IPWEA SA 2014 - Conference

Low Volume Asphalt Trial

Rod Ellis

30 May 2014

Support from:

Government of South Australia
Department of Planning, Transport and Infrastructure

arrb GROUP

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Introduction

- Local Government Research and Development Scheme 2012
- Led by The City of Salisbury with additional funding by the following Councils:
  - City of Salisbury
  - City of Burnside
  - City of Playford
  - City of Port Adelaide Enfield
  - West Torrens City Council
  - Adelaide Hills Council
  - City of Adelaide
  - City of Unley
  - City of Marion
  - Light Regional Council
  - IPWEA

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Project Scope

- Expert Panel
- Engagement with Industry
- Development of protocol and trial requirements
- Establishing 11 trial sites
- FWD Testing
- Construction of 11 trial sites
- Assemble results and collate
- Interim Report
- Monitoring over 2 years
- Final Report

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Project Team

- LGA Representative – Neville Hyatt
- Council Lead – John Hutton City of Salisbury, Support Peter Levett
- Consultants – Rod Ellis Tonkin Consulting and Erik Denneman (ARRB)
- Technical Advisor – Hugo van Loon
- AAPA Rep – Simon Abrahams & Klinton Devenish

- Expert Panel – the above
- Contractors – TopCoat, Fulton Hogan, Boral and Downer
- Councils – 10 Councils
- BPUG – key forum to feedback to Local Government

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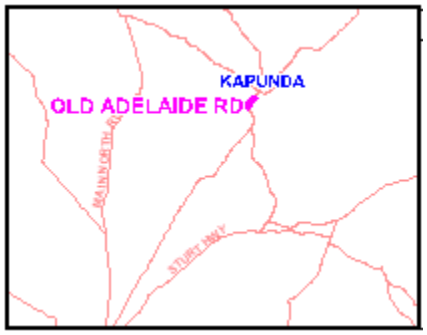
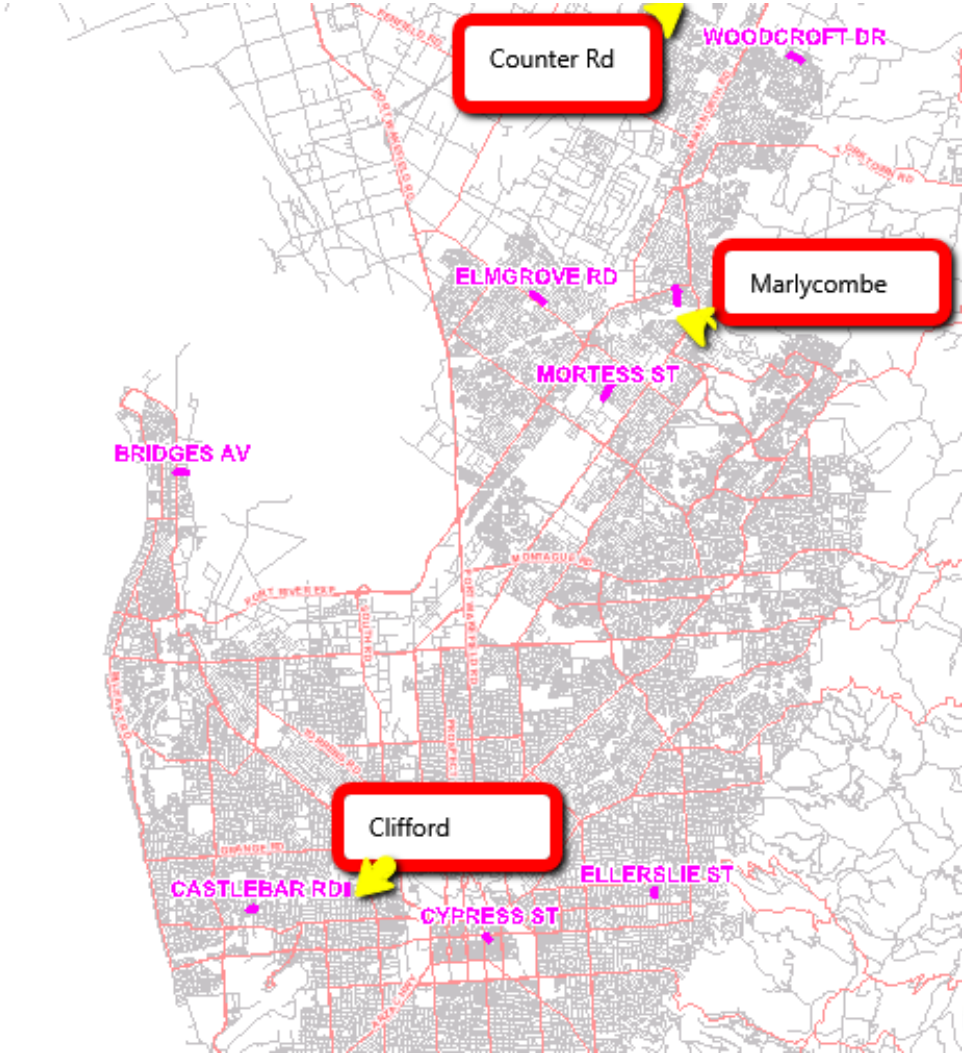
11 Sites


