

BUILDING BRIDGES

for the **FUTURE**



RICHMOND
VALLEY
COUNCIL



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WORKING COUNCIL-TO- COUNCIL

Councils operate in a difficult environment with continuous change in the areas of:

- Budgetary constraints
- Changing State and Federal funding arrangements (Auslink and Roads to Recovery)
- Increased accountability
- Environmental management
- OH&S compliance
- Risk management
- Protection of employment
- Desire for achieving regional outcomes
- Resource sharing.

Richmond Valley Council (RVC) can assist in addressing these challenges in the area of bridge management by providing the following services:

- Investigation reports
- Concept reports
- Design
- Component supply
- Construction
- Decommissioning
- Temporary bridges

RVC operates with a Quality System which incorporates all aspects of precasting, construction, Occupational Health & Safety, and Environmental Management.

RVC has been building bridges for over 30 years and have the capacity to undertake works at remote locations. We have successfully completed projects in South East Queensland and Northern New South Wales from Maroochydore to Taree and west to Warialda.

the BENEFITS *and* advantages

Having constructed in excess of 200 bridges our specialist team of project managers, design engineers and tradesmen as well as Council's logistics and support processes, ensure the availability of skills to provide practical and affordable solutions to your bridge asset problems.

Our knowledge of Government practices enables us to seamlessly integrate our services into your works programs for complete bridge asset services or supply/design of components.

RVC believes the best solution is the one that is suited to the site specifically and with this in mind we approach design and construction by considering all available materials, products and techniques.

RVC has its own precasting and prestressing facilities to ensure the availability of quality components and further ensure the quality of the completed bridge. We have the facilities to manufacture Qld Main Roads prestressed planks, NSW RTA prestressed planks, Super T beams and NAASRA Type 2 trough girders.

RVC also has the manufacture rights for the patented Doolan Deck Modular Bridging System.

Use of this modular bridging system has enabled us to provide:

- **Cost Savings of 40-60%** compared to traditional construction methods.

Where appropriate, investment in utilising existing sub-structures can be capitalised using the Doolan Deck system, therefore negating the need to increase costs on unnecessary replacement materials.

- **An Environmentally Sound Product.** The off-site manufacture of the modules and the method of construction of Doolan Deck bridges results in a very low impact on the environment. Governing authorities such as the Department of Natural Resources (QLD) have supported the construction of Doolan Deck bridges over the Brisbane River because of minimal disturbance to stream flows in the Brisbane water supply catchment area.



RICHMOND VALLEY COUNCIL HAS BUILT IN EXCESS OF 200 BRIDGES ACROSS A WIDE AREA RANGING FROM MAROOCHYDORE IN THE NORTH TO TAREE IN THE SOUTH AND AS FAR WEST AS WARIALDA.

**COMPLETE
SERVICE
AVAILABLE**

Richmond Valley Council (RVC) recognises that Local Government organisations may or may not have the staff resources and skills required for the planning, design, construction and decommissioning of bridges.

With this in mind we have developed the staff and skills to enable us to provide a complete service to other Local Government organisations in the areas of planning, design, construction and decommissioning of bridges.

Richmond Valley Council has qualified and experienced staff who can provide the following:

- Project Management
- Investigation
- Concept development
- Design
- Precast/Prestressed product supply
- On-site construction
- Supervision for construction
- Decommissioning of old bridges.

RVC has also completed numerous projects utilising staff from client organisations. These co-operative arrangements can help train the client's workforce in new areas and help promote a greater sense of ownership of the assets among these personnel.

Our Local Government experience facilitates our seamless integration into your organisation.

Whatever the project requirements, we are confident that RVC can provide you with a complete service.

the **BENEFITS** *and* **advantages**

from **THIS...**



to **THIS...**



**RICHMOND VALLEY COUNCIL
CAN PROVIDE A *complete* SERVICE**

**PRESTRESSED
AND
PRECAST
BRIDGE
COMPONENTS**

Richmond Valley Council (RVC) has been manufacturing precast and prestressed concrete products for 21 years.

Standard prestressed products that we currently have manufacture facilities for include:

- Octagonal prestressed piles
- Qld Main Roads design prestressed planks
- Type 2 NAASRA trough girders
- Super T girders.

RVC also manufacture a number of precast reinforced concrete bridge components including:

- Doolan Deck modular bridge units (more details on following pages)
- New Jersey and Type F concrete barrier units
- Castellated kerb units
- Wing wall units
- Precast Abutments/Piers
- Precast concrete piles.

We believe that manufacture of bridge components in a factory facility is beneficial in many ways. These include:

- Stricter control of manufacture conditions
- Higher quality product achievable
- Less time spent on-site
- Traffic deviations minimised
- Less inconvenience to the public
- Site costs reduced.

OFFSITE *manufacture*



COMPLETED DOOLAN DECK MODULES WAITING DELIVERY.



DOOLAN DECK MODULE MANUFACTURE FACILITIES



COMPLETED PRESTRESSED OCTAGONAL PILES WAITING DELIVERY

ABOUT THE DOOLAN DECK SYSTEM

Doolan Decks are a modular precast timber and concrete panel made at Richmond Valley Council's casting yard to your exact specification.



This not only ensures an exact fit but that the quality of the product is high.

Due to the **UNIQUE** *design*

the Doolan Deck Modular Bridging System offers unrivalled flexibility that enables it to be used in almost any situation.

