AAPA's 14th International Flexible Pavements Conference

Sydney
25–28 September 2011

Topic: PREVENTION OF CRACK PROPAGAGTION

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Organisation: Pavement Analysis

AUSTRALIAN ASPHALT PAVEMENT ASSOCIATION

BACKGROUND

INSITU RECYCLING

BACKGROUND

- Asphalt overlays are the most common method of rehabilitation to bring the road to as-new condition.

- There are four main types of asphalt mixes used for overlays listed as follows: -

  (a) Dense grade – 35,50 & 75 blow.
  (b) Gap grade – 35 & 50 blow.
  (c) Open grade, and more recently
  (d) Stone mastic asphalt (SMA)

- The above asphalt types have various properties and where they are good in one area my not be so good in others. For instance: -

BACKGROUND

	Durability	Strength	Skid	Texture	Spray	Noise	Cost
Dense grade	***	***	***	***	*	***	8.40
Gap grade	*****	*	****	*	*	***	8.70
Open grade	*	*	***	*****	*****	*****	8.40
SMA	*****	*****	***	*****	****	****	9.90

- At the City of Stirling it was found that asphalt overlays on block cracked host surfaces were re-cracking within a short period after the overlay.
- The short period prior to the re-cracking of the pavement was unacceptable to Council.


15/06/2010

INSITU RECYCLING

STUART STREET TRIAL

INSITU RECYCLING

- In May of 1998, after careful consideration of all of the products available for the prevention or reduction of reflective cracking in overlays, it was decided that there is possibly no easy or cheap fix and in situ stabilisation using emulsion as the stabilising agent would produce a product which was flexible enough to be able to “give” within its make-up during change in temperature such that it would not crack in defined areas but rather move minutely all over its surface area and therefore stop reflective cracking coming from the sub base.

- The areas earmarked for this type of treatment were areas where the base was constructed with gravel or where the base course had been constructed using very high PI crushed rock base.


BITELLI 90
BRIERTY
BITELLI
BRIERTY


CATERPILLAR


ST 20

FWD Testing prior to Construction

STUART ST TRIALS

RECYCLED WITH THE ADDITION OF 5% EMULSION

PRIOR TO RECYCLING :	**Deflection : 0.80mm**
	Curvature : 0.23mm
TOLERABLE (Austroads):	**Deflection : 1.30mm**
(Residential St)	**Curvature : 0.22mm**
POST RECYCLING :	**Deflection : 0.42mm**
(After I year)	**Curvature : 0.12mm**
POST RECYCLING :	**Deflection : 0.47mm**
(After 2 years)	**Curvature : 0.10mm**

INSITU RECYCLING

- **ELIMINATES CRACKING - A LONG TERM SOLUTION**
- **INCREASES PAVEMENT STRENGTH- Stuart St increased strength from about 2E5 to 7E6**
- **ALLOWS LONGITUDINAL & TRANSVERSE GRADE IMPROVEMENT**
- **VERY FAST CONSTRUCTION - MINIMAL DISRUPTION**
- **CONSERVES RESOURCES – ECONOMICAL**
- **STOPS THE UNNESSESARY FILLING OF REFUSE SITES**

INNOVATIONS

PREVENTION OF CRACK PROPAGATION

SIXTH AVE TRIAL

- About two years after the Stuart Street trial, it was concluded that the emulsion stabilisation was successful in stopping reflective cracking and that all block cracked pavements at the City of Stirling would be recycled with the addition of 5% (60/40) emulsion.
- The first full scale contract commenced in November 2000, the value being some $1.5mil
- At the same time it was also decided that council should investigate other, more cheaper methods of preventing or retarding crack propagation
- The Sixth Ave trial was developed and construction of the various sections concluded 28.06.01

SIXTH AVE TRIAL

- The trial consists of basically 7 sections of some 100m in length between Beaufort St and Hamer Pde which have different types of pavement preparation prior to overlay
- There is also a 200m section East of Beaufort St where there is no host surface preparation. However there are 4 different asphalt mix types used in the overlay
- This puts the total different scenarios in this trial at 30