KAPUNDA
OLD ADELAIDE RD


Counter Rd
WOODCROFT DR
ELMGROVE RD
Marlycombe
MORTESS ST
BRIDGES AV
Clifford
CASTLEBAR RD
CYPRESS ST
ELLERSLIE ST

Scope of mixes trials

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- Some of the trial mix designs will include Reclaimed Asphalt Pavement (RAP) to increase environmental sustainability and reduce cost.
- Some of the trial mix designs will include warm mix asphalt additives to further improve compactability of the mixes and increase environmental sustainability.
- Some of the trial mix designs will include a softer grade bitumen (Class 170), to improve compactability, durability and flexibility of the material.

- A finer grading curve was specified, together with Lab Gyratory compaction target and increased bitumen content.

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Trial Sites

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- The trial site should be an urban street carrying traffic that falls within the lowest category of Table A 2 of the Austroads ‘Guide to Pavement Technology Part 4B: Asphalt’, i.e.:
- A street that carries less than 100 commercial vehicles per lane per day
- The structural design level for the street should be less than 5 x 10^5 ESAs
- Light free flowing traffic
- For the purpose of the trial a street should be selected that does not include steep inclines or busy intersections.

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Trial Sites

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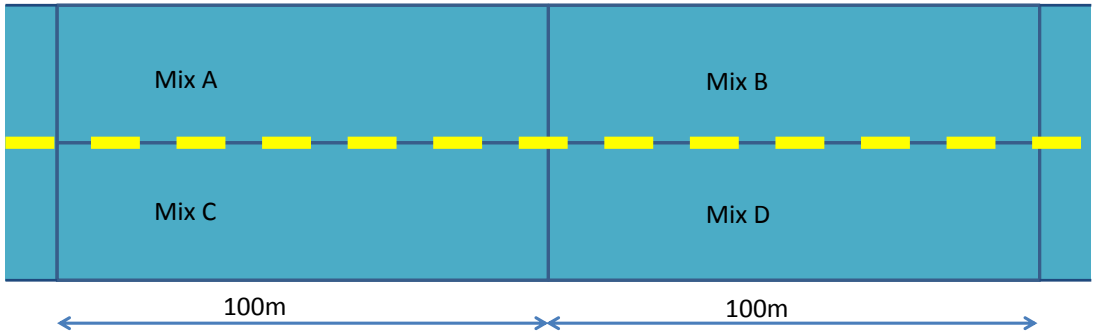
- A each site four variations of a single mix design at each site. Ideally however, there would be a 50 m change over zone between mixes to prevent the need for cold joints between the mixes.



A. Class 320 bitumen
B. Class 320 bitumen in combination with a warm mix additive
C. Class 170 bitumen in combination with 20% RAP
D. Class 170 bitumen in combination with 20% RAP and a warm mix additive

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Protocol

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- Standard Forms
  - Visual assessment
  - FWD
  - Laboratory testings (Grading, binder, lab voids, BFT,ITS etc)
  - During Construction (Temperature, rolling patterns)
  - Post Construction (Cores)
  - Photos of surface

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Technical Overview - Hugo van Loon

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LG Hot Mix Trial

Presentation by Hugo van Loon

DPTI: Senior Asphalt Engineer

Government of South Australia
Department of Planning, Transport and Infrastructure

Fine Asphalt Mix

- Department's specification contains requirements for coarse dense mix asphalt
- Needed fine dense mix requirements for pathways, bikeways and maintenance
- BPUG was looking for improvements to fine dense mix asphalt for low traffic volume roads

Fine Asphalt Mix: Technical Req'ments

- Current LG dense mix design to AS2150:
  - Wide gradings envelope
  - Wide design air voids
  - No checking of insitu air voids

