Preventing Pre-mature Rutting

Dr Greg Arnold
Engineering Policy Manager
Transit New Zealand
Preventing Premature Rutting

• Rutting – where and why
• Preventing rutting from compaction
  – Strong construction platform
  – Changes to TNZ B2
• Preventing rutting from shear movement within materials
• Choosing the best pavement appropriate for traffic and environment
• Lowest initial cost or lowest whole of life costs, considering risk of failure
Rutting – Forestry road - Scotland

From my supervisor’s presentation – Andrew Dawson – University of Nottingham
Rutting – Forestry road - Scotland
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Rutting – shear in base

Aggregate

Soil

b

b/3
Rutting – compaction in base

Aggregate

Soil
Rutting – shear in subgrade
Rutting

- Thin aggregate
  - high shear on subgrade
  - subgrade rutting

- Thick aggregate
  - high shear on aggregate
  - aggregate rutting greater if
    - poor quality and/or
    - wet
    - poor compaction
Rutting

• Aggregate movement predominant contributor to surface rutting

• Aggregate proportion of rutting is
  – greatest when aggregate thickest
  – as much as 100% in some places
  – >40% even when subgrade has rutted

• Rutting –
  – Compaction related
  – Shear related
Rutting

Compaction and Consolidation (build up of residual stresses)

Shear
2mm per 1M
CAPTIF Results

• Two pavements same subgrade and aggregate – two depths
• Both the same life
• 50% rutting occurred in aggregate
• 320mm – 2.4 million ESA life
• 250mm – 2.4 million ESA life
CPTIF Results

Linear Extrapolation - Lower 90th %ile

Pavement Life, wheel passes ($10^6$)

- 320mm
- 250mm
- 250mm
- 320mm
- Rounded aggregate
- 300mm
- Repaired
- RCC
RLT tests

RLT Extrapolation (to N of interest)
(i) 0 to 25k; (ii) 25k to 100k; (iii) 100k to 1M; and (iv) >1M

Cumulative Permanent Strain

Curve fitted to RLT data - \( y = 1.5x^{0.6} \)

Loads

Permanent Strain (%)

0 50,000 100,000 150,000 200,000 250,000

Material Testing stress Permanent strain Permanent strain rate (tangential)

<table>
<thead>
<tr>
<th>Material</th>
<th>Testing stress</th>
<th>Permanent strain</th>
<th>Permanent strain rate (tangential)</th>
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</thead>
<tbody>
<tr>
<td>TEST</td>
<td>( p )</td>
<td>( q )</td>
<td>25k, 100k, 100k, &gt;1M</td>
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Tabulate RLT permanent strain rates with test stress

Fit data to Two parameter model Eqn 7.10:
\[ \varepsilon_{rate} = e^{(a)} e^{(bp)} e^{(cp)} - e^{(a)} e^{(bp)} \]

Eqn 7.4 Permanent strain

<table>
<thead>
<tr>
<th>Eqn 7.4</th>
<th>Permanent strain</th>
<th>Permanent strain rate (tangential)</th>
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</thead>
<tbody>
<tr>
<td>Constants</td>
<td>25k (magnitude)</td>
<td>25k - 100k</td>
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<tr>
<td>a</td>
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<td>-</td>
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<tr>
<td>b</td>
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<td>c</td>
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• Aim to develop a RLT test methodology to classify basecoarse (those in top layer) aggregates for:
  • High, medium or low traffic for both wet and dry conditions
  • Currently favour Arnold simplified for this