SIXTH AVE TRIAL

- The pavement profile of Sixth Ave, and in fact the majority of Inglewood and Mt Lawley comprises some 150 to 200mm of gravel base over a sand, silty-sand sub grade with a CBR of 7 to 12
- The pavement depth varies from around 100mm in some places to 300mm
- The surface generally has 1 or 2 chip seal applications and 1 AC layer.
- The moisture content varies from around 3 to 6% and is significantly higher under the umbrella of tree foliage


STOP


ST 200
BRIENTY

MONITORING

- The trial was visually assessed every 3 months for the first 2 year, then every 6 months there after
- The pavement was tested for structural capacity at the commencement of the trial and again in 02, 04, 05 and after 10 years in 2011
- Results of all visual and structural evaluations have and will continue to be documented
- Results have and will continue to be reported to interested parties during conferences or special seminars

SIXTH AVE TRIAL

Cracking after 2 years

SIXTH AVE TRIAL

Cracking after 4 years

CONCLUSION at 4years

- After 4 years the section where there is no host surface preparation, all the different asphalt types except SMA had cracked. The gap graded AC was first
- All of the asphalt types, except SMA had minor cracks on the section that has a SAMI seal and the section with the geotextile
- The section that has been milled 100mm and replaced with 100mm of ESL also showed cracking in the gap graded and dense graded AC
- No other sections, except for some hair-line cracks in the mill & fill 35mm showed signs of cracking

SIXTH AVE TRIAL

Evaluation of Cracking
After 10 years

SIXTH AVENUE TRIAL CRACKING EVALUATION-10 YEARS

Section		Cracking - % of host surface					
		GG		DG		SMA	
		Ext.	Sev.	Ext.	Sev.	Ext.	Sev.
1	No host surface preparation	100	100	70	70	0	0
2	Apply SAMI	25	50	12	40	0	0
3	Mill 20mm, Apply geotextile	20	50	25	50	0	0
4	Mill 35mm, place 35mm 50 blow	3	20	1	10	0	0
5	Mill 50mm, place 50mm 50 blow	0	0	0	0	0	0
6	Mill 75mm, place 75mm 50 blow	0	0	0	0	0	0
7	Mill 50mm, place 50mm 50 blow	0	0	0	0	0	0
8	In situ recycle 100mm with 2% bit	5	30	5	30	0	0
9	In situ recycle 100mm with 3% bit	0	0	0	0	0	0
10	In situ recycle 100mm no addition	12	35	8	30	0	0
11	In situ recycle 100mm no addition	12	35	8	30	0	0
12	Mill 100mm, place 100mm ESL	14	35	10	30	0	0
13	Mill 100mm, place 100mm FCR	2	20	2	20	0	0

