SH5 Mohaka River Bridge

Achieving Value for Money

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SH5 Mohaka Bridge - Presentation

- Background
- Maintenance
- Improvements
- Strategic Importance
- Structural Concerns
- Design - Deck Strengthening
- Construction - Deck Strengthening
- Customer Focus
- Value for Money
Built: 1962
- 5 spans total length 216m
- Reinforced concrete deck & piers
- Steel truss arch structure
- 49m above Mohaka River
**SH5 Mohaka Bridge - Maintenance**

- **Routine Maintenance**
  - Drainage
  - Vegetation/detritus clearance
  - Deck resurfacing/resealing

- **Structural Maintenance**
  - Steelwork repainting
  - Bridge joint repairs

*After*
1988 Major Work:
- Locking of the simply supported ‘drop-in’ span to make the superstructure continuous

2007 Guardrail Upgrade:
- Installation of TL3+ modified trise beam guardrail

2010 Seismic Strengthening:
- Steel strengthening
- Ground stabilisation

2011 Emergency Work
Vital commercial link
Located on SH5
96km south of Taupo
46km north of Napier
2hrs, 142km

Alternative routes
via Gisborne/Opotiki
8hrs, 570km
via Palmerston North
6hrs, 420km
August 2007 – collapse of I-35W Minnesota Bridge, USA

- 13 fatalities
- 145 injuries
SH5 Mohaka Bridge - Structural Concerns

Similar shape and design

I-35W Bridge Minnesota (total length 518m)

SH5 Mohaka Bridge (total length 216m) scaled up
Safety recommendations by US National Transportation Board

NZTA commissioned Opus - detailed structural assessment of Mohaka Bridge

- Detailed assessment identified several structural deficiencies
  - Deck deterioration*
  - Gusset plate strength
  - Transom end horizontal cracking*
  - Transom U48 diagonal cracking
  - North end land-span beam strength

Previously aware of:...
Interim Bridge Management Plan drafted

- Set out strategic management of the bridge
- Identified risks and mitigation measures
- Concluded:

  - Deck as key vulnerability with deck cracking either reaching or nearing the serviceability limit. Deterioration is exacerbated by the use of plain round mild steel reinforcement and the thin 150mm deck”
  - The High Productivity Motor Vehicle (HPMV) legislation in force from 1st May 2010 would necessitate the strengthening of the deck
June 2011 detailed inspection of bridge deck soffit
Sept 2011 report concluded the Crack-to-Reinforcing-Ratio varied 9.1% - 63.6%

Upon report NZTA advised 1st July 2012 - deadline for all strengthening & other essential maintenance including the need to accommodate HPMV loads

Designs prepared for:
- Deck strengthening
- Crack injection
- Deck waterproofing
- Steel strengthening
- Miscellaneous work
Deck strengthening considerations:

- Deck replacement - cost, design lead-time
- Externally bonded - carbon fibre reinforced polymer (CFRP)
- Externally bonded - steel plate

CFRP recommended:
- Lighter in weight making handling & installation easier, quicker and cheaper
- Requires minimal propping during adhesive curing stage
- Does not significantly increase the deck weight
- Live load reduction is negligible
- Materials durable
- No maintenance requirement
- Additional material cost outweighed by above
Crack injection considerations:

- Improve durability of concrete
- Cracks $\geq 0.3\text{mm}$ to be injected
- High compressive strength not required
- No requirement to restore monolithic properties of deck
- Needs to be flexible in permanent state
- High bonding strength

Polyurethane resin recommended:

- Tolerant to moisture
- Flexible
- High bonding strength
Deck waterproofing considerations:

- Not ‘standard’ practice in NZ
- Commonly used in other parts of the world but typically require 100mm thick surfacing
- NZ bridges, typically surfacing only 20-40mm, Mohaka 30mm
- Two types considered:
  - Spray application
  - Polypropylene mesh bituminous membrane
- Bituminous membrane recommended:
  - History of successful use in Australia
  - Suitable for use with surfacing thickness of 40mm
  - Relatively simple to install
  - Cheapest
Sequencing of the work:

