NETWORK WIDE ASSESSMENT FOR PERMIT VEHICLES

Dr Andrew Sonnenberg
National Bridge Engineering Manager
Overview

• What Vehicles need permits?
• Why provide permits?
• What are the risks?
• The benefits of automated bridge assessment
• Where to next?
Background

• Collaboration between Pitt&Sherry and Department of State Growth.
M.R.B.

Diagram of Live Loads to be Used in Design of Bridges and Culverts on Main Roads

Class B
(2nd Class Bridges)

Wheel Loads: 1½ Tons 2½ Tons

10'

10'

10'

10'

10'

10'

10'

10'

8 Ton Tractor

Trailer 5½ Tons Loaded

Trailer 5½ Tons

Trailer 6½ Tons

Wheel Loads

Date 7/9/35

Approved

Chairman

M. I. E. Aust.
In 1996 NRTC report identified benefits of increasing mass limits for vehicles fitted with road friendly suspension systems.

- Carry heavier loads
- Reduce exports costs
- Fewer vehicles
- Better safety
- Improved environmental performance
• 280 tonne gross trailer mass
## Historical Design Loads

<table>
<thead>
<tr>
<th>Year</th>
<th>Vehicle</th>
<th>Total Mass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre 1945</td>
<td>Varied, examples include Steam Rollers, Crusher Train and Standard Truck</td>
<td>Around 8 - 30T</td>
</tr>
<tr>
<td>1946 to 1976 approx</td>
<td>MS18 (H20-S16-44)</td>
<td>32T</td>
</tr>
<tr>
<td>1976 to 2004 approx</td>
<td>T44</td>
<td>44T</td>
</tr>
<tr>
<td>2004 to current</td>
<td>SM1600</td>
<td>160T</td>
</tr>
</tbody>
</table>
Why provide permits?

• Manage the safety
• Protect Assets
• Benefits
  – Reduced number of trucks on the road
  – Difficulty in splitting loads
  – Reduced time for construction (bigger equipment the faster the process)
  – Overall reduction in costs
What needs to be assessed
What needs to be assessed
What needs to be assessed
What are the risks?

Is this 108 tonne permit vehicle safe to travel?
• One person died and ten others were injured
Guidelines for assessment

Pitt&Sherry used the guidelines on over 400 structures for Councils in the North of Tasmania and for over 300 structures for the Department of State Growth.
Assessment levels

• Five levels of assessment
  – BAL 1: The capacity available for live load based on original design standard
  – **BAL2: Capacity is calculated for each structural element, with distribution factors determined from formulae**
  – BAL 3: An extension of BAL 2 for specific purposes
  – BAL 4: Distribution factors from a grillage or similar model
  – BAL 5: Advanced assessment that may utilise finite element models or load test data.
## Analysis Tool

<table>
<thead>
<tr>
<th>Bridge Name</th>
<th>Bridge Number</th>
<th>Segment</th>
<th>Segment Group</th>
<th>Representative Segment</th>
<th>Support Type Configuration 1</th>
<th>Support Type Configuration 2 (if Applicable)</th>
<th>Rep Segment Check</th>
<th>Rep Segment Count</th>
<th>Support A</th>
<th>Support B</th>
<th>Bearing Offset End A</th>
<th>Bearing Offset End B</th>
<th>Effective Span</th>
<th>Average Beam Spacing</th>
<th>Edge Beam Center to Face of Kerf</th>
<th>Edge of Kerf to Edge of Kerf</th>
<th>Encroachment by Weighing Aids</th>
<th>Muscles of Elevation of Beam</th>
<th>G</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Crawfish Creek Bridge</td>
<td>102</td>
<td>1</td>
<td>1</td>
<td>N</td>
<td>SS</td>
<td>SS</td>
<td>0</td>
<td>0</td>
<td>18.29</td>
<td>0.1905</td>
<td>0.1905</td>
<td>17.91</td>
<td>2.29</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>200.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crawfish Creek Bridge</td>
<td>102</td>
<td>2</td>
<td>1</td>
<td>Y</td>
<td>SS</td>
<td>SS</td>
<td>0</td>
<td>0</td>
<td>18.29</td>
<td>0.1905</td>
<td>0.1905</td>
<td>17.91</td>
<td>2.29</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>200.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crawfish Creek Bridge</td>
<td>102</td>
<td>3</td>
<td>1</td>
<td>N</td>
<td>SS</td>
<td>SS</td>
<td>0</td>
<td>0</td>
<td>18.29</td>
<td>0.1905</td>
<td>0.1905</td>
<td>17.91</td>
<td>2.29</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>200.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Analysis Tool

AssetAsyst™

Version 1.39.0-09b3f23
Username: asonnenberg
Password: 
Network  Mobile

Latest News:
- 12/09/2017 Free Webinar - Depreciation of Assets
- 15/08/2017 IPWEA Conference - Come meet us
- 30/05/2017 ** FREE WEBINAR TOMORROW **
- 16/01/2017 AssetAsyst 1.35.0 Released
- 17/01/2017 Webinar Replay: Reports
- 11/10/2016 Recording of Bridge/Culvert Demonstration
- 26/08/2016 Missed our recent webinar, or want a recap? Double-click to
- 12/05/2016 AssetAsyst 1.32.0 Released (New Work Order System)
- 24/03/2016 Create Custom Asset Types
- 10/12/2015 AssetAsyst 1.30.0 Releases
- 07/12/2015 Predictive Modellings of Bridges
- 03/12/2015 AssetAsyst ensures future of bridges
Inputs Required - Customers

