Introducing SMA to Australian Runways

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Acknowledgements

- Flight Lieutenant Sean (Jamo) Jamieson
  - RAAF Civil Engineer
  - Seconded to USC for 12 months
  - Master of Science (Civil Engineering)
  - This is Jamo’s project

- Industry supporters
SMA for runways

- Australia traditionally used dense graded grooved Marshall asphalt
- Grooves are 6 mm (0.25 in) by 6 mm and 32 mm (1.25 in) apart
- Minimise the impact of ‘wet’ conditions on skid resistance
- Just like the USA and the UK (different grooves)
- The rest of the world does not
  - BBA
  - SMA
  - OGFC
- Should Australia continue to do so?
SMA for runways

• SMA in Australia
  – Common for roads in most States
  – Cairns International
    • 1999 10 mm and 14 mm SMA
    • Still in place on aprons
    • 2005 international apron SMA 14
  – Sydney International
    • 1999 trials on a taxiway
    • Unsuccessful - very coarse, uneven surface finish
    • Likely due to construction issues
  – No other known use on Australian airports
SMA for runways

• Performance-based airport asphalt specification
  – Developed in 2017
  – Maintains the basis of dense graded volumetrics
  – Contractor selects the binder
  – To achieve performance properties
    • Deformation
    • Fracture
    • Moisture
  – Contractor warrants performance
• Used on five runway resurfacings
• Provides a basis for alternate volumetrics/mixture types
SMA for runways

Shearing

Groove closure

Top-down cracking
## SMA for runways

<table>
<thead>
<tr>
<th>Statistic</th>
<th>USA</th>
<th>Australia</th>
<th>AU/US</th>
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<tbody>
<tr>
<td>Mainland area</td>
<td>9.1 million km²</td>
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<td>Population</td>
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<td>8%</td>
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<td>GDP</td>
<td>US$ 19.4 trillion</td>
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<td>7%</td>
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<tr>
<td>Interstate length</td>
<td>92,000 km</td>
<td>16,000 km</td>
<td>17%</td>
</tr>
<tr>
<td>States</td>
<td>50</td>
<td>6</td>
<td>12%</td>
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<tr>
<td>Concrete runways</td>
<td>Lots</td>
<td>None</td>
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## SMA for runways

### Table: Mainland Area Comparison

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**BITUMEN = ASPHALT (LIQUID)**

**ASPHALT = CONCRETE (MIXTURE)**
## SMA for runways

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<tr>
<th>X&lt;sup&gt;th&lt;/sup&gt; busiest airport</th>
<th>USA</th>
<th></th>
<th>Australia</th>
<th></th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Airport</td>
<td>Passengers</td>
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</tr>
<tr>
<td>1</td>
<td>Atlanta</td>
<td>50,000,000</td>
<td>Sydney</td>
<td>43,000,000</td>
</tr>
<tr>
<td>3</td>
<td>Chicago</td>
<td>39,000,000</td>
<td>Brisbane</td>
<td>23,000,000</td>
</tr>
<tr>
<td>6</td>
<td>New York</td>
<td>30,000,000</td>
<td>Gold Coast</td>
<td>6,000,000</td>
</tr>
<tr>
<td>10</td>
<td>Charlotte</td>
<td>22,000,000</td>
<td>Darwin</td>
<td>2,000,000</td>
</tr>
<tr>
<td>20</td>
<td>Philadelphia</td>
<td>15,000,000</td>
<td>Port Headland</td>
<td>500,000</td>
</tr>
<tr>
<td>50</td>
<td>Columbus</td>
<td>4,000,000</td>
<td>Olympic Dam</td>
<td>74,000</td>
</tr>
</tbody>
</table>
SMA for runways

- Aircraft skid resistance
  - Internationally regulated
  - International recommendations are mandated in Australia
  - All runways (regardless of size) must
    - Exceed 1 mm surface texture, or
    - Exceed minimum friction values, or
    - Groove the surface

- Dense graded
  - 0.4-0.6 mm surface texture
  - Marginal friction values
  - So the only choice is grooving
SMA for runways

- **Grooves**
  - Cost $500-800 k (in a $6-10 M resurfacing)
  - Takes 4-6 weeks of nightly closures
  - Increase rubber build-up on touch-down
  - Complicate preservation and other maintenance
  - Grooves can close
    - Under slow moving tyres
    - Moving parallel to grooves
    - High tyre pressure
    - During hot weather
    - Can not be re-opened or re-sawn
SMA for runways

• Desire for ungrooved runways
• Other countries use them
  – Norway – SMA
  – France – BBA (gap)
  – China – SMA
  – Germany – SMA/OGFC (open)
• More than 40 runways in China, including Beijing
• But to avoid grooving it must
  – Achieve 1 mm surface texture, or
  – Achieve and maintain minimum friction
SMA for runways
SMA for runways

- Process for introducing SMA as an ungrooved runway surface
  - Collaborative effort
  - Based on Performance-based specification
  - Volumetric changes
  - Other associated changes

- Validation process
  - Mixtures in four labs
  - Using four different aggregate sources
  - But the same bituminous binder
  - Field trial for texture/friction measurement
## SMA for runways

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<tr>
<th>Physical Requirement</th>
<th>Protects Against</th>
<th>Test</th>
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<tr>
<td>Deformation resistance</td>
<td>Groove closure</td>
<td>Copper wheel tracking</td>
</tr>
<tr>
<td></td>
<td>Rutting</td>
<td>(65°C and 10,000 passes)</td>
</tr>
<tr>
<td></td>
<td>Shearing / shoving</td>
<td></td>
</tr>
<tr>
<td>Fracture Resistance</td>
<td>Top down cracking</td>
<td>Four-point bending</td>
</tr>
<tr>
<td></td>
<td>Fatigue cracking</td>
<td>(20°C and 200µε)</td>
</tr>
<tr>
<td>Durability</td>
<td>Erosion and FOD</td>
<td>Established volumetrics</td>
</tr>
<tr>
<td></td>
<td>Asphalt stripping</td>
<td>Modified Lottman (TSR)</td>
</tr>
</tbody>
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SMA for runways
SMA for runways

• Two mixtures
  – Chinese SMA 13
  – German SMA 11

• Performance tests
  – Deformation
  – Fracture
  – Moisture

• Plus
  – Cantabro losses
  – Surface texture
SMA for runways

- Field trial
  - Taxiway at RAAF airfield near Brisbane
  - Two paver runs (joints)
  - 100 m long each (friction)
  - Scheduled for 11 November

- Outcome
  - Texture and friction
  - Heavy aircraft loading
  - Side-by-side dense graded

- Monitor over coming years
SMA for runways

- Implementation
  - Publish
  - Promote
  - Educate
- Performance-based Specification
- Full-scale resurfacing
  - Regional airport
  - Medium airport
  - Significant airport
- Ongoing monitoring
SMA for runways

- Other things we are working on
  - Alternates to flexural beams for concrete compliance
  - Sprayed sealing for regional airports
  - Foamed bitumen stabilisation of marginal materials
  - Non-destructive testing for strength rating
  - Accelerated asphalt aging box and test
  - Synthetic binders for asphalt
  - Reflection crack mitigation test device
  - Ravelling resistance test
  - RAP in airport asphalt
  - Recycled soft plastic for binder modification
THANKYOU