- Critical operations:
  - Milling
  - Deck preparation
  - Waterproofing
  - Re-surfacing
  - Concrete deck soffit repairs
  - Crack injection
  - Corrosion inhibitor application
  - CFRP deck strengthening

- Non-critical operations:
  - Steel strengthening
  - Transom repairs (U18 crack repair & U33 bolt replacement)
Tender & Contract details:
- Designs completed
- Contract 1113/W6 documents prepared to NZS 3910:2003
- Tender Prequal PQM (Simple), measure & value
- Tendered 17 Dec 2011
- Tenders closed 24 Jan 2012
- Contract awarded 1 Feb 2012 to Fulton Hogan Ltd
- Contract period 10 weeks, due date for completion 26 Apr 2012
- Commenced on site 16 Feb 2012
- Actual date for completion 8 May 2012
- Engineer’s estimate $1.2M~
- Tender price $1.3M~
- Final Contract Price $1.5M~
Deck waterproofing:
- Mill full depth of surfacing one lane
- Initial preparation of surface - tungsten tipped wire brush
- Final preparation - diamond tipped grinder
- Primer applied
- Membrane laid
- Re-surfacing
- Repeat for second lane
Crack injection:
- Joint inspection, agreed cracks to be grouted ≥ 0.3mm wide
- Low-pressure water blast cleaning of deck soffit
- Grout nipples fixed with temporary adhesive mortar
- Cracks temporarily sealed
- Pressure injected & cured
- Nipples removed
- Mortar removed
- Core samples taken
CFRP strengthening:

- Position set out
- High-pressure water blast or grind - achieve 0.5mm roughness
- CFRP panels supplied cut to length
- CFRP Surface cleaned
- Adhesive applied
- Positioned & trimmed
- Propped & cured
- Pull-off samples >2.0MPa
- Apply UV protection
Steel strengthening:
- Gusset plate strengthening at transoms U23 & U25
- Additional cover plate installed
- Angle bolted
- North end beam span
- Channel welded
- Web stiffeners
Miscellaneous work:
- Resurfacing - macadam wearing course Mix14
- Application of corrosion inhibitor protective coating
- Crack Weld repairs to transom U18
- Bolt replacement U33
- Concrete spall repairs

Additional work:
- Guardrail maintenance
- Pier joint renewal
- Abut A joint repair
- Approach resurfacing
Customer First Strategy:
- NZTA's Customer - all road users (& neighbours)
- NZTA has a responsibility to minimise any adverse or undesirable impact arising from any activity
  - Listen to customers needs
  - Provide outstanding service - meeting customer expectations
  - Deliver value for money
  - Assure positive experience
  - Communicate with (not to) customers

Regional office made commitment to local industry with respect to HPMV.
Good Asset Management:
- NZTA provided clearly identified Levels of Service (LOS):
  - Strengthening of bridge deck
  - Capable of accommodating HPMV vehicles
  - Complete physical work by 30 June 2012
  - Maintain access across bridge at all times for all vehicles including overweight and over-dimension
- Minimise impact on customers
- Procure work with customer first approach
Communication:
- NZTA/Opus constructive open dialogue with:
  - Heavy Haulage Association
  - Local logging industry
  - Police CVIU
  - Local communities - schools
  - Event organisers - Horse of the Year Show
  - Road Controlling Authority - NZ Army exercise.
Delivery of all LOS requirements:
- Consultant/Contractor met in most cost effective manner:
  - Strengthening of bridge deck
  - Capable of accommodating HPMV vehicles
  - Completed physical work by 8 May 2012
- Maintained access across bridge at defined times for overweight and over-dimension vehicles
- Minimal disruption
- Procure work with customer first approach
- Bridge deck life extended >15 years before replacement considered
The End?