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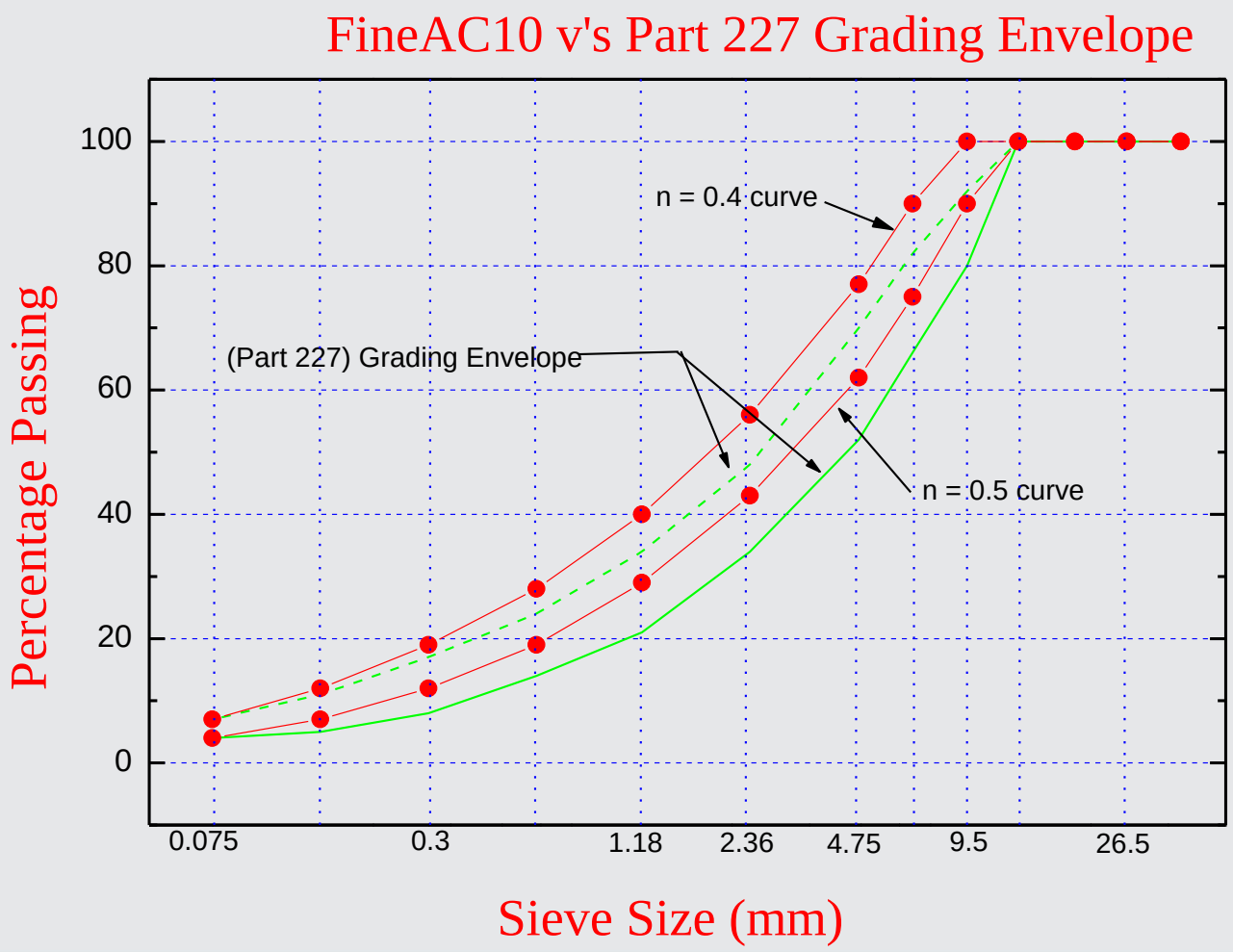