![Image of a customer management interface with the name Pitt&Sherry entered]
### Structure Information

#### Layout

<table>
<thead>
<tr>
<th>Point</th>
<th>Label</th>
<th>Group</th>
<th>Substructure Check Required</th>
<th>Distance from point 1 (m)</th>
<th>Support Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Abutment 1</td>
<td>0</td>
<td>✔️</td>
<td>0</td>
<td>Simply Supported</td>
</tr>
<tr>
<td>2</td>
<td>Pier 1</td>
<td>0</td>
<td></td>
<td>10</td>
<td>Continuous</td>
</tr>
<tr>
<td>3</td>
<td>Pier 2</td>
<td>0</td>
<td></td>
<td>20</td>
<td>Continuous</td>
</tr>
<tr>
<td>4</td>
<td>Abutment 2</td>
<td>0</td>
<td></td>
<td>30</td>
<td>Simply Supported</td>
</tr>
</tbody>
</table>

#### Superstructure Capacity

<table>
<thead>
<tr>
<th>Seg. Number</th>
<th>Location (m)</th>
<th>Beam</th>
<th>V (kN)</th>
<th>M+ (kNm)</th>
<th>M- (kNm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>Internal</td>
<td>200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>Internal</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>10</td>
<td>Internal</td>
<td>220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>External</td>
<td>150</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Substructure Capacity

<table>
<thead>
<tr>
<th>Point</th>
<th>Label</th>
<th>Vehicle Drive Line</th>
<th>Available Capacity For Live Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Design Lane</td>
<td>500</td>
</tr>
</tbody>
</table>
Input required – Distribution factors

• Advice provided by ASSHTO.
• Vary depending on the type of vehicle on the bridge and hence a range of distribution factors are needed.
• Allow different values for external and internal beams.
### Vehicle builder

**Vehicle Builder**

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Paste From Excel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Customer</td>
<td>General Mass Limit Class</td>
</tr>
<tr>
<td>Min Dimension 1</td>
<td>Min Dimension 2</td>
<td></td>
</tr>
<tr>
<td>Max Dimension 1</td>
<td>Max Dimension 2</td>
<td></td>
</tr>
<tr>
<td>X:</td>
<td>Y:</td>
<td></td>
</tr>
</tbody>
</table>

#### Axles

**Axle Groups**

- Add
- Remove

<table>
<thead>
<tr>
<th>Number</th>
<th>Group</th>
<th>Min Axle Spacings</th>
<th>Max Axle Spacings</th>
<th>Tyres Per Axle</th>
<th>Ground Contact Width</th>
</tr>
</thead>
</table>

**Graphical representation of vehicle goes here**
Inputs – Choose vehicles
## Inputs – Choose the structures

### Heavy Vehicle Analysis Wizard

<table>
<thead>
<tr>
<th>Number</th>
<th>Name</th>
<th>Line</th>
<th>Chainage</th>
<th>Span Type</th>
<th>Asset Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>B50193</td>
<td>Waterman's Place</td>
<td>0</td>
<td>Deck/Slab</td>
<td>Bridge</td>
<td></td>
</tr>
<tr>
<td>B50194</td>
<td>Surrey Street</td>
<td>0</td>
<td>Deck/Slab</td>
<td>Bridge</td>
<td></td>
</tr>
<tr>
<td>B50195</td>
<td>Freehold Place</td>
<td>0</td>
<td>Open Gird</td>
<td>Bridge</td>
<td></td>
</tr>
<tr>
<td>B50196</td>
<td>South Street</td>
<td>0</td>
<td>Deck/Slab</td>
<td>Bridge</td>
<td></td>
</tr>
<tr>
<td>B50197</td>
<td>Isabella Place</td>
<td>0</td>
<td>Deck/Slab</td>
<td>Bridge</td>
<td></td>
</tr>
<tr>
<td>B50200</td>
<td>Ripon Street South</td>
<td>0</td>
<td>Arch Culvert</td>
<td>Culvert</td>
<td></td>
</tr>
<tr>
<td>B50201</td>
<td>Darling Street</td>
<td>0</td>
<td>Arch Culvert</td>
<td>Culvert</td>
<td></td>
</tr>
<tr>
<td>B50203</td>
<td>Steinfield Street North</td>
<td>0</td>
<td>Arch Culvert</td>
<td>Culvert</td>
<td></td>
</tr>
<tr>
<td>B50205</td>
<td>King Street South</td>
<td>0</td>
<td>Arch Culvert</td>
<td>Culvert</td>
<td></td>
</tr>
</tbody>
</table>

**Owner:**
- Search
- Reset

### Add Selected
- Add All

**Asset Class:**
- Bridge
- Culvert
Results

• Vehicle passes all checks
• Vehicle requires marked lane travel
• Vehicle required centreline travel
• Further assessment required
• Vehicle not permitted to travel
Benefits of using technology

- Use the information from previous assessments (vehicles and capacities)
- Low cost assessment
- Consistency of approach
- Integration with other systems, GIS, Heavy Vehicle Regulator
- Save permit history against each asset
- Less trained workers can undertake vehicle checks
Benefits of automation

• Reducing the risk of injury and death
Future works

• Extend the analysis for drop in spans and cantilevers
• Refine the reporting
• Determine capacity based on a generic load assessment (auto filled from BAL-1 type check)
• Display the vehicle load configuration
• Integrate with the heavy vehicle regulator
• Place in coding of the automatic calculation of distribution factors
Summary

- There is a need to assess permit vehicles
- If you get the process wrong it could be deadly
- It’s a task that is well suited to automation