning road bridge without a load limit. The replacement of the deck of the truss spans with SLT decking and the approach spans with a concrete timber composite deck would ensure that routine maintenance on the Bridge and the need for replacement timber is minimised.

The proposed work is not considered to result in a reduction in the heritage significance of the Hinton Bridge. It would bring the Bridge commensurate with current use in the most heritage sympathetic manner available and would avoid the necessity for replacing the Bridge.

The NSW Heritage Office approved the proposed strengthening works.

## **8 REFERENCES & NOTES**

1. RTA, NSW “Statement of Heritage Impact – Proposed rehabilitation and strengthening works on Hinton Bridge over the Paterson River, Hinton NSW”, August 2003.
2. McMillan Britton & Kell Pty Ltd “Study of Relative Heritage Significance of all Timber Truss Bridges in NSW”, December 1998