MODULE *dimensions*

can be varied to suit a number of situations, for example: utilisation of existing sub-structure, skewes, road widths, etc.

DOOLAN *decks*

have already been manufactured to suit the following situations:

- Skewed bridges
- Sloping headstocks on super-elevated sections
- One-way and two-way crossfall
- Differing levels in headstocks
- Utilising existing sub-structure
- Variation in unit widths from 2.0m to 4.3m
- Variation in length of units from 6.0m to 15.0m

TIMBER *girders*

are used as the primary structural element. These girders are connected by steel shear pins and plates to a reinforced concrete deck.

the **CONCRETE** *deck*

acts as the running surface for vehicles as well as weather protection for the timber girders.



A REVOLUTIONARY MODULAR BRIDGING SYSTEM

The Doolan Deck Modular Bridging System was originally developed as a maintenance strategy for existing timber bridges. However, due to its adaptability and superior performance it has proven its suitability for not only maintenance but replacement and new bridge works.

The cost of bridge construction and maintenance has significantly increased over the last ten years due in part to the introduction of more comprehensive safety and environmental requirements together with augmented wages and allowances for remote construction work.

Thus modular construction, which allows for the majority of construction to be carried out in a safe and controlled environment in a well maintained and central location, can substantially reduce overall construction costs.

Modular techniques also allow for bridges to be rebuilt in stages where possible, utilising existing sound substructure and existing road approaches obviating the need for expensive road deviations.

The Doolan Deck System for modular bridge construction has been developed to offer a product that is quicker and cheaper to build and erect than conventional bridges and has enhanced safety and environmental features.

Deck modules may be constructed from reinforced concrete, prestressed concrete, composite steel/concrete, timber/concrete or newly developed materials that are suitable.

UNIQUE FEATURES OF THE DOOLAN DECK SYSTEM INCLUDE:

- The hanging of girders from the deck and allowing an end diaphragm to span between column heads.
- The connection of the modules at or close to the neutral axis in the longitudinal direction to produce a pseudo-continuous deck and a unique jointing system.
- The connection of the units in both the longitudinal and transverse directions so that expansion and contraction is limited to the perimeter of the connected modules.

Any of the above features will constitute a breach of patent if used by unauthorised manufacturers.

PSEUDO-CONTINUOUS MODULAR BRIDGE DECKS

In order that large horizontal forces due for example to vehicle braking or impacts can be transmitted through the structure in the plane of the deck, continuous structures are favoured. A continuous structure is one that is constructed in one continuous length over three or more supports. Expansion joints are then positioned at discrete points to accommodate movements generated through temperature, creep and shrinkage.

Modular elements by their definition will need to be coupled in some manner after delivery to site to achieve continuity. This may be done by mechanical means or by leaving intermediate sections to be constructed on-site. However, this is costly and time consuming and sometimes defeats the benefits gained by off-site modular construction. The quality of in-situ concrete joining strips is often difficult to achieve in remote areas where delivery of premixed concrete is problematic.

A system which provides the benefits of continuity with minimal cost and time delay and at the same time ensures long lasting joint details has been developed and is described in the following as "pseudo-continuity".

PSEUDO-CONTINUITY & DOOLAN DECK MODULAR UNITS

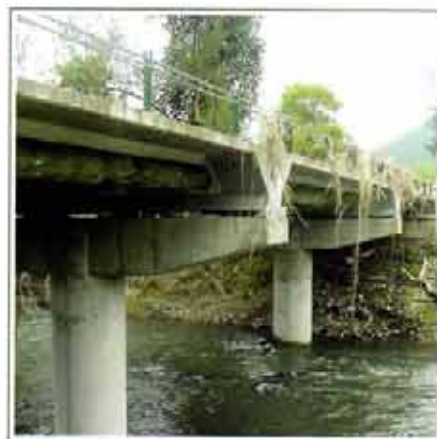
It is the object of the Doolan Deck Modular System to provide a modular load carrying member which may be coupled in the primary direction and plane to produce a "pseudo-continuous" structure which exhibits the desirable attributes of a fully continuous structure.

In the preferred embodiment, modules are coupled at or close to the primary neutral axis of the module with stressed or plain steel rods or cables and separated by means of elastomeric spacers inserted between the modules.

Semi rigid jointing material is then captured in the specifically formed transverse joints and creep and shrinkage movements are transferred to the extremities of the coupled modules, as for a continuous structure.

The arrangement allows flexing of the modules without change in length of modules due to the close proximity of the connection to the modules' neutral axis. Thus, what is described as "pseudo-continuity" is achieved.

Without this unique characteristic, modules would be free to move independently causing long term joint durability problems. The connection also allows for the high lateral strength of the deck in the horizontal plane to be utilised to resist lateral forces on the bridge.



The system described above is a patented system.



BENEFIT & RISK ASSESSMENT OF DOOLAN DECK SYSTEMS

MODULE TYPE	TIMBER/ CONCRETE
Weight of Typical 12m Module (Tonnes)	25-30*
Span Capability	15m
Approx Cost/m ² (ex casting yard)	\$750-\$900
Ongoing Maintenance	Low
Transport and Erection Robustness	High
Ecological Sustainability	Partly
Carbon Credit	Positive
Regional Job Creation	High
Worker Safety	High
Environment Protection	High

* Depends on depth of baunch over girders.