SIXTH AVE TRIAL

Structural Testing

&

Evaluation

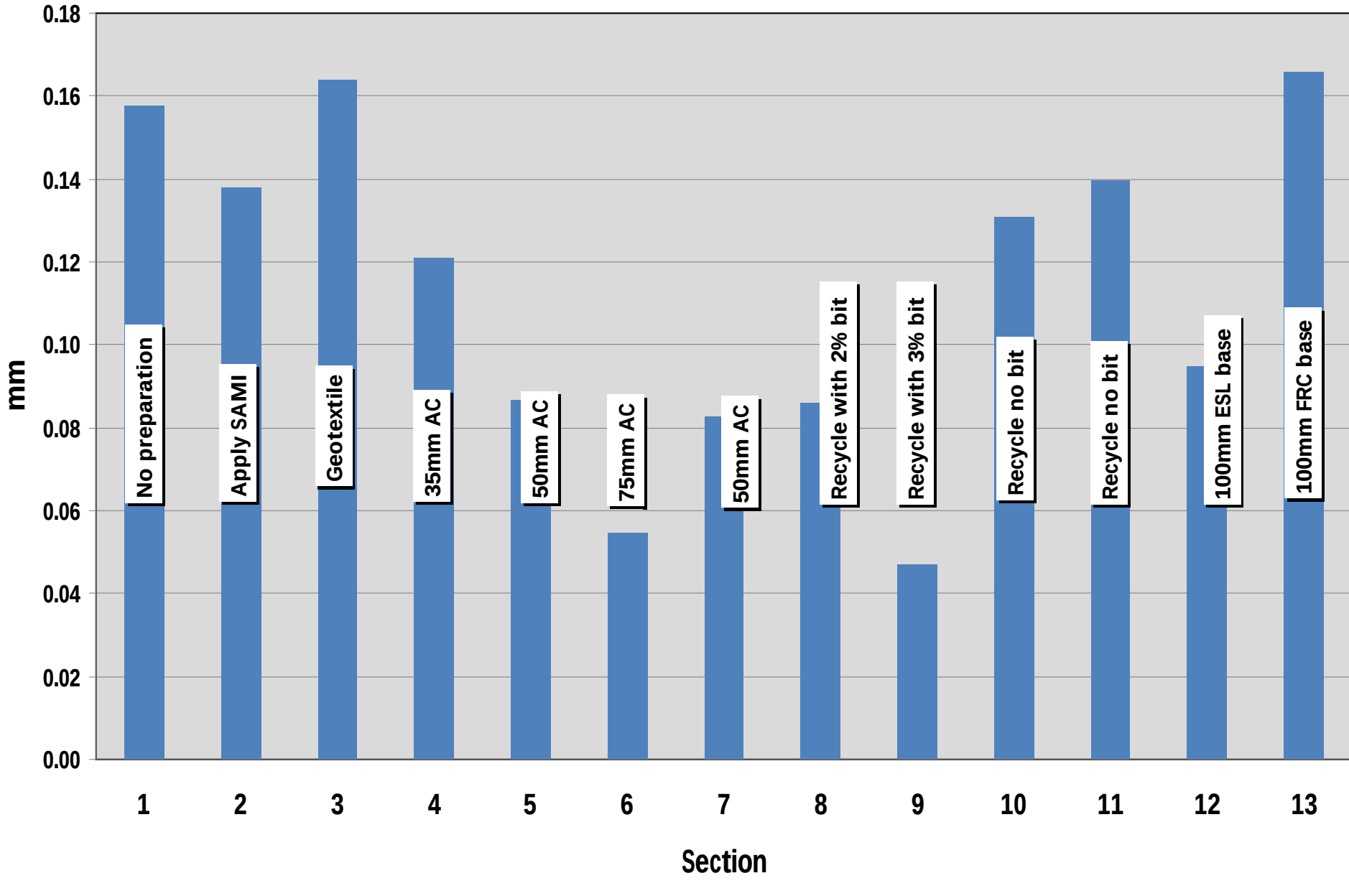

CAUTION
ROAD TESTING
PREPARE TO STOP
9RP 542
9MB 201
LAND CRUISER

SIXTH AVE TRIAL

- Typically, Residential streets are designed for about 300,000 ESA's
- Local distributors are designed for about 500,000 ESA's
- Distributors about 1,000,000 ESA's & heavy distributors & industrial roads > 1,000,000 ESA's
- Sixth Ave was tested prior to construction
- Deflection was well within tolerable
- Curvature was tested at 0.25mm which is tolerable for about 300,000 ESA's (i.e. Structurally Ok)

SIXTH AVENUE TRIAL – STRUCTURAL EVALUATION

Section		Curvature (mm)			
		2002	2004	2005	2011
1	No host surface preparation				0.158
2	Apply SAMI	0.193	0.208	0.183	0.138
3	Mill 20mm, Apply geotextile	0.208	0.248	0.198	0.164
4	Mill 35mm, place 35mm 50 blow	0.150	0.155	0.185	0.121
5	Mill 50mm, place 50mm 50 blow	0.150	0.175	0.115	0.087
6	Mill 75mm, place 75mm 50 blow	0.150	0.130	0.117	0.055
7	Mill 50mm, place 50mm 50 blow	0.145	0.120	0.110	0.083
8	In situ recycle 100mm with 2% residual bitumen	0.165	0.125	0.130	0.086
9	In situ recycle 100mm with 3% residual bitumen	0.130	0.105	0.100	0.047
10	In situ recycle 100mm no addition, SAMI prime	0.200	0.155	0.160	0.131
11	In situ recycle 100mm no addition, normal prime	0.175	0.170	0.205	0.140
12	Mill 100mm, place 100mm ESL	0.227	0.210	0.150	0.095
13	Mill 100mm, place 100mm road base	0.255	0.210	0.265	0.166