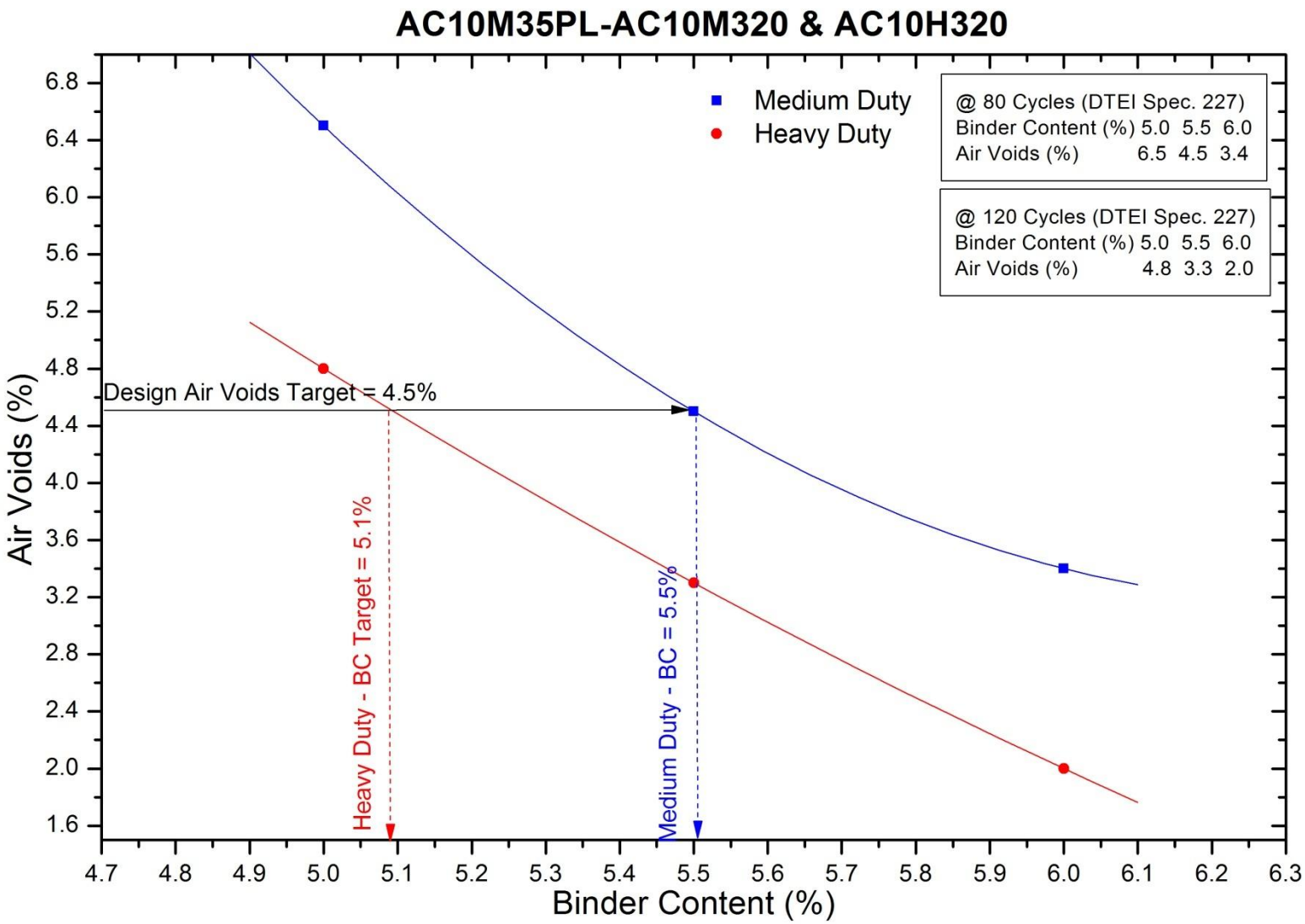
IPWEA 2014 Conference:
BPUG – Results and discussion on Local Government