BENEFIT ASSESSMENT - *Timber/Concrete Modules*

DURABILITY

It has been established that timber, adequately protected from the elements, will last indefinitely. Many examples exist where timber framed structures are still performing after 500 years or more. In comparison, modern steels and reinforced concrete have only been in existence for around one hundred years and many structures using these materials are now reaching the end of their serviceable life. This is not to say that well detailed and constructed steel and concrete structures will not last or perform as required. It is simply to point out that timber (particularly Australian hardwoods) is a much under estimated material and has been squandered in unprotected situations due to its hitherto abundance and low cost.

STRENGTH

Australian hardwoods have strengths up to half that of mild steel yet they are only one eighth the weight. Timber therefore has a very substantial strength to weight advantage over other materials described herein. The strength to weight advantage of timber over concrete may be as much as 10 to 1 and with a much higher impact resistance.

LOW LEVEL SUBMERSIBLE BRIDGES

Timber/Concrete modules are more robust and durable in the case of low level submersible bridges. The timber girders have a lower and smoother profile and are therefore less susceptible to log impact forces.

The timber girders are also much stronger in the transverse direction than either the steel or concrete girders with a much better impact capability.

Timber girders are also less susceptible to the sand blasting effects of material carried in high velocity flood waters which tend to remove protective coatings from steel girders and reduce the cover to reinforce-

ment in concrete structures.

The size of the timber girders required, compared to steel or concrete, encroaches far less on the waterway area.

TRANSPORTATION AND HANDLING

Due to the structurally conservative shape of the timber girder, round versus I - shape in the case of steel and due to its superior strength and impact resistance in the case of concrete, Timber/Concrete modules are able to absorb more robust treatment in their transportation and handling.

This is important as damage caused in this phase if undetected may have long term durability problems or if detected could signal unacceptable construction delays.

ECOLOGICAL SUSTAINABILITY

Timber girders are a renewable resource and are an exceedingly energy efficient way to produce a valuable building material. Timber also consumes CO₂ in its growth thus benefiting in the greenhouse effect. Round girders up to 500mm diameter are used and cut as regrowth at around 15 to 20 years or from plantation stocks at around 25 to 30 years. As the whole round girder is used there is not the usual 60% waste encountered at the mill.

It is estimated that the Timber/Concrete module produces a product that by environmental standards is carbon neutral. The Doolan Deck Modular Bridging System is favoured by the Department of Fisheries over other methods (eg. box culverts) because of the minimal disturbance to the river bed, the off-site manufacturing and the availability of constructing a clear span over smaller creeks and streams.

BYRON CREEK BRIDGE - FOR BYRON SHIRE COUNCIL



RISK ASSESSMENT - Timber/Concrete Modules

FIRE

- Australian hardwood has a higher resistance to heat and fire rating than both steel and concrete.
- As opposed to the traditional all timber bridge there are no holes in the deck capable of producing updrafts to form a fire.

The concrete deck acts as a blanket to prevent the flow of hot air and thus only heat searing of the timber is considered likely even in a severe fire.

- The risk is put at <1% chance and as modules are fully replaceable fire is not considered a threat.

Fire would not render a module unserviceable in all probability.

- A Composite Timber/Concrete bridge constructed on the Pacific Highway at Maria River in 1954 and still in service is in high risk fire area. There has been no damage to the structure though numerous forest fires have passed through the site since the bridge was constructed.

TERMITES

- Termites require a moist atmosphere and secret access if possible. Both these requirements are negative in the case of deck modules.

Of the 500 modules produced over a ten year period there has been no termite problem. The Maria River Bridge (referred to earlier) has had no termite problems for the 50 years of the structure albeit in a high risk termite area.

In the case of termites entering the timber, a covered mud track must be constructed across easily visible concrete surfaces.

Risk is put at less than 0.1% chance and as modules are fully replaceable termites are not considered to be a threat.

All timber used is also CCA treated to provide further protection.

SHRINKAGE OF TIMBER

- Shrinkage of timber at the interface of concrete and timber may be of the order of 2mm. However, this will not affect the horizontal capacity of the plates or the coach screws.
- Shrinkage of the timber actually tightens the grip on the screws and plates.

FATIGUE OF TIMBER

- Tests carried out at Sydney University indicate that at the maximum stress levels anticipated there is no fatigue movement.

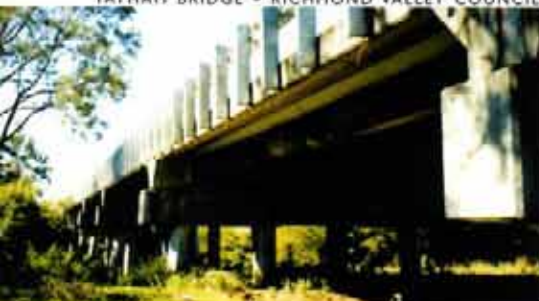
After 500,000 cycles of T44 loading deflections had not altered by any measurable amount.

This is probably due to the fact that the timber is stressed to less than 15% of its ultimate capacity. In fact, it is the concrete which is stressed to 40% capacity that is most likely to exhibit problems if not compacted fully.

