Two layer paving with porous concrete upper layer

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Disclaimer: The opinions expressed in this presentation are those of the presenter and do not necessarily reflect the views or the practices of the Roads & Traffic Authority NSW
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Introduction

- Background
- Hand placing trial
- Slipforming trials
- Concrete mix details
- The next step
Traditional tyre/surface noise reduction solutions are:
- open graded asphalt (OGA)
- stone mastic asphalt (SMA)

Problems with some porous materials are:
- Voids become clogged
- Ravelling in wheel paths
- Cracking in transverse joints
What is porous concrete?

- Has been called no fines, open graded or pervious concrete
- Has been used in subsurface drainage for many years, including as a subbase layer in tunnels
- Similar to open graded asphalt except cement (and additives) rather than bitumen is used as the binder
Options for concrete surfacing – low noise

- Avoid transverse tyning (OK for low speed roads)
- Exposed aggregate surfaces (trials conducted in NSW & Vic.)
- Diamond grinding (Two machines in NSW)
- Porous concrete
Road & pavement design

- Porous concrete layer is nonstructural
- Need to have layer full width due to slipforming operations & drainage paths
- Need to consider impact of shoulder surface and edge/trench drains
- Formation needs to be wide enough for access to paving operations from both sides
Project started in 2004
Develop a specification and construction process for the construction of a thin bonded porous concrete layer, with

- low-noise characteristics over a base concrete, whilst
- maintaining similar skid resistance and durability as normal base concrete

Research has been funded by RTA’s Infrastructure Maintenance Branch
What’s in it for the road owner?

We hoped for:

☐ Is there a long term solution for an ‘open graded’ surface on a long-life base?

☐ Minimise resurfacing costs (eg OG asphalt)

☐ More voids but still retain strength
  - better noise reduction
  - less splash generation
  - reduced aquaplaning risk
  - reduced thermal impact to base layer
Laboratory testing – 2005 trials
Laboratory testing – 2005 trial outcomes

- Single 10mm aggregate with no fines and GP cement
- 25 to 30% voids from trials
- More voids less strength & hence solution is to add polymer emulsion additives to the cement (to build mortar film)
- Compressive strength – 20 to 25 MPa
  Flexural strength – 2 to 2.5 MPa
  Tensile strength – 4 to 6 MPa
  Shrinkage – 550 $\mu$e @ 56 days
Field testing - Hand placement

Configuration:
- 40mm OGC
- 200mm R83 base
- Plastic sheet
- Natural material
Field testing - Hand placement

Using double vibrating screed was satisfactory but it needed a ‘bow’ plate to improve compaction & not reduce voids
Field testing - Window of laying ‘wet on wet’

Time elapsed between placing of the base concrete & the porous concrete surfacing at the same point on the pavement with slipformers progressing at approximately 1m per minute.
Overseas porous concrete trials - Belgium
Overseas trials – Belgium (2007)
Overseas two layer paving – Kansas USA
**Slipforming trials**

- Can we slipform the material & how thin?
- Can we get the two layers to ‘stick’?
- How do we compact the material?
- Will it have long term skid resistance?
- What do we do at the edges?
- How do we repair the layer?
- .......................?
Northern Hume Alliance – New trials 2008/09
Slipforming trials – Layer thickness

- Open graded asphalt
  - 30mm thick, 10mm aggregate, min. 20% voids
- Target thickness is 50mm but start at 100mm
Slipforming trials – Compaction of layer

- Internal vibration is not possible
- Compaction from above
Slipforming trials – Edges of layer

Standard PCP detail of edges

- Porous concrete
- 75 – 100 mm
- CRCP 190 mm
- AC10 correction course

Crossfall

200

100
Slipforming trials – Holbrook trial

- Rain has delayed trials until late August
- Trial to be conducted in a rest area
- Deceleration lane - 200m with porous over PCP
- Acceleration Lane - 130m with porous over CRCP
- 5.6m width of paving
- It is anticipated that heavy vehicles will use this rest area & subject the surface to braking and accelerating wheel loads
Slipforming trials – Holbrook trial testing

- Compressive strength
- Pavement layer thicknesses from cores & edge
- Void content (draft RTA Test Method T378)
- Permeability testing of cores (draft RTA Test Method T377)
- Light hammer for indications of delamination
- Shear strength at interface of two layers at 28 days
- Noise measurements using the bypass technique
- Temperature measurements of the base concrete to assess the thermal effects of the porous concrete layer
- Skid resistance using both SCRIM and RTA T231
- Ravelling in terms of loose aggregates displacement and depth of rutting in the wheel paths
- Ride quality
- Mapping of surface crack patterns
- Edge drop off
Concrete mix details

- 10mm coarse aggregate (1,500kg)
- No sand
- 300 kg/m³ of SL cement
- 50 kg/m³ of Fly Ash
- w/c ratio 0.24 (not too dry)
- Admixtures
  - Polyheed & Rheomac (BSAF)
- 7 day compressive strength
  - cylinder 24 to 30 MPa
  - cores 17 to 23 MPa (not adjusted)
- Density of core 1.8 to 2.1 t/m³
- Permeability 2.3 to 7.3 mm/s
The Next Step

Full scale trials:
- Learn from Holbrook trial
- Further sites needed
- Road & pavement design
- Site logistics
- Field equipment – Can we keep using existing pavers?
- Develop & refine specifications & test methods
- On going evaluation
Questions

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