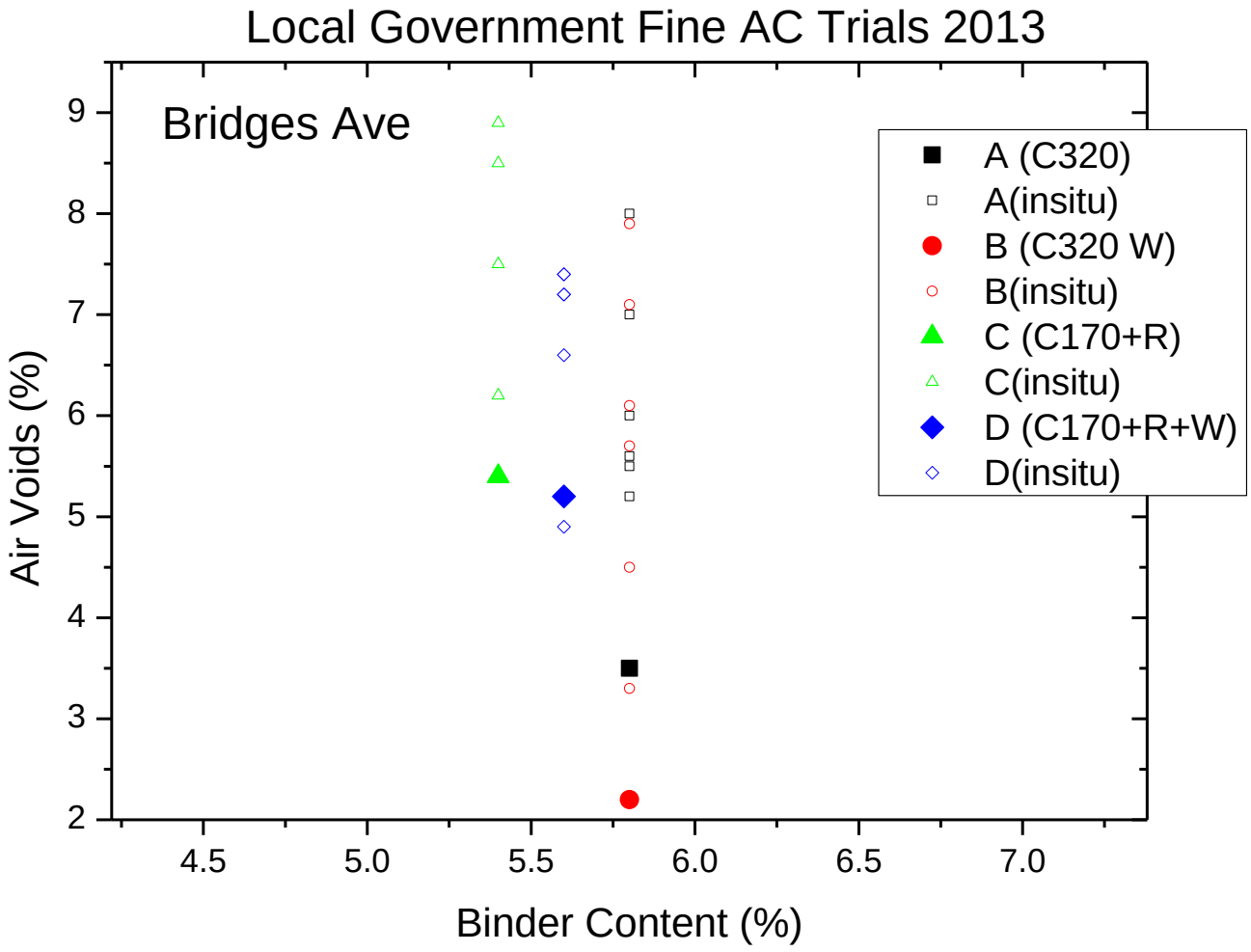
Government of South Australia
Department of Planning, Transport and Infrastructure