BENEFIT & RISK ASSESSMENT OF DOOLAN DECK SYSTEMS

MODULE TYPE	CONCRETE
Weight of Typical 12m Module (Tonnes)	35
Span Capability	15-20m
Approx Cost/m² (ex casting yard)	\$900-\$1,000
Ongoing Maintenance	Low
Transport and Erection Robustness	Medium
Ecological Sustainability	No
Carbon Credit	Negative
Regional Job Creation	Medium
Worker Safety	High
Environment Protection	Medium

TATHAM BRIDGE - RICHMOND VALLEY COUNCIL



FEATURES & ADVANTAGES OF DOOLAN DECK SYSTEMS

FEATURES

The Doolan Deck Modular Bridging System is very versatile and can easily be adapted to suit virtually any existing or new sub-structure arrangement. Some of the unique features of this system are:

- Ability to vary widths (typical range 2.0m to 4.3m)
- Ability to vary lengths of modules (length range depends on materials used) typically up to 15m
- Units can be manufactured for skewed bridges
- Ability to vary crossfalls on modules (ie: one way or crowned)
- Can be manufactured to provide both one-way and two-way crossfall on bridges
- Can be manufactured to suit sloping headstocks and super-elevated sections of road
- Can be manufactured to suit differing headstock levels
- Can be manufactured to fit existing sub-structure arrangements
- Can be manufactured to suit the installation of a variety of barrier systems.

ADVANTAGES

As a result of the off-site casting and the on-site connection details the Doolan Deck Modular System has a number of advantages over traditional construction methods or would-be competitors.

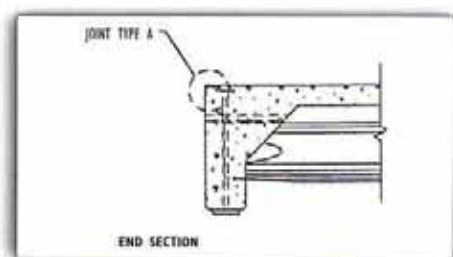
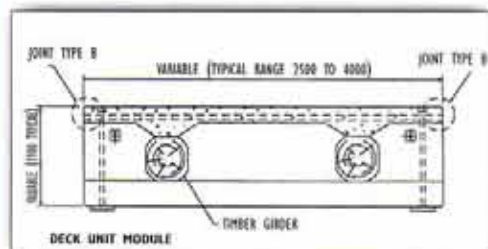
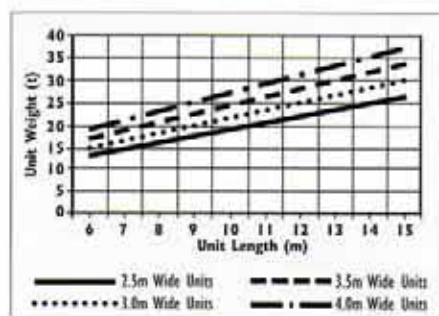
These include:

- Quality of product can be better managed

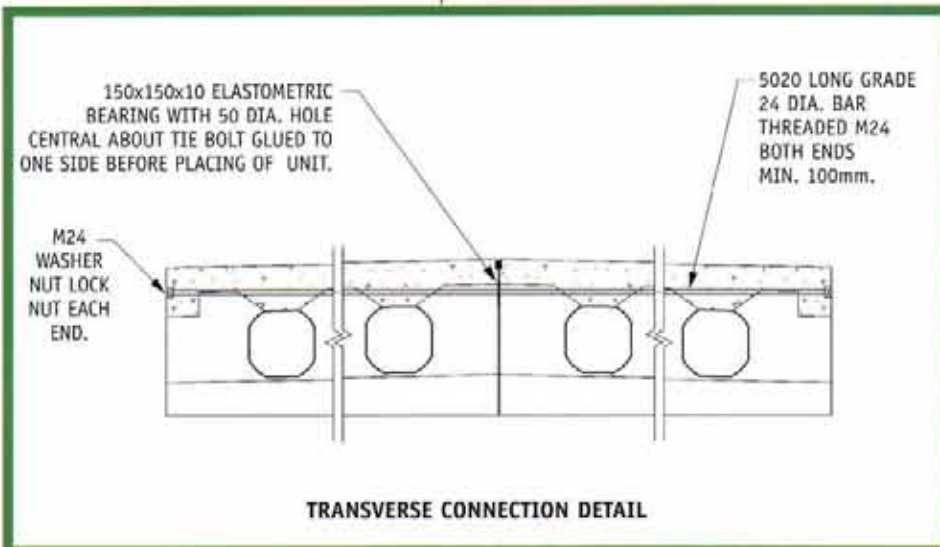
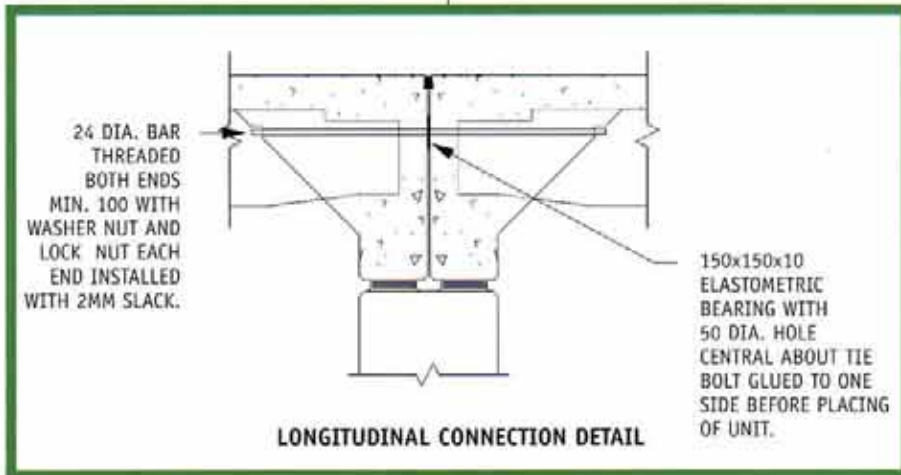
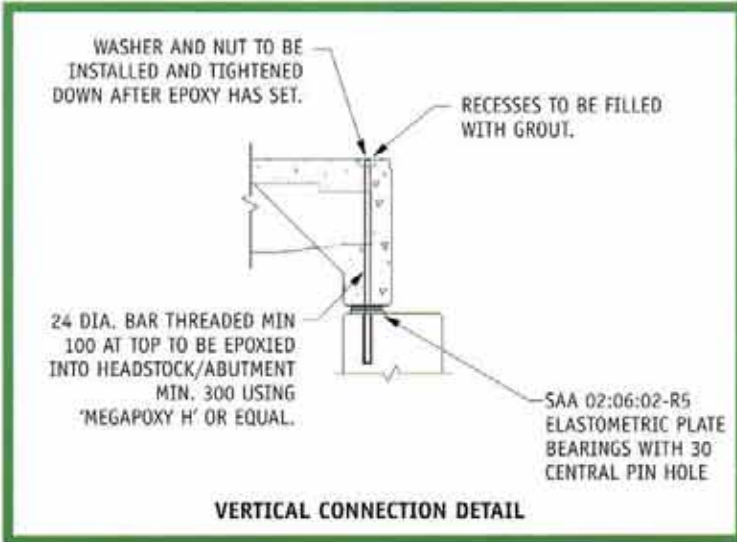
- Safety of workers is greatly increased at less cost
- Environmental concerns are more easily managed and reduced
- Less time is required at site which minimises disruption to traffic
- Bridges may be constructed quickly in half widths reusing road approaches and obviating need for acquisition
- Side tracks may be dispensed with which is of particular benefit in environmentally sensitive areas, rough terrain or where construction space is limited
- Overall construction costs can be substantially reduced, in many cases by over 50%
- By coupling modules in the manner described previously, a form of pseudo-continuity can be obtained. Thus, movement of modules due to temperature, creep and shrinkage is accommodated as would be the case for a continuous deck
- Positive coupling of the modules also allows the vehicle braking forces to be transmitted through the structure to selected points and also helps to distribute the 500KN AUSTRROADS 92 side loading requirement

