Load Transfer Sequencing for Maintenance of Lift Span Bridges
Presentation Outline -

• **Lift Span Bridges**
  - History
  - Typical Structural Forms and Operation

• **Load Transfer Sequencing – Temporary Supports**
  - Nyah Lift Span Bridge
  - Gonn Crossing – Murrabit Lift Span Bridge
Movable Span Bridges

• **What are they?**
  • One or more spans capable of moving by mechanical means to allow the movement of large vehicles underneath

• **When are they used?**
  • Typically used over rivers in low lying regions where large built up embankments would prove costly

• **Use in NSW**
  • Sixty-six movable span bridges constructed in New South Wales
  • Twenty-six still in use and managed by NSW Roads and Maritime Services (RMS)
  • Fourteen moveable bridges still operational
Movable Span Bridges – Three types

- **Vertical Lift Span Bridges**
  - Purely vertical lift, no rotation
  - Examples: Nyah, Gonn Crossing

- **Bascule Span Bridges**
  - Rotation causing span to lift vertically
  - Example: Clarence River Bridge

- **Swing Span Bridges**
  - Rotation causing span to twist laterally
  - Example: Pyrmont Bridge, Glebe Island Bridge
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Vertical lift span bridges

- **Identified by tall Column structures**
  - Provide support for the lifting pulley system
  - Guide the moving span vertically
  - The weight of the span is typically balanced by a counterweight system to reduce the work required to lift the span
  - Earlier designs had independent columns and lifting mechanisms
  - Led to jamming
  - Later designs included bracing between the columns and more complex lifting mechanisms
Vertical lift span bridges in Southwest NSW

- **Seven structures maintained by RMS in South West Region**
- Six over the Murray River:
  - Barham-Koondrook
  - Gonn Crossing-Murrabit
  - Swan Hill
  - Nyah
  - Tooleybuc
  - Abbotsford
- One over the Darling River
  - Wentworth
- **All seven lift spans are operational**
Vertical lift span bridges – Ongoing maintenance

- **Jointly funded by NSW RMS and VicRoads**
  - 50:50 split for the Murray River border bridge maintenance program

- **Conflicting needs of the road vehicle traffic and the river boating traffic**
  - Must maintain a level of service to ensure safe travel for both

- **Constitutional requirements**
  - Navigable waterway must be maintained

- **Weather dependency**
  - Murray river levels are generally uncontrolled and unpredictable
  - Impacts the frequency for openings and planned maintenance
Nyah Lift Span Bridge

- Officially opened in July 1941
- Connects Nyah, Vic to Koraleigh, NSW
- Mix of structural steel and concrete, two lanes wide
- Central span can be raised to achieve 10m clearance to the high flood level
Preliminary counterweight support concepts

- Fixed bracket
- Ramps required on approach spans
- Raise lift span with jacks under girders
- System to raise or lower counter weights
- Steel wire cable to brace counter weights running over existing wheels
- Counter weights approx. 40t each

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NSW Government
Transport Roads & Maritime Services
Final counterweight support design

- **Design intent:**
  - Existing structure and load paths utilized
  - Stressing strand draped over existing pulley system
  - Jacking assembly welded to side of column used to lift counterweights and release existing steel wire cables
Counterweight support cradle

- Counterweight assumed to be unreinforced
- Impractical and unsafe to utilise existing counterweight support brackets during the replacement process
- Cradle designed to support counterweight and provide attachment points for the stressing strand
- Braced to existing column for stability
Jacking bracket

- Designed to resist shear force through the welds between the gussets and existing column
- Column plate insufficient for the moment due to eccentricity, resisted by moment couple between bearing of the gussets and pre-tensioned threaded bar
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- Designed to resist shear force through the welds between the gussets and existing column
- Column plate insufficient for the moment due to eccentricity, resisted by moment couple between bearing of the gussets and pre-tensioned threaded bar
- Stool inserted so load is not supported on hydraulic pressure, and to protect jacks from vandalism
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Nyah Lift Span - Summary

- Technical work completed at bridge deck level
  - Counterweight support cradle installation
  - Jacking process
- Road access only impacted during critical work stages
  - Site works were completed during bridge closures between 7am and 5pm on weekdays from Monday 13 April to Friday 24 April 2015, with two half-hour opening blocks each day for school traffic between 7.45am and 8.15am and 3.45pm and 4.15pm.
- Old 35mm 6 x 19 IWRC Galvanised 1770 Grade cables were destructive tested and broke at between 674kN and 799kN.
  - Minimum breaking force as per AS3569: 716kN
- Works were valued at $700,000
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Gonn Crossing-Murrabit Lift Span Bridge

- Officially opened in July 1926
- Connects Murrabit, Vic to the locality of Gonn Crossing, NSW
- The first all steel construction lift span across the Murray
- Originally design to carry both rail and road traffic
The building of the Murrabit Bridge was a great event in the district. There were hundreds of workers involved and a huge camp city was set up. A boarding house was established just upstream where meals were provided in a large tent.

Local bullock teams brought in the timber used for the piles of the concrete piers, and others were floated down the river from Echuca beside a barge, the hold of which was filled with sawn timber for decking. The barge could carry 150 bales of wool as back loading.

The bridge was opened on July 1, 1926. First all-steel construction lift span bridge across the Murray between Victoria and New South Wales, designed to carry both road and rail traffic. The bridge was designed with a novel lifting device with the span able to be lifted by a winch in two and a quarter minutes by two men or in five minutes by one man.

The bridge consists of two 90 feet (approx. 28 metres) fixed spans and of one lift span.

At first the lifting of the bridge was the job of the Railway Station Master at Murrabit, but then an official bridge keeper "Scottie" was appointed. He lived in a railway hut at the bridge where the road now lies, and wore a railway uniform with "Bridge Keeper" on his cap.

The bridge was an essential component of the Kerang to Stony Crossing railway line, designed to open up the rich Riverina to Melbourne Ports. The bridge operated as a railway bridge until the train from Murrabit to Stony Crossing ended in 1943. The train from Murrabit to Kerang continued until the line ceased to operate on December 20, 1961.
Gonn Crossing – Re-use of the existing process

• The geometry of the Gonn Crossing bridge eliminated the possibility of using the same support process as Nyah
Gonn Crossing – Counterweight support design

- Bridge geometry could accommodate a direct column support between the counterweights and the approach span girders
- Jacking stool at the base used to lift the counterweights
- Jack specified had a locking collar to release hydraulic pressure
- Support column braced to existing structure
Gonn Crossing – Support struts installed
Gonn Crossing – Jacking stool
Gonn Crossing Lift Span - Summary

• Technical work completed at bridge deck level
  • Column brace installation
  • Jacking process
• Proprietary products used where possible to limit fabrication costs
• Road access only impacted during critical work stages
  • Site works were completed during two days of bridge closures from the 30 November to 1 December 2015 from 9AM to 3:30PM with an opening time of 12-1PM, and for 3 weeks from 14 January to 5 February 2016 from 8am to 5pm.
• Works were valued at $850,000
Conclusion

• BG&E have devised two separate structure specific methods to support the counterweights during maintenance works

• Both methods allowed continued use of the road crossing during the replacement works

• Safe work practices and methodologies were developed
Acknowledgement

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