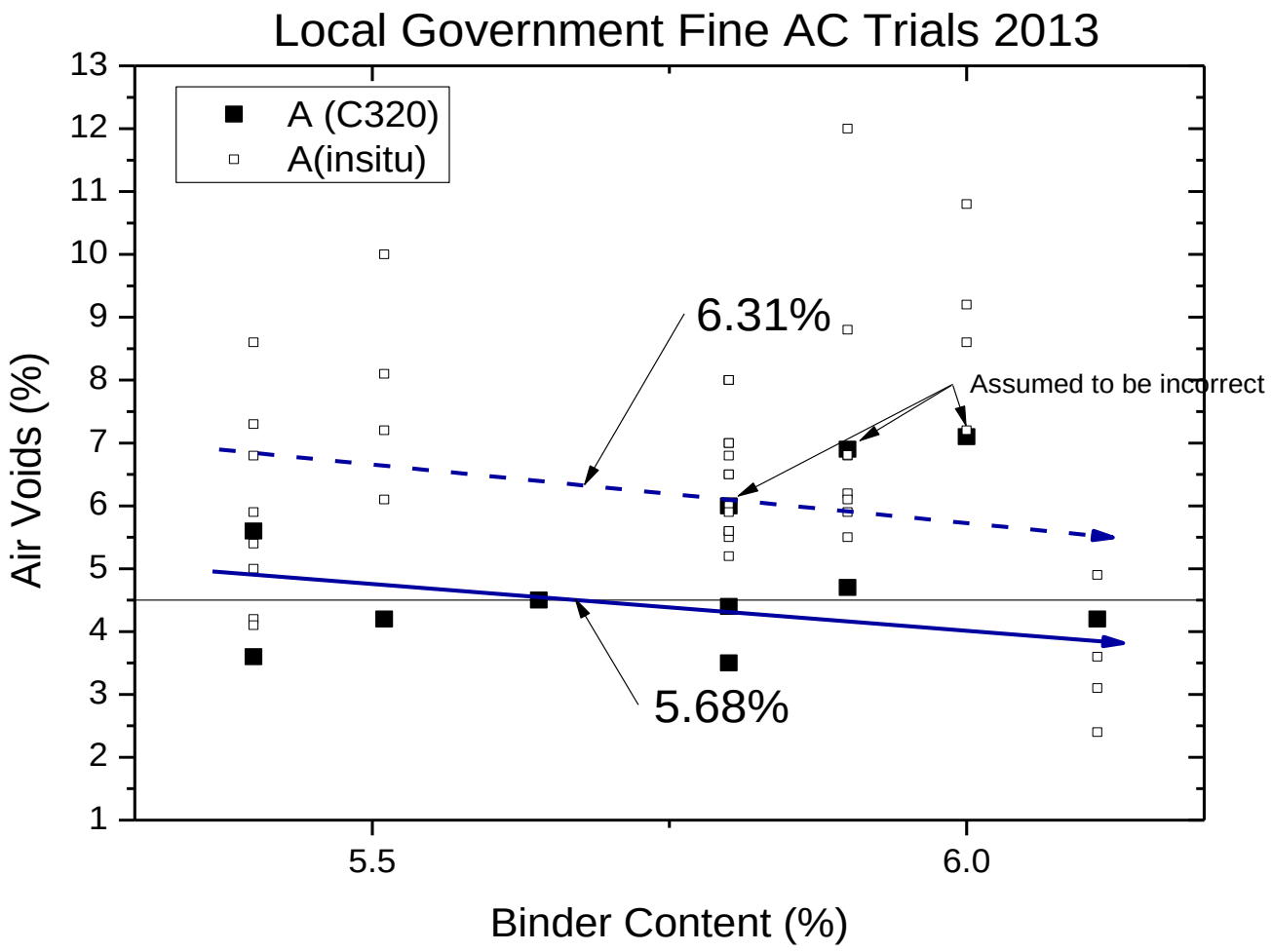

FineAC10 v's Part 227 Grading Envelope
Percentage Passing
100
80
60
40
20
0
n = 0.4 curve
(Part 227) Grading Envelope
n = 0.5 curve
0.075
0.3
1.18
2.36
4.75
9.5
26.5
Sieve Size (mm)


AC10M35PL-AC10M320 & AC10H320
Medium Duty
Heavy Duty
@ 80 Cycles (DTEI Spec. 227)
Binder Content (%) 5.0 5.5 6.0
Air Voids (%) 6.5 4.5 3.4
@ 120 Cycles (DTEI Spec. 227)
Binder Content (%) 5.0 5.5 6.0
Air Voids (%) 4.8 3.3 2.0
Design Air Voids Target = 4.5%
Heavy Duty - BC Target = 5.1%
Medium Duty - BC = 5.5%
Air Voids (%)
Binder Content (%)
6.8
6.4
6.0
5.6
5.2
4.8
4.4
4.0
3.6
3.2
2.8
2.4
2.0
1.6
4.7 4.8 4.9 5.0 5.1 5.2 5.3 5.4 5.5 5.6 5.7 5.8 5.9 6.0 6.1 6.2 6.3

Fine Asphalt Mix: Technical Req'ments

- Trial dense mix design
  - Finer part of AS2150 gradings envelope
  - Design air voids set at 4.5% at 50 cycles
  - Insitu air voids targeted to be 4 to 6%


Local Government Fine AC Trials 2013
Bridges Ave
Air Voids (%)
Binder Content (%)
9
8
7
6
5
4
3
2
4.5
5.0
5.5
6.0
6.5
7.0
A (C320)
A(insitu)
B (C320 W)
B(insitu)
C (C170+R)
C(insitu)
D (C170+R+W)
D(insitu)


Local Government Fine AC Trials 2013
A (C320)
A(insitu)
6.31%
Assumed to be incorrect
5.68%
Air Voids (%)
Binder Content (%)
13
12
11
10
9
8
7
6
5
4
3
2
1
5.5
6.0

Asphalt Mix	Mix Description	Binder Content at 4.5% air voids	Insitu Air Voids at Target Binder content to achieve 4.5% voids
A	AC10L320	5.68*	6.31
B	AC10L320 Warm	5.54*	7.24
C	AC10L170 20% RAP	5.75	6.76
D	AC10L170 20% RAP Warm	5.75	7.34

