Creating Connections

Greg Arnold – Road Science
Anthony Stubbs – Road Science
Brett Kelly – Downer
Thomas Wright – Opus

Performance Based Testing for Design of Area Wide Pavement Treatments
East Waikato Maintenance Contract

Network Budget Forecast
Flat-lined budget until 2014/15 Season.

2011/12 Total Network Budget
Reduced by 11% compared to the previous five year average.

Existing 5-Year Hybrid Lump Sum Contract
Collaboratively renegotiated a reduced lump sum, retaining existing performance criteria.
East Waikato Maintenance Contract

Potential of Performance-based rehabilitation design.

Saving of 12% on rehabilitation costs.

Historic Austroads Approach
  Overlay aggregate and 1.5% cement stabilised.

New Performance-based Approach
  Design specifically for the rehabilitation.
Repeated Load Triaxial Tests on test pit aggregate – East Waikato Hybrid
- How good is the existing material in the road?

300 thousand loads

Poor result existing
- Needs cement and,
- Flexural Beam Test

Good result
- Traditional treatment
Flexural beam tests optimises cement/binder content and depth

Stabilisation:
- How deep (D)?
- How much cement/binder?

To little cement – too weak
To thin – will break
To thick – uneconomic
Creating Connections

INSITU ROAD AGGREGATE CRAP?

idos

RELIES ON AGGREGATE INTERLOCK

LOW QUANTITIES OF BINDER FOR STRENGTH WHEN WET

UNBOUND GRANULAR DESIGN

RELIES ON CEMENT BONDS

FLEXURAL BEAM TEST

TENSILE STRENGTH DESIGN

YES

NO

Recommended Testing/Design

Creating Connections

Low Volume Roads Workshop 2013
Repeated Load Triaxial Tests on test pit aggregate – East Waikato Hybrid
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Creating Connections

INSITU ROAD AGGREGATE CRAP?

YES

FLEXURAL BEAM TEST

LOW VOLUME ROADS WORKSHOP 2013

Downer
### CIRCLY Output

**Creating Connections**

#### Calculation Options

- **Calculate damage factors**
- **Calculate selected results at user-defined values**

#### Tiverton Road - [Damage Calculation Details]

**Traffic Spectrum:** 2 Million ESAs

#### Summary

<table>
<thead>
<tr>
<th>No.</th>
<th>ID</th>
<th>Title</th>
<th>Current Thickness</th>
<th>CDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cemt</td>
<td>Cement 3000 MPa Tensile Strength 3</td>
<td>5000.0</td>
<td>1.30E-01</td>
</tr>
<tr>
<td>2</td>
<td>Gran_200</td>
<td>Granular, E=2000MPa</td>
<td>400.000</td>
<td>1.88E-03</td>
</tr>
<tr>
<td>3</td>
<td>Sub_Q84R</td>
<td>Subgrade Q84R Aniso</td>
<td>0.000</td>
<td>2.65E-04</td>
</tr>
</tbody>
</table>

#### Performance Criteria and Traffic multipliers:

<table>
<thead>
<tr>
<th>No.</th>
<th>Material Type</th>
<th>Performance Criterion</th>
<th>Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cement Stabilized</td>
<td>4% Cement Beaten 1.5MPa 0.4 stress ratio</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>Unbound Granular (Austroads 2004 sub-layer)</td>
<td>Good Subbase</td>
<td>1.00</td>
</tr>
<tr>
<td>3</td>
<td>Subgrade (Austroads 2004)</td>
<td>Subgrade failure criterion (Austroads 2004)</td>
<td>1.00</td>
</tr>
</tbody>
</table>

#### Low Volume Roads Workshop 2013

**ROAD SCIENCE**

**LEADING PAVEMENTS TECHNOLOGY**

**Downer**
Cement 5000MPa Tensile Strength is 1.7MPa

Maximum damage values for each vehicle type

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Damage Factor</th>
<th>Critical Stress (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESA750-Full</td>
<td>0.18964E+02</td>
<td>-0.77 E+00</td>
</tr>
</tbody>
</table>

Maximum of total damage = 18.96374

-ve because in tension

(0.77 MPa)

Granular, E=200MPa

Maximum damage values for each vehicle type

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<th>Critical Strain</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESA750-Full</td>
<td>0.18906E-02</td>
<td>0.21726E-03</td>
</tr>
</tbody>
</table>

Maximum of total damage = 1.8905672E-03

Subgrade, CBR4, Aniso

Maximum damage values for each vehicle type

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<th>Damage Factor</th>
<th>Critical Strain</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESA750-Full</td>
<td>0.20516E-03</td>
<td>0.34793E-03</td>
</tr>
</tbody>
</table>

Maximum of total damage = 2.0516428E-04
Taihape to Napier Road – Low Volume

Subgrade CBR = 6%

Stabilised Material, $E_{CT}$, $\nu_{CT}$

$\sigma_{t_{ct}}$

CIRCLY Calculated Tensile Stress = 380 kPa

250mm Cement Stabilised