Understanding what you really want from level 3 bridge inspections and bridge load capacity assessments

Neal Lake
Why undertake a Level 3 bridge load assessment

- Heavy vehicle access requests
- Old design standard
- Deterioration reported from Level 2 inspections
- Reports of unusual bridge behaviour
- Suspected damage from major loading events
  - Overload
  - Flooding
  - Damage from vehicle strikes
- Modification to the structure or additional dead loads
- No information on the original design
- Poor construction quality
When faced with a substandard bridge

Options?

Take the risk

- Hope for the best or understand risks

Repair, Maintain, Modify

- Maintain original design capacity

Strengthen

- Upgrade the bridge to a higher capacity

Replace

- New design to meet requirements
Decision Making Process and Considerations

Basis of Decision making

• **Review Context**
• **Define Objectives**
• **Factors Influencing**
• **Courses of action**
• **Alignment of stakeholders**
• **Plan**
The Rating Equation

AS5100.7

Rating Factor = \( \frac{\text{Available bridge capacity for live load effects}}{\text{Live load effects of nominated rating vehicle}} \)

- WIM
- Ambient traffic response
- Analytical load assessment
  - Tier 1 Line model
  - Tier 2 Grillage and Capacity
- Tier 3 Everything else
Process for Bridge Assessment


**Tier 1**

**Tier 2**

- As cycles increase
- Cost increases
- Sophistication increases
- Certainty increases (hopefully)

**Tier 3**

Only cycle if the potential gains will assist to achieve the defined objectives within the cost/risk/performance balance

[Diagram of Bridge Assessment Process]
RFQ Issues

• Combining Level 3 investigations with strengthening/retrofit

• Scope that will not achieve the objectives:
  – Level 3 testing without considering whether the overall objectives are likely to be achievable
  – Scope with context
  – Asked to pricing without context
  – Load/Performance testing

• Scopes that are way too extensive for the actual budget
Load Testing

• Expensive
• At service levels tells you very little about behaviour at ultimate (cannot reliably use to calibrate analytical models)
• Dynamic testing relates to service loads not ultimate loads and depends on many variables not part of the testing
• Proof loading can be effective but difficult to safely do if there are no drawings (More relevant when there is a family of bridges) (expensive)
Load Testing

How do they know the load limit on bridges, Dad?

They drive bigger and bigger trucks over the bridge until it breaks.

Then they weigh the last truck and rebuild the bridge.

Oh, I should've guessed.

Dear, if you don't know the answer, just tell him!
Heavy Vehicle Applications

What should councils be expected to undertake

- Line model comparison should be the primary basis (can be based on design era)
  - span length
  - span continuity
  - design vehicle or known acceptable loading configuration
  - L2 structure condition.
- Anything more: there should be a request for addition funding
- Use Level 3s to determine the impacts of deterioration / damage on the intended design capacity
Using AS ISO 13822

What should councils be expected to undertake

- Plausibility check – enables a critical review of any discrepancies between the results of the analysis and the real-life condition of the structure thus identified “plausibility gaps” can be used to identify many solutions that may be cost effective that can still achieve the required outcomes.
Conclusions

• Faced with a substandard bridge; Take the risk, repair, maintain or modify, strengthen replace
• Follow a decision making process RDFCAP
• Take an iterative approach to Level 3 investigations
• Make sure that any investigations will get you closer to a decision
• Make sure service provider is not invested in a certain outcome
• Get advice from someone knowledgeable in the area
QUESTIONS?
Failure Investigations

Note: Solid lines show existing barriers, dotted lines show proposed project barriers. Line thickness represents barrier effectiveness.