- As for a continuous bridge the coupling of the modules allows for an expansion joint to be provided at discrete points (normally only at one point for bridges up to 60m)
- If a joint problem should arise the diaphragm provides a solid base to re-attach protection angles or the like and does not render the module unserviceable as would an unthickened slab ending as thin as 150mm.
- A full depth diaphragm allows fill to be compacted against the module for short span bridges without the need for dwarf walls or the like. A geotextile is used to prevent fines fouling rubber bearings (As with timber bridges, expansion can be accommodated with the elasticity of the soil. This is appropriate on low trafficked or unsealed roads)
- The diaphragm ends also mean that the situation of four unsupported corners at the intersection of transverse and longitudinal joints cannot occur. This situation would be considered to be an unacceptable long term durability risk factor as failure of corners would render modules unserviceable and repair difficult.

TYPICAL DOOLAN DECK BRIDGE MODULE - TIMBER/CONCRETE



CONNECTING MODULES



The Doolan Deck Modular Bridging System provides connectors in all three principle directions of the structure, ie, vertically, longitudinally and transversely.

Important factors considered in the detailing of these connectors are:

- Load capacity
- Ease of installation
- Ability to be removed easily to allow removal of modules
- Accessibility for maintenance inspections

The details shown on this page are the typical connection details generally used.

