Sustainable Resources “What will we be allowed to use to build tomorrows roads?”

By Stacy Goldsworthy and Angela Wang
Critical Success Factors for Recycled Aggregate

- Levies
- Sustainable Procurement
- Specifications
- Performance out in the road
High Level - NZ Waste Strategy

Waste Minimisation Act 2008
- Council waste minimisation and management plans (WMMP)
- Waste disposal levy
- Waste Minimisation Fund
- Voluntary product stewardship accreditation
- ‘Priority product’ declaration
- Product-based regulations
- Landfill levy-related regulation

New Zealand Waste Strategy
Legislative framework

Waste Minimisation Act 2008
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Resource Management Act 1991
- District and regional plans and resource consents (eg, for landfill)

Local Government Act 2002
- Long-term council community plans

Climate Change Response Act 2002
- By-laws (eg, emissions on disposal, disposal fees, waste operator licence requirements)
- Synthetic greenhouse gas levy

Hazardous Substances and New Organisms Act 1996
- Regulations related to hazardous substances

Ozone Layer Protection Act 1996
- Controls on import and release of ozone-depleting gases

Agricultural Compounds and Veterinary Medicines Act 1997
- Registration of products (eg, agrochemicals)

Imports and Exports (Restrictions) Prohibition Order (No 2) 2004
- Implement international conventions (eg, Basel Convention)

Other tools
- Ministry guidelines, codes of practice, and voluntary initiatives
- Education and awareness campaigns
Specifications

- NZTA currently have the M/4 RCC variation.
- Auckland Transport have developed the Technical Design Manual which has Recycled and Synthetic Aggregates included for pavement construction.
- Further specification development required to reduce risk profile for all stakeholders.
Sustainable Procurement

- NZTA have adopted the GreenRoads™ infrastructure rating tool.
- Auckland Transport are evaluating the Infrastructure Sustainability Council of Australia (ISCA) rating tool
- New Zealand Green Building Council (NZGBC) have recently included Recycled Aggregate in their Materials Credit
Currently being used in New Zealand to rate infrastructure projects.
- Recycled Aggregate features strongly to achieve the Materials credit.
- New Zealand variation to the rating scheme to suit our conditions to be discussed.
Validating a Pavement Design

Linear-elastic modelling / mechanistic design
(Circly / Austroads Figure 8.4)
Validating a Pavement Design

Material properties –
Grading, Plastic Index, CBR, Crushing Resistance Weathering etc.
Pavement Design Consideration

Subgrade

Angularity, Weathering, Crushing Resistance and Moisture Sensitivity
RUT RESISTANCE
Pavement Design Example

25 Year Design ESA = 10 Million

Increase DESA by 10 years: Design ESA = 15.4 Million

+20 mm

495 mm

Basecourse Modulus = 500 MPa

Subgrade CBR = 5
Recycled Crushed Concrete - Grading

Particle Size Distribution (Auckland Transport Draft Spec)

- AT RCC Upper
- RCC Lower
- M/4 Lower
- AT RCC Lower
- MR-9 Lower
- M/4 Upper
- RCC Upper
- MR-9 Lower
# Recycled Crushed Concrete - Specifications

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Test / Specification</th>
<th>NZTA M/4 AP40 Minimum Excepted Result</th>
<th>NZTA M/4 RCC Basecourse Minimum Excepted Result</th>
<th>Auckland Transport AP40 Minimum Excepted Result</th>
<th>Auckland Transport AP40 RCC Minimum Excepted Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soaked CBR</td>
<td>NZS 4402:1986, Test 4.1.3 &amp; NZS 4407:1991, Test 3.15</td>
<td>≥ 80%</td>
<td>≥ 80%</td>
<td>≥ 80%</td>
<td>≥ 40%</td>
</tr>
<tr>
<td>Crushing Resistance</td>
<td>NZS 4407:1991, Test 3.10</td>
<td>≥ 130kN</td>
<td>≥ 130kN</td>
<td>≥ 130kN</td>
<td>≥ 100kN</td>
</tr>
<tr>
<td>Grading</td>
<td>NZS 4407:1991, Test 3.8.1</td>
<td>As specified</td>
<td>As specified</td>
<td>As specified</td>
<td>As specified</td>
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<tr>
<td>Sand Equivalent</td>
<td>NZS 4407:1991, Test 3.6</td>
<td>≥ 40</td>
<td>Not specified</td>
<td>≥ 30 or above</td>
<td>≥ 25 or above</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>NZS 4407:1991, Test 3.4</td>
<td>≤ 5</td>
<td>≤ 5</td>
<td>≤ 5 or below</td>
<td>≤ 5 or below</td>
</tr>
<tr>
<td>Clay Index</td>
<td>NZS 4407:1991, Test 3.5</td>
<td>≤ 3</td>
<td>Not specified</td>
<td>≤ 3</td>
<td>≤ 3</td>
</tr>
<tr>
<td>Weathering Resistance</td>
<td>NZS 4407:1991, Test 3.11</td>
<td>AA, AB, AC, BA, BB, or CA</td>
<td>Not specified</td>
<td>AA, AB, AC, BA, BB, or CA</td>
<td>Not specified</td>
</tr>
<tr>
<td>Broken Face Content</td>
<td>NZS 4407:1991, Test 3.14</td>
<td>70% of 37.5mm - 4.75mm ≥ 2</td>
<td>70% of 37.5mm - 4.75mm ≥ 2</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
<tr>
<td>Other</td>
<td>Visual / Assessment</td>
<td>Not specified</td>
<td>Type I Material: Glass, brick, stone, ceramics and asphalt &lt; 3% Type II Material: Plaster, clay lumps and other friable material &lt; 1% Type III Material: Rubber, Plastic, Bitumen, Paper, Wood and other vegetable or decomposable matter &lt; 0.5%</td>
<td>Not specified</td>
<td>Not specified</td>
</tr>
</tbody>
</table>

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What About RUT Resistance

The RLT is a test that “…simulates traffic loading on an aggregate in order to determine the number of wheel loads required to reach a limiting pavement rut depth.” – NZTA T/15 Notes
What About RUT Resistance

Poor Result  Good Result
RUT Resistance – RCC Vs. NZTA M/4

RCC Aggregate Vs. NZTA M/4 (Auckland) - Dry

- Permanent Deformation (%) vs. Number of Load Cycles

- Lines represent:
  - RCC 65
  - RCC 40
  - NZTA M/4 (Auckland)
Moisture Sensitivity of our Pavement

AUCKLAND

Dry-days 66%

TAUPO

Dry-days 77%
Moisture Sensitivity – What to do??

200 mm

Insitu Stabilise with Lime and/or Cement

“Mitigate the effects of deleterious swelling clay minerals…” – NZ Supplement

“…correct other deficiencies in properties (e.g. by reducing plasticity…” – Austroads 2014
RUT Resistance – RCC Vs. NZTA M/4

RCC Aggregate Vs. NZTA M/4 (Auckland) - Wet

- RCC40 Saturated/Soaked
- M4 Saturated/Soaked
- M4 Saturated/Soaked

Number of Load Cycles

Permanent Deformation %
Theory, Reality, and Practical...

Existing specifications to validate M/4 and RCC are slightly varied.

Rut resistance of various materials are varied - RLT

Differences in materials are allowed and are normal – Doesn’t affect compliancy

RCC less moisture sensitive than quarried aggregate - RLT

Next phase… Implementation and more field results.
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