Risk management and bridges

Narelle Dobson | Department of Transport and Main Roads (Engineering and Technology, Structures)
Overview

Governance

Bridge condition

Bridge capacity

Risk management
Queensland's *Transport Infrastructure Act* (1994)

- Construction, maintenance and operation of Government supported transport infrastructure —

  - Carried out to required standards
  - Efficient, affordable, right quality
  - Safe transport of persons and goods
  - Best practice and national benchmarks
Austroads’ benchmark for risk management

• Use a “systematic approach” to asset management.
• “Building blocks” of an effective asset management system:
  - inventories
  - inspection systems
  - analysis tools
  - condition assessments
  - service/intervention levels
  - protocols for prioritisation.
Assessment of existing structures
ISO/AS 13822: 2001

• “… is based on an approach that is substantially different from the design of new structures, and requires knowledge beyond the scope of design codes.”
• “Current codes are normally design codes and therefore cannot be used directly for assessment.”
Policy and standards

• Bridge Condition assessment
  - Benchmarked against ISO55001

• Bridge Capacity assessment
To maintain good condition, we need regular health checks

**People**

- **Attrition**
  - Bone density
  - Elasticity
  - Cholesterol
  - Wrinkles

- **Distress**
  - Genetic
  - Malnutrition
  - Accident
  - Injury

**Bridges**

- **Attrition**
  - Rust
  - Decay/rot

- **Distress**
  - Design/construction anomaly
  - Chemical effect
  - Repeat use
  - Load impact disasters
Bridge Condition Inspections

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Increasing focus on risk—
- Structure-specific
- Component-specific.
Condition assessment approach

- Frequencies relate to risk
  - Material
  - Previous condition rating
  - For example, timber every 12 months (and maintenance)

- Prioritise poor condition
  - Overall structure
  - Critical components.

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## Bridge Information System (BIS)

- Repository of Data for Structural Inventory, Design Inventory and Condition Data
- Data verification
- Accessible to Regions, Districts, RoadTek and other Transport and Main Roads stakeholders
- WhichBridge analysis tool - ranking and prioritisation for bridges and culverts.

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<th>BRIDGE INFORMATION SYSTEM</th>
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<td>- Structural Inventory (Location, Geometry, etc.)</td>
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<td>- Design Inventory (Design Data, Equivalence Ratings, etc.)</td>
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<td>- Inspection Inventory (Element Inventory, Condition, etc.)</td>
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- Incorporation of Whichbridge
- Bridge Sufficiency Analysis
Example – WhichBridge output

- Informs prioritisation through ‘condition risk’ scores
- Informs dollar estimates for rehabilitation funding.

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Structure Management Plan (SMP) – When condition is not OK

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<th>Increase</th>
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<td>• Repair</td>
<td>• Load</td>
<td>• Inspections</td>
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<tr>
<td>• Rehabilitate</td>
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<td>• Strengthen</td>
<td>• Speed</td>
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<tr>
<td>• Replace</td>
<td>• Travel path</td>
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- Repair
- Rehabilitate
- Strengthen
- Replace

- Load
- Frequency
- Speed
- Travel path

- Inspections
- Maintenance
Risk management of timber bridges

- 10% of the bridge network
- 20% of the inspection budget
- 20% of the servicing budget
- 50% of the rehabilitation budget
- Degrading structural material
- Designed to 1922 standard – as legal loads continue to increase most timber structures now overstressed
- Detail component dimensions and timber species identification
- Supply of suitable timber to undertake repairs.
Example SMP for timber bridge
Risk management of scour

- Water normally flows faster around piers and abutments.
- Severe scour can remove foundation material leading to displacement/vibration/collapse.
Bridge Capacity Assessment

- **Risk management**
  - Assessment criteria
  - Inaccurate bridge assessments
  - Potentially structurally deficient bridges.

- **Inspection**
  - Defect consistent with calculated deficiency
  - Structure Management Plan.

- **Advanced assessment**
  - Plausibility gap.

- **Foundations**
  - Serviceability limit state
  - Continuous bridges on steel piles.

Department of Transport and Main Roads, 2012, *Structural Assessment of Existing Bridges: Organisational Policy*, September
Bridge Capacity Assessment use

- Strategic Access Route identification (for network)
- Inform global route restrictions including
  - Class 1 and Class 2 Crane Maps
  - Conditions of Operation Database
- Vehicle permits (for route)
- Informs and can trigger SMPs.
Interface with National Heavy Vehicle Regulator (NHVR) national notices

• NHVR notices
  - may “replace” former permits
  - certain Classes of vehicle
  - compliance with the State Road Authority's Conditions of Notice
  - Specific routes for example, Higher Mass Limits (HML) only.

• Operating conditions for notices
  ▪ Do Not Cross
  ▪ Speed limited (for example, 10 km/ hr)
  ▪ Travel location limited (for example, centre of bridge).
Route restriction (vulnerable asset) maps
Managing risk through permits

- Vehicles defined in legislation, regulation and policy
- Vehicle trafficking profile
  - Number of permit vehicles on the bridge
  - Frequency, Mass and Speed
  - Location of vehicle driving path

- For some vehicles, historic trafficking profiles (for example, occasional frequency, slow and centre line travel) under review for permit-assessment.
Permits requiring Structural Assessment

**NSFV**
(Non Standard Freight Vehicles including Performance Based Standards)

- Multi-combination vehicles
  - A-Doubles, B-Triples, AAB Quads

**Excess Mass Special Assessment**
(Vehicles and combinations that exceed Vehicle Limits Manual)

- Mobile Cranes, Concrete Pumps, Drilling Rigs
- Heavy Load Platforms
- Load Carrying Vehicle Combinations

- 90
- 3000
Structural assessment for permits

• Identify structures
• Establish load effects of permit vehicle
• Compare effects with
  ▪ Bridge capacity ratios for reference vehicle/s
  ▪ Previously approved permit vehicles
  ▪ Other previous known use considered
• Consider structural condition
  ▪ Level 2 and Level 3 Inspection Outcomes
  ▪ Structure Management Plans (SMPs)
  ▪ Crane maps
• Access decision.
New category: Performance Based Standards (PBS) In-Principle Support

- Introduced by NHVR in January 2016
- In-principle support for PBS prior to vehicle construction
- 71 applications to Transport and Main Roads in final quarter of 2015/2016.
Vines Creek

Condition

- Very poor
- Attrition distress

Theoretical capacity

- OK – for good condition

Fix

or

Attrition

Distress

Attrition

Distress
Kelly St George

Condition

Localised capacity distress

Theoretical capacity

Poor due to historic design flaws

Fix

Attrition

Distress

or

Attrition

Distress
Kelly St George – Pier 1
Assessing capacity – Satisfactory past performance (per AS 13822 Cl 8.1)

• “Structures designed and constructed based on earlier codes, or designed and constructed in accordance with good construction practice when no codes applied, may be considered safe to resist actions other than accidental actions (including earthquakes) provided that: …
Satisfactory past performance (per AS 13822 Cl 8.1)

Safe provided:

1. No significant damage, distress or deterioration
2. Sound structural system
3. Service for sufficiently long period of time for extreme actions due to use
4. Sufficient durability ensured
5. No changes for a sufficiently long period of time and no such changes are anticipated"
Going forward

Theoretical capacity

Embodied Condition

MIND THE GAP

Satisfactory Past Performance
Thank you