TYPICAL CONFIGURATIONS FOR DOOLAN DECK STRUCTURES

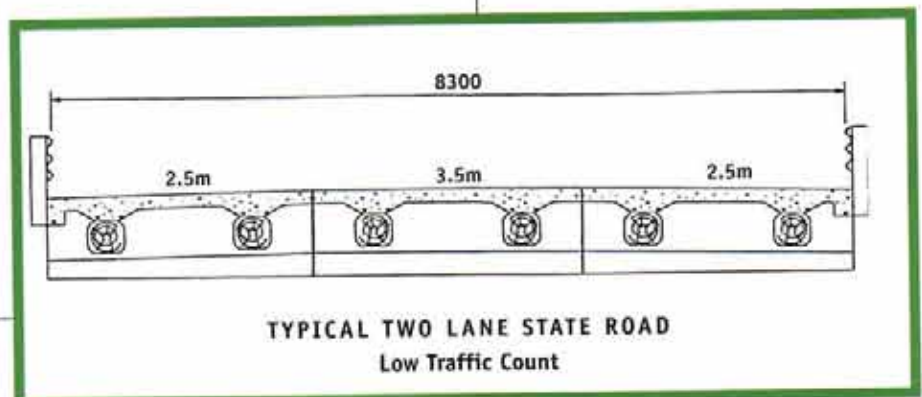
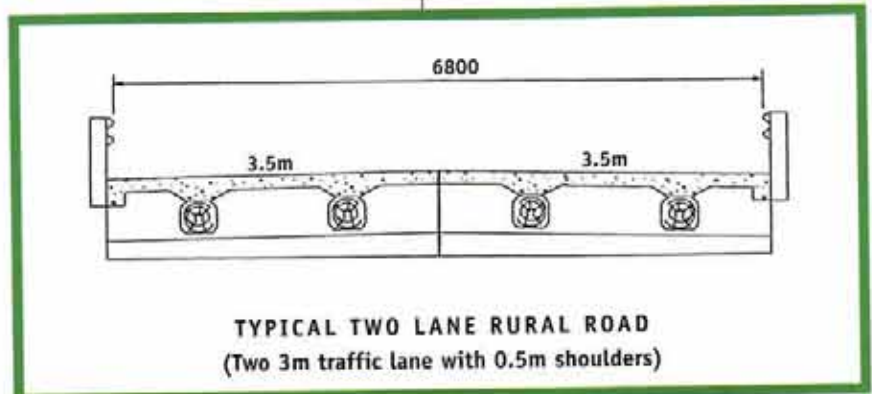
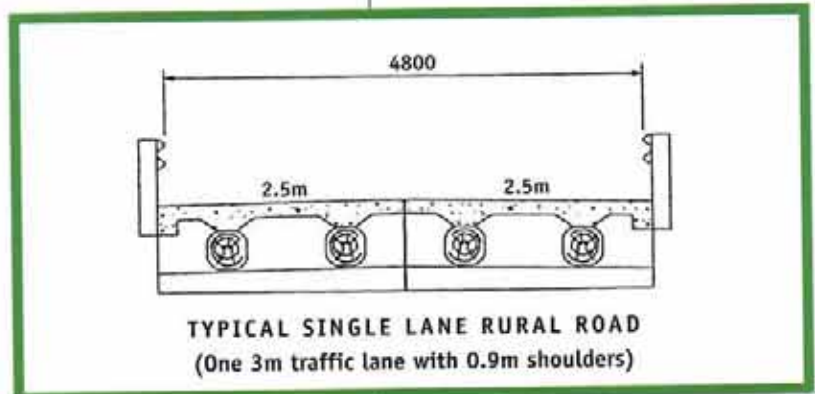
For purposes of transportation and installation it has been found that there are certain sizes and configurations of modules that provide the most economical solution.

These sizes and configurations are dependant on the number of traffic lanes and the width of the bridge to be constructed.

It is also important to consider the requirements of the NSW Road and Traffic Authorities (RTA) Chief Bridge Engineers Circular 99/1 which defines the requirements for modular bridge decks.

Longitudinal joints in modular structures should be kept out of vehicle wheel paths where possible and accordingly the preferred module configurations are as shown here.

Transverse joints in modular bridges should incorporate the unique pseudo-continuous detail described on page 11 and as required in RTA BEC99/1.



JOINT DETAILS

TYPE A

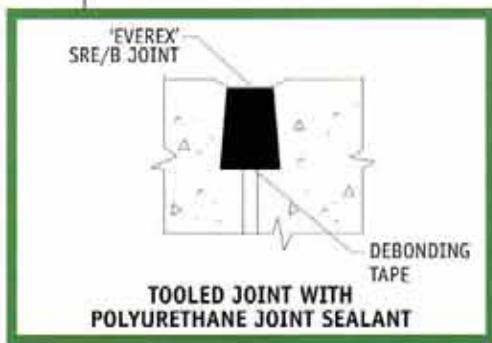


Type A joints are the transverse joints between deck modules, i.e. they are perpendicular to the direction of traffic.

There are basically two options for this joint:

- Steel Protection Angle or proprietary expansion joint OR
- Tooled Joint with SRE (semi rigid epoxy) sealant capable of accommodating flexural or bearing movement (movements around 1 to 2mm).

The joint needs to be reloaded after installation to prevent tension at surface interface.

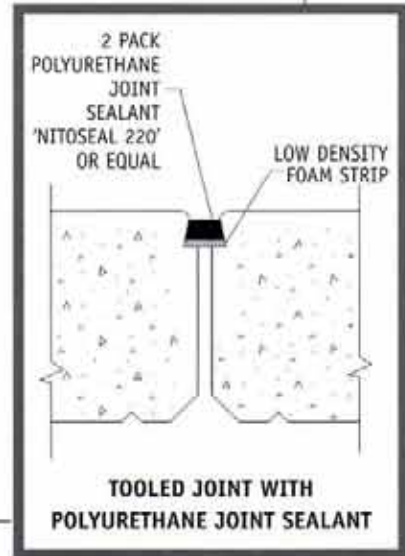
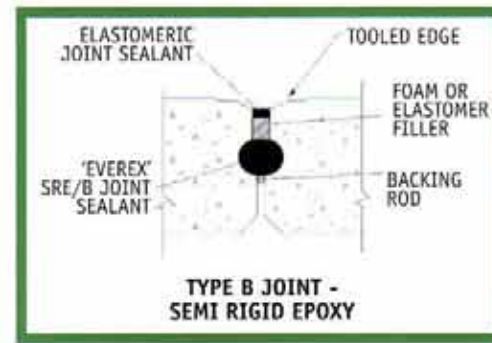


TYPE B

Type B joints are the longitudinal joints between deck modules, i.e. they are parallel to the direction of traffic.

There are basically two options for this joint:

- Tooled Joint with Polyurethane Joint Sealant OR
- Tooled Joint with SRE filler (to provide shear transfer capabilities).



DESIGNED & DEVELOPED BY TERRY DOOLAN

B.Sc. (Mathematics),
B.E. (Civil Eng.),
M. Eng. Sc. (Structural)

The Doolan Deck System was originally developed by Mr Terry Doolan.