Table 1: Binder Content to achieve 4.5% air voids and Insitu Average at that binder content

Asphalt Mix	Mix Description	Binder Content at 4.0% air voids	Insitu Air Voids at Target Binder content to achieve 4.0% voids
A	AC10L320	6.0*	5.7
B	AC10L320 Warm	5.7*	6.87
C	AC10L170 20% RAP	5.97	6.34
D	AC10L170 20% RAP Warm	5.98	6.96

Table 2: Binder Content to achieve 4.0% air voids and Insitu Average at that binder content

Fine Asphalt Mix Design (Part 227)

TABLE 4.3(a) MIX PROPERTIES OF FINE DENSE MIX ASPHALT			
CHARACTERISTIC	**FineAC7**	**FineAC10**	**FineAC14**
Nominal Mix Sieve Size (mm)	6.7	9.5	13.2
Minimum Binder Content (%)	6.0	5.7	5.2
Production Air Voids (%) (@ 50 cycles)	4.0	4.0	4.5
Production Air Voids Tolerance (%)	3.0 – 5.5	3.0 – 5.5	3.5 – 6.0
Target In-situ Air Voids (%)	2.0 – 5.0	3.0 – 7.0	4.0 –7.0
Binder Film Index (µm) Minimum	8.0	8.0	8.0

Goal

- *Longer life asphalt for Lightly Trafficked roads that minimises whole of life cost and has environmental benefits*

Characteristics

- a fine, dense graded aggregate distribution in combination with a high binder content.
- create mixes that are easy to compact, this to remedy the rapid cooling that takes place when mixes are constructed in thin layers
- Considers challenges such as stiffness of underlying pavement,
- irregular shape of underlying pavement,
- access for full size paving and compaction equipment.
- Mixes will be constructed to a low in-situ air voids content. This will reduce the permeability of the mixes, which helps to protect the underlying granular layers and limits oxidation aging of the binder.
- The high flexibility of the mixes will accommodate the relatively high deflections in residential street pavements

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Mix Philosophy

Refer Linden et al (1989)

Asphalt pavement life is reduced by 10% for each % increase in voids above 7%

Oliver 1992

- “Ageing of binder greatly reduces for mixes that are compacted to 6% air voids and below”

APRG technical noted light duty non structural asphalt surfaces and overlays (July 1997)

- Aims: Low air voids (density)
- High bitumen content (impermeability)

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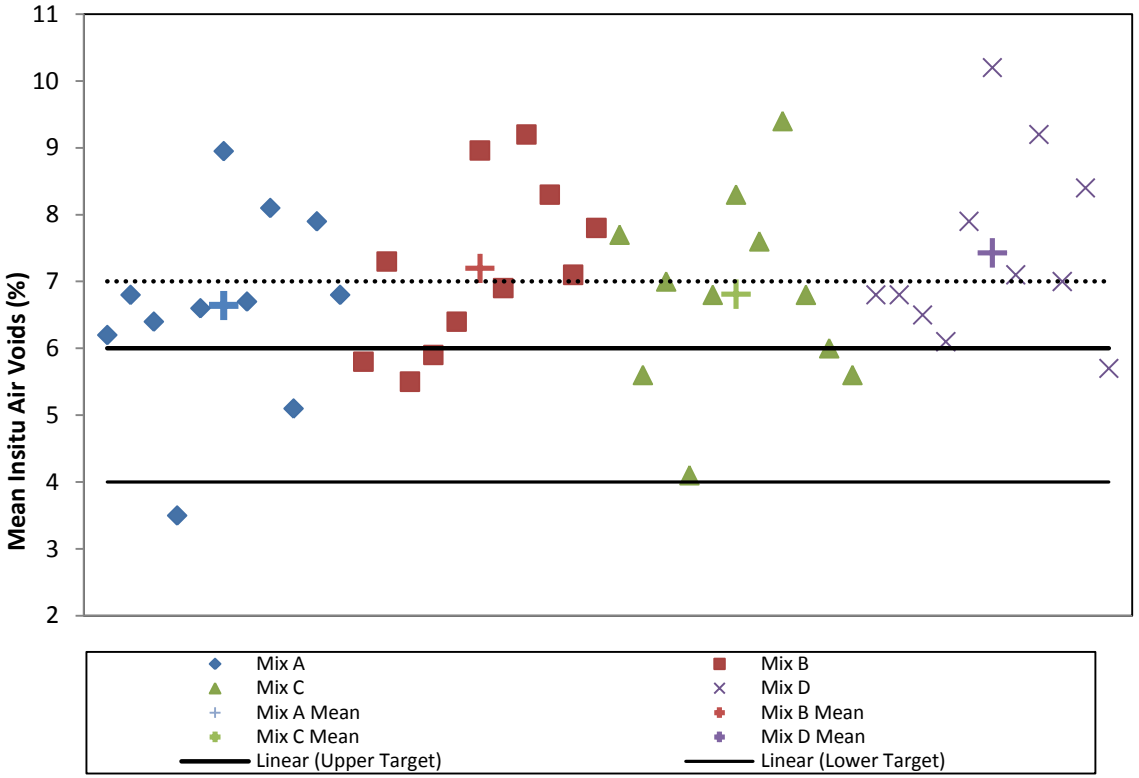
Insitu Air Voids with mean and target limits



