Pavement Specifications: Fit for Purpose

Outline
• Pavements 101
• Pavements performance Spec
• Case study & performance data
• Benefits
• Conclusions & Recommendations

Pavement Types
• Rigid pavements
  – Unreinforced concrete slabs
  – Reinforced concrete slabs
  – Continuously reinforced concrete slabs
• Flexible pavements
  – Chip seal over granular and/or modified aggregates
  – Asphalitic concrete

Flexible Pavement Types

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thin bituminous seal over unbound granular</td>
</tr>
<tr>
<td>Thin bituminous seal over unbound granular on cemented</td>
</tr>
<tr>
<td>Full depth asphalt</td>
</tr>
<tr>
<td>Asphalt on unbound granular</td>
</tr>
<tr>
<td>Asphalt on unbound granular on cemented</td>
</tr>
<tr>
<td>Asphalt on cemented material</td>
</tr>
<tr>
<td>Asphalt on modified material</td>
</tr>
</tbody>
</table>

Load, W

Unbound Granular Pavement

Basecourse
Subbase
Subgrade
### Performance Specifications for Pavement Design & Build

- Developed to allow alternative materials (e.g., stabilised) that give similar performance to standard premium quality basecourse or subbase aggregates
- Trial of specifications began in 2000
- M/22: Notes for the Evaluation of Base and Sub-base Aggregates

www.fultonhogan.com

### Performance Specifications for Pavement Design & Build

- Based on only 1 – 3 year guarantee, but pavement design life is 25 years. For agency to take the risk after warranty period:
  - check pavement layer thicknesses against Austroads Guide to Design of Road Pavements
  - check materials are durable & strong (M/22)
  - ensure pavement layers compacted to required density & depth
  - ensure pavement satisfies roughness, rutting, surface texture & skid resistance acceptance criteria

www.fultonhogan.com

### During Tender

- During Tender, Contractors pavement design & materials chosen are checked for:
  - Proposed pavement materials are strong & durable
  - Pavement thickness meets or exceeds design traffic using Austroads procedures
  - Pavement layer stiffnesses assumed in design are conservative & meet specific requirements in Tender documents

www.fultonhogan.com

### During Construction

- During Construction, Engineer checks that Contractor’s Pavement Design & Proposed Materials are as Built
  - Pavement materials compacted to the required density & thicknesses
  - Pavement layer stiffness’ assumed in design are achieved in the constructed pavement

www.fultonhogan.com

### After Construction

- Contractor to maintain pavement for 12 to 36 months to comply with following criteria:
  - Roughness
  - Skid resistance
  - Surface shape (i.e., rutting and/or shoving)
  - Surface texture, chip loss & waterproofness
- Need to satisfy these requirements at end of construction & after every 12 months

www.fultonhogan.com

### Guide for Material Properties

- Contractors must prove that road base & sub-base materials have sufficient strength & durability to least 25 yrs
- Strength required can be governed by Contractor’s Pavement Design
- Required Properties for Pavement
  - adequate shear strength
  - minimal deformation
  - hold & support surfacing
  - not be detrimental to performance of the surfacing (e.g., cracking)

www.fultonhogan.com
Strength Requirement

- Strength proven by:
  - Full scale road tests
  - Full scale accelerated testing (CAPTIF)
  - Laboratory testing (Repeat Load Triaxial Test, for permanent strain)

Locations of Projects

- State Highway 22 re-alignment
- Hawkes Bay Expressway
- Glenhope Kawatiri re-alignment

Case Study

SH 6 Glenhope to Kawatiri
- Rural
- Site passes thru national forest
- 10.5 km realignment
- lump sum $5m incl $1.5m pavement & 1st coat seal
- work started Oct 2000; completed Apr 2002

Standard Basecourse Aggregate Properties (M/4)

<table>
<thead>
<tr>
<th>Property</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crushing Resistance</td>
<td>130 kN load produces &lt; 10 % fines</td>
</tr>
<tr>
<td>Weather Quality Index</td>
<td>AA, BA, AC, BB, CA</td>
</tr>
<tr>
<td>California Bearing Ratio</td>
<td>&gt; 80</td>
</tr>
<tr>
<td>Broken Faces</td>
<td>&gt; 70% with &gt; 2 broken faces</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>≤ 5</td>
</tr>
<tr>
<td>Maximum Particle Size</td>
<td>AP40 - 40 mm</td>
</tr>
<tr>
<td></td>
<td>AP20 - 20 mm</td>
</tr>
</tbody>
</table>

Glenhope Project

- Basecourse materials complied with standard premium crushed (M/4) aggregate in all respects, except % of crushed faces
- Confirmed expected performance with Repeat Load Triaxial test (RLTT)

Broken Faces on Aggregate

TNZ M/4 spec requires > 70% broken faces
Target & actual achieved broken faces for alternative aggregate:

<table>
<thead>
<tr>
<th>Sieve Sizes:</th>
<th>M/4</th>
<th>Target</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>37.5 - 19.0 mm</td>
<td>&gt;70</td>
<td>&gt;60</td>
<td>64</td>
</tr>
<tr>
<td>19.0 - 9.5 mm</td>
<td>&gt;70</td>
<td>&gt;40</td>
<td>52</td>
</tr>
<tr>
<td>9.5 - 4.75 mm</td>
<td>&gt;70</td>
<td>&gt;40</td>
<td>43</td>
</tr>
</tbody>
</table>
1. Crushing Details for B/3 AP40 (Actually what happened)

- 70,000m³ (Some Blending) (Necessary)
- By-Product [Only some 20mm]
- 15,000m³ [Down Product taken out]

2. Crushing Details for M/4 (What it would have been if we had to make M/4)

- 100,000m³
- By-Product [All 30mm down] [Product would be wasted]

Rut Depth

- www.fultonhogan.com

Roughness

- www.fultonhogan.com

Benefits

Road agency:
- Encourages innovation
- Utilises contractor experience
- Focuses on performance rather than historical empirical relationships
- Apportions risk fairly between Client & Contractor
- Achieves potential environmental benefits over traditional recipe based specifications

Environmental Benefits

- Allows alternative, recycled or lower quality materials to be used
- Reduces waste (fuel & material)
- Encourages recycling
- Encourages industry research & development

Technical Risks

Risks to Agency:
- Paying for a product that does not meet long term expectations
- Paying more for products by transferring risk of failure

Risks to Contractor:
- Materials do not perform as indicated by laboratory testing or trials
- Conditions encountered are substantially different from those anticipated & allowed for in design & tender
Mitigate Risks by

- Better Understanding of Performance-based Specifications by Client’s Representatives & Contractor
- Partnering/collaborative relationships
- Mandatory QA requirements
- Continue to improve understanding of long term environmental & structural behaviour

Contractor’s Perspective

- Tender evaluation is important step of process
  - client must ensure that process is rigorous & tender evaluation team is competent
  - partnering approach between parties
- Must know properties of materials in advance
- Developing quarry evaluation procedure, to identify engineering properties of potential materials needed for performance contracts
- Better use of resources & technical expertise

Assessing Performance

- Should rely on statistical analysis of material property and construction data
  - Collect additional test data
- Specify 90% or 95% or 99% level of confidence depending on how critical individual property is
  - Level of confidence selected dictates frequency of testing

Summary

- Performance specifications for flexible pavements in New Zealand
- Case study demonstrated substantial benefits to both agency & contractor
- Agency should focus on investigation, design data & performance requirements
- Increased collaboration between industry & road agencies is essential to improve performance prediction techniques