It was fully tested for T44 truck loading at the University of Sydney J.W. Roderick Materials and Structures Testing Laboratory.

Tests were carried out in accordance with the Austroads Bridge Design Code Section 2.3.8

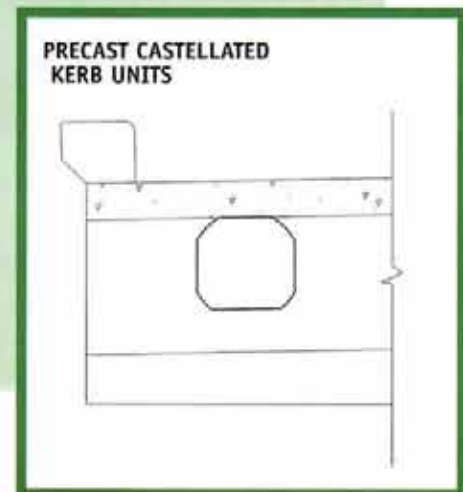
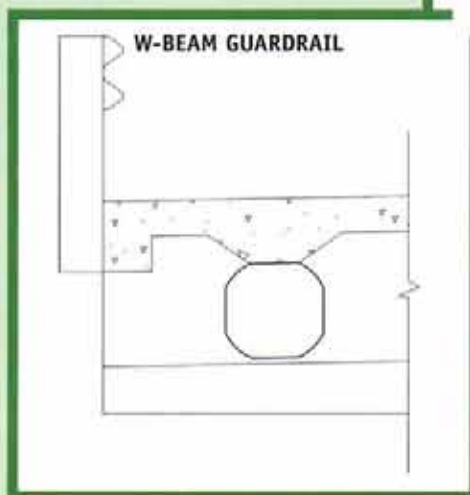
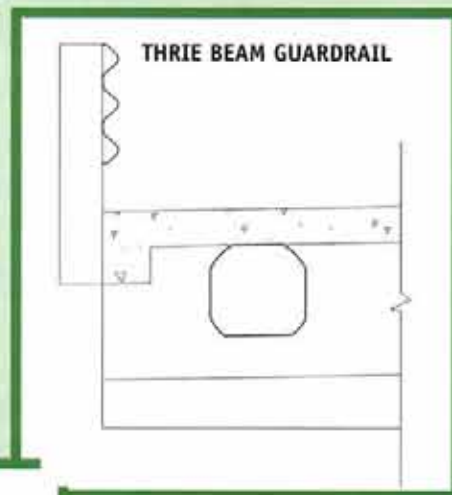
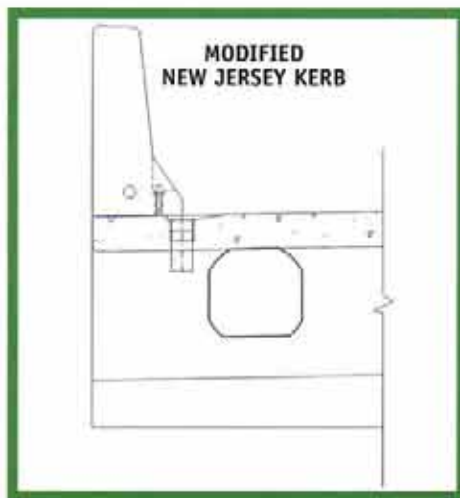
which specifies a number of cycles of loading on roads of functional class 1, 2, 3, 6 or 7.

In 1991 Mr Doolan registered the patent and in 1995 the patent was purchased by Richmond River Shire Council (since amalgamated with Casino Council to form Richmond Valley Council).

BARRIER SYSTEMS

The Doolan Deck Modular Bridging System is also very versatile when it comes to barrier systems. The listed systems have been used with modules.

- **New Jersey Kerb**
 - **Thrie Beam**
 - **W- Beam**
 - **Brifen Wire**
- **Precast Castellated Kerb Units**
- **I-Beam and 2/RHS rails spanning module**



PREFABRICATED BRIDGING OPTIONS



Concept of prefabricated bridges using Doolan Deck modular units

To take the concept of Doolan Deck modular deck units further, consideration should be given to prefabricating a majority of the bridge sub-structure off-site.

It is now possible to manufacture a majority of the components of the bridge sub-structure off-site under controlled conditions. This then allows the benefits of modular bridge deck units to be obtained in the sub-structure construction.

The fact that the completed modules are easily transportable to site means that there are significant savings in both time and labour costs when compared to conventional bridge construction methods.

- **Cost savings of 40-60% have been achieved.**
- **Speed of installation. The fastest time for construction of a complete bridge span has been 4.5 days.**

The completed modules are easily lifted in to place with a mobile crane.

Other benefits include:

- Quality of product can be better managed
- Safety of workers is increased
- Environmental concerns are more easily managed and reduced
- Less time is required at site which minimises disruption to traffic
- Much of the sub-structure of existing timber bridges may be used in a medium term rehabilitation and when money is available the sub-structure may be removed and modules replaced in a very short time frame, as little as one or two days.



Completed modules are easily transported to site which represents significant savings in both time and costs.