2011 Curvature
mm
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
No preparation
Apply SAMI
Geotextile
35mm AC
50mm AC
75mm AC
50mm AC
Recycle with 2% bit
Recycle with 3% bit
Recycle no bit
Recycle no bit
100mm ESL base
100mm FRC base
1
2
3
4
5
6
7
8
9
10
11
12
13
Section

SIXTH AVE TRIAL
Skid Resistance after 2 years

- Gap-graded asphalt (7mm):

Corrected Skid	69
Texture depth	0.2mm
IFI	0.06

- Dense-graded asphalt (7mm):

Corrected Skid	63
Texture depth	0.3mm
IFI	0.12

- SMA (7mm):

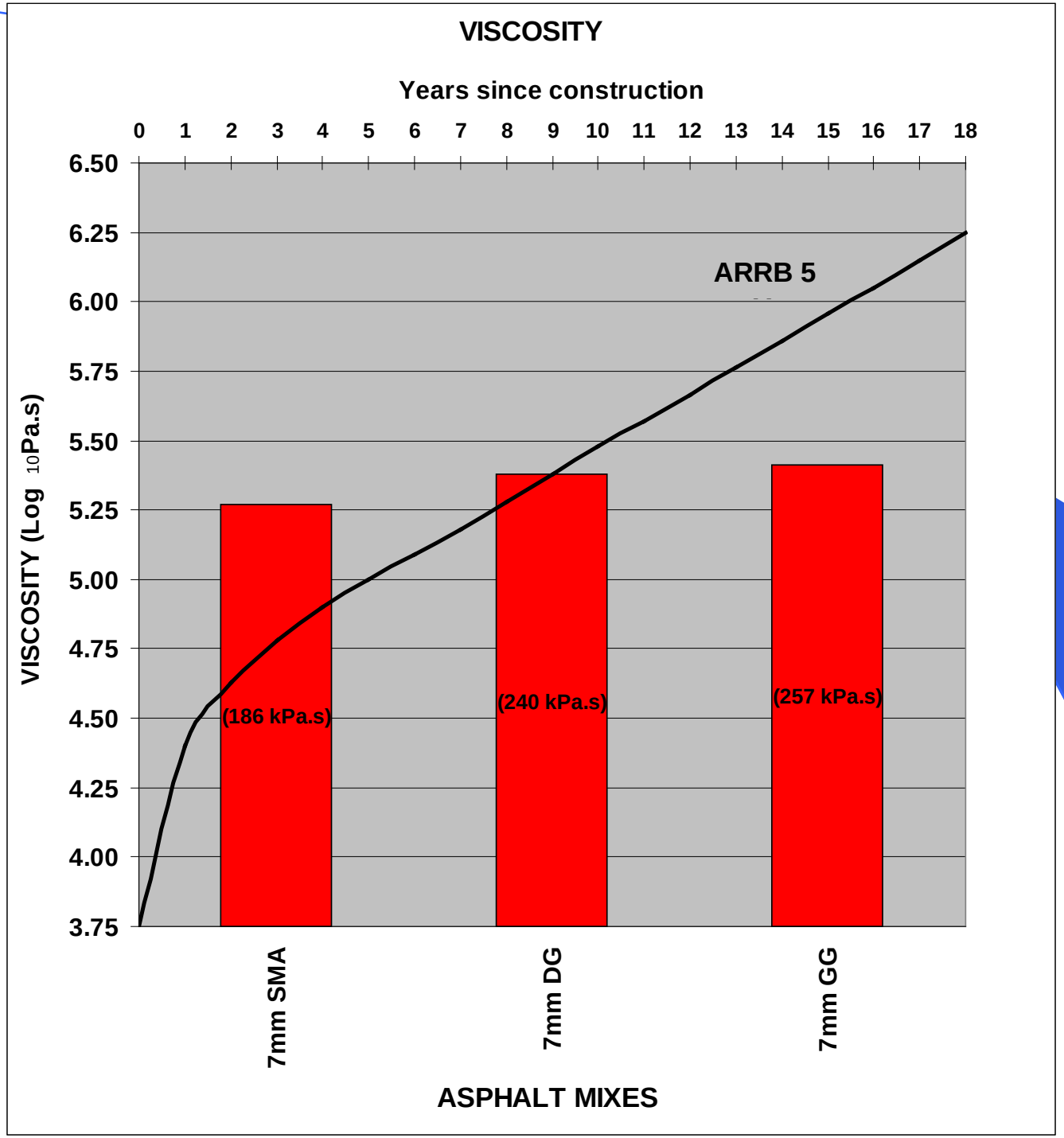
Corrected Skid	65
Texture depth	0.7mm
IFI	0.27

SIXTH AVE TRIAL

Binder Hardening

or

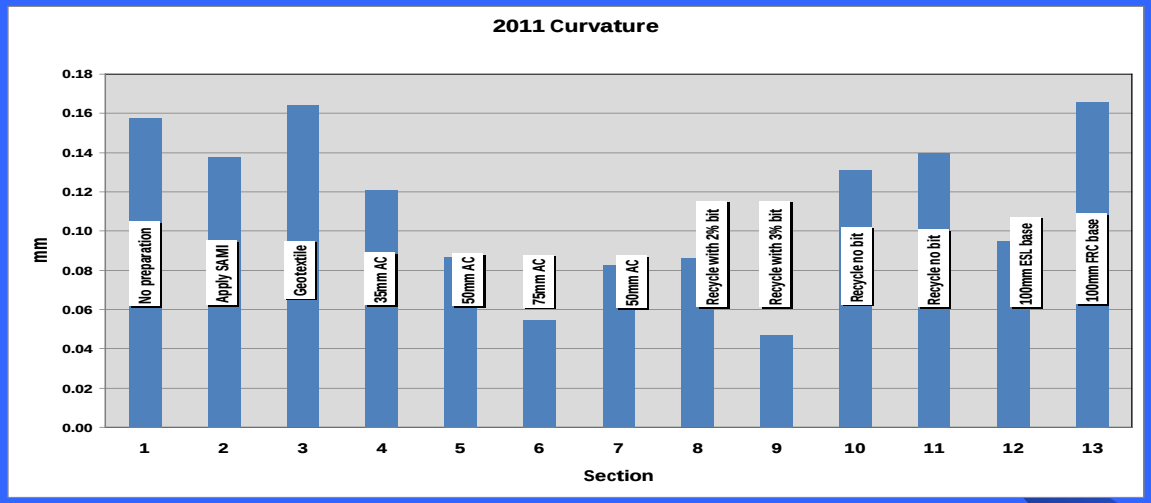
Viscosity


VISCOSITY
Years since construction
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
6.50
6.25
6.00
5.75
5.50
5.25
5.00
4.75
4.50
4.25
4.00
3.75
VISCOSITY (Log 10Pa.s)
ARRB 5
(186 kPa.s)
(240 kPa.s)
(257 kPa.s)
7mm SMA
7mm DG
7mm GG
ASPHALT MIXES

SIXTH AVE TRIAL

Conclusions

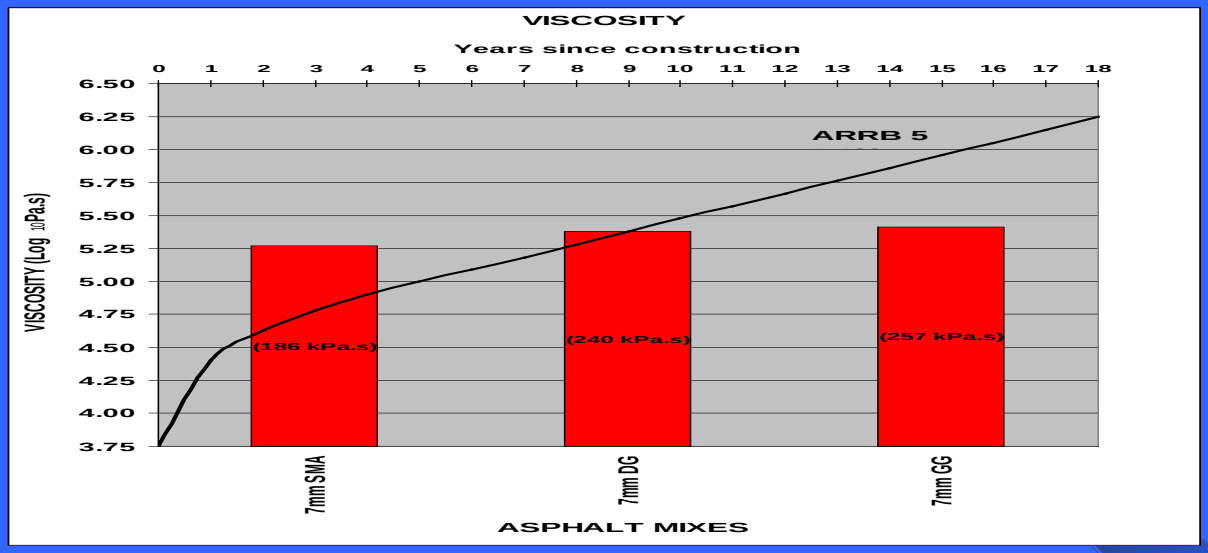
The gap-graded asphalt and the dense-graded asphalt on the section with no host surface preparation, have cracked. There is no cracking what so ever in the SMA on any section. SMA is the most economical resurfacing treatment when prevention of crack propagation matters.



The structural capacity of the road sections that were situ recycled with the addition of 3% residual binder or constructed with 100mm of asphalt have increased such that the sections are good for classification as distributor roads with well over 1 x E6 ESA's

Skid Resistance

The friction resistance of the smoother gap graded asphalt is superior to dense grade and SMA. However the texture depth of the SMA is far better than the others. This would result in a calculated IFI that would be far superior than the other two surfaces.

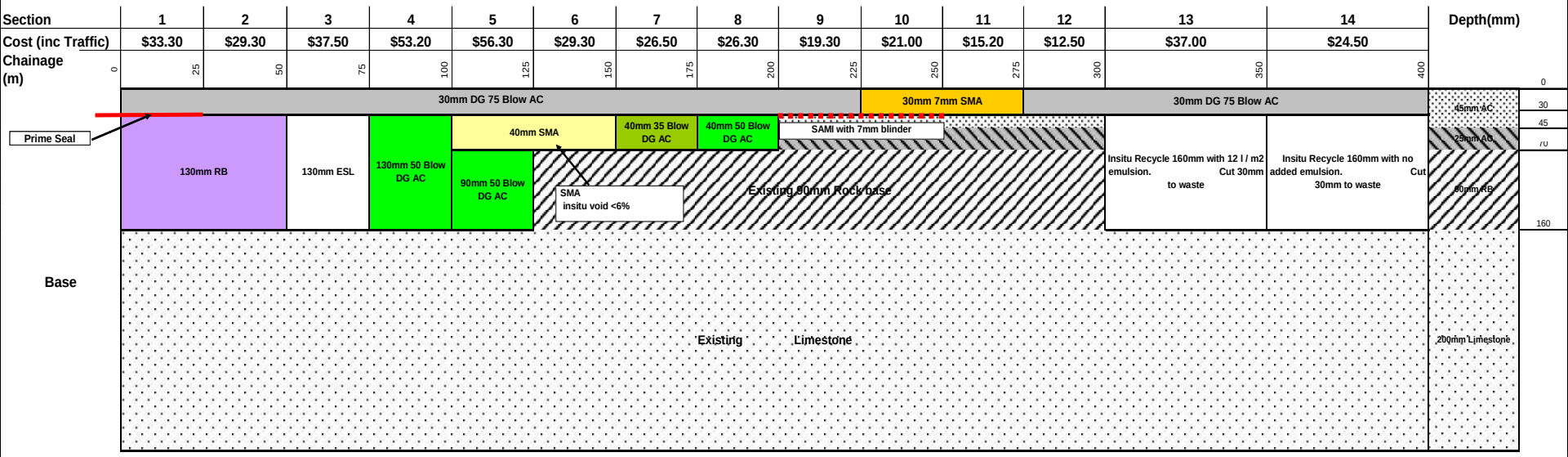