A: C320
B: C320 WMA
C: C170 RAP
D: C170 RAP WMA

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Key points

- Deflection - Not a dominant factor <1.3mm
  - Need to explore impact >1.3mm
- Air voids - Need to change mix requirements to achieve 4-6% in field
- Binder - Increase binder above 5.7%
- Filler - Relate to binder
  - 5.7 – 6% assumed filler/binder 1-1.1, BFT (60%) >8.5%
  - 6% assumed filler/binder 1.1-1.4, BFT (60%)<8.5%
  - Avoid BFT >9.5%
- Lab voids - Adopt 4% (50 cycles gyproc AS2891.2)
- Warm asphalt - Get mixes more workable, recognise offset between labs and field compaction
- ITS - Will be lower, too early to observe impact

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Trial Recommendations

- Adopt 4% Laboratory air voids (50 cycles Gyropac – AS 2891.2.2) for mix designs to improve workability for low volume road asphalt. The specification will provide a suitable range.

- Incorporate a minimum binder film thickness (60% absorption) of 8.0 micron recognising the trial results and monitoring with road authority's trends across the country.

- Mix designers should consider the field void performance and relationships with BFT (60%) and filler/binder ratio when selecting filler content in mixes.

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Trial Recommendations

- A minimum binder content of 5.7% should be specified.
- Local Government should consider making density determination from the insitu asphalt part of the normal product acceptance process
- Local Government and Industry should use the results of this trial to develop reasonable incentive/penalty clauses in contracts to reward Contractors for delivering low field air void mixes (4-6%) and penalise contractors for high air void mixes commensurate with the expected life reduction for every % above 7%.

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Trial Recommendations

- Local Government should be aware of the potential for lower compaction with warm asphalt and industry should embrace more workable mixes to achieve compaction at lower field temperatures. This should occur with understanding of the offset between laboratory and field compaction and temperature.

- Review density results for ‘conventional’ asphalt mixes used on low volume roads in SA and compare them to the results for the fine graded high binder content mix used in this study.

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Trial Recommendations

- Review construction practices, and in particular, compaction practices.
- As a result of this trial local government should use the specification update through DPTI which includes the key recommendations from the trial.
- LGA consider scope for continuation of a coordinated approach to funding research and to keeping abreast of national development.

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Other important considerations

- FAC10 - Needs to be used when appropriate – Low Volume Roads Only…other options for heavy traffic
- Local Government to administer compaction criteria Part 228 with informed judgement as industry adapts to delivering low void asphalt. Non Conformances need to be sensibly managed as FAC Mix phases in and confidence levels improve
- The market forces and business realities need to be respected together with delivering a product Local Government wants
- Great progress in Industry/Local Government working on this together.
- The protocol and Research culture can be continued with funding to develop greater confidence in use of RAP and Warm Asphalt once workable mixes are produce more readily.

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Further Works

- IPWEA (SA) will be looking to LGA for further R&D funding to continue the research in 2014/2015
- Protocol established by this project will be adapted and issued more broadly for testing results to be gathered before, during and after placement to record and centrally collated
- Continue with reference group (IPWEA,DPTI,LGA/AAPA and Tonkin/ARRB)
- Ongoing feedback to members AAPA, IPWEA and BPUG
- Further learning feedback into FAC10 specification development with DPTI

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Why Continue with Research

- We need to see if low field voids can be delivered consistently and cost effectively
- We need to identify any teething problems with dealing with non conformances in field compaction
- The trial clarified what we want to achieve, however the current mixes generally didn't meet expectation, hence we need to see if specification changes can deliver results
- We want to see improved results with RAP and Warm Asphalt
- We want to build on the learning and continue to improve collectively (Both in the way Council supervise and Contractors deliver)

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Aim to slow down aging process

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