1. Installation over an irrigation channel giving a clearspan to the channel.
2. Two lane bridge with cycleway, under construction.
3. Installation in progress at a difficult site.



examples of **WORK COMPLETED**

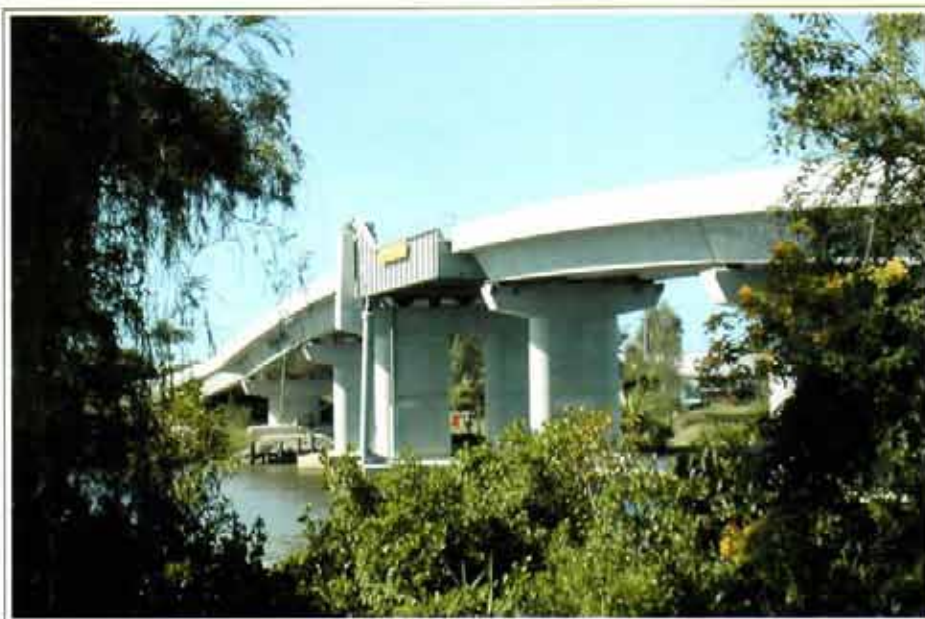


◀ **BURTONS BRIDGE**
ESK SHIRE COUNCIL

Complete design of the bridge and manufacture of precast Doolan Deck Modules carried out by RVC. On-site construction carried out by Esk Shire Council staff with supervision by RVC staff.

BARTHOLOMEWS BRIDGE ▶
BOONAH SHIRE COUNCIL

Complete design of bridge, supply of prestressed planks and on-site construction.



◀ **BROADWATER BRIDGE**
RICHMOND VALLEY COUNCIL

Complete design, manufacture of prestressed concrete piles and trough girders and all on-site construction by RVC. Work also included refurbishment, widening and installation of lift span.

examples of **WORK COMPLETED**

DUCK CREEK BRIDGE ▶
KYOGLE SHIRE COUNCIL

Complete design of the bridge and manufacture of prestressed concrete planks and all on-site construction carried out by RVC staff.



◀ **DEEP CREEK BRIDGE**
RICHMOND VALLEY COUNCIL

Manufacture of precast Doolan Deck Modules and in-situ construction carried out by RVC.

BEECH TREE ROAD BRIDGE ▶
KYOGLE SHIRE COUNCIL

Complete design of the bridge, manufacture of precast Doolan Deck modules and on-site construction carried out by RVC staff.



IMPORTANT

**CONSTRUCTION OF ROAD APPROACHES AND
ON-GOING ROAD MAINTENANCE.**

A note of warning for all road building organisations.

Large vibrating steel drum rollers are common now on all road construction and maintenance jobs.

Operators need to be made aware that vibrating rollers should not work within 5m of the bridge abutment for fear of shearing piles below ground level or moving the abutment and jamming the expansion joints and seriously affecting the performance of the structure.

Rollers should not be driven on or over concrete bridges without adequate precautions to stop the large concentrated loads cracking concrete decks, especially at joints. It is now common practice to grade and roll local gravel roads in one operation using large steel drum rollers.

Care should be exercised when proceeding over concrete structures during this operation to minimise any damage that could occur. If this cannot be achieved a float should be used which is the legal requirement. Ignorance is no defence for the damage of a public asset.

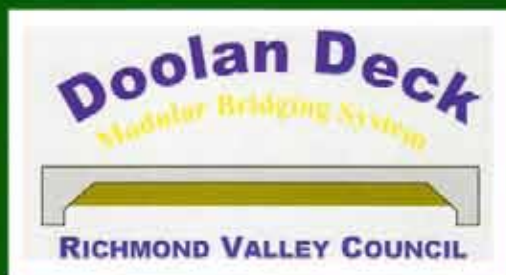
**OUR EXPERIENCE IN BRIDGE BUILDING
EXTENDS BEYOND MODULAR BRIDGING SYSTEMS**

We are absolute in our resolve regarding the advantages and benefits of the Doolan Deck Modular Bridging System. However, we recognise that there are times when conventional bridging methods are more appropriate and we have the experience and expertise in these construction techniques as well.

Prestressed piles and planks manufactured by us satisfy both NSW RTA and QLD Main Roads specifications.

Should you have any requirements or enquiries in this regard we are more than happy to spend the time with you and are confident that you will be more than pleased with the results.





RICHMOND VALLEY COUNCIL

68 WALKER STREET
(LOCKED BAG 10)
CASINO N.S.W. 2470

PHONE: (02) 6660 0300

FAX: (02) 6662 4946

EMAIL:

council@richmondvalley.nsw.gov.au

www.richmondvalley.nsw.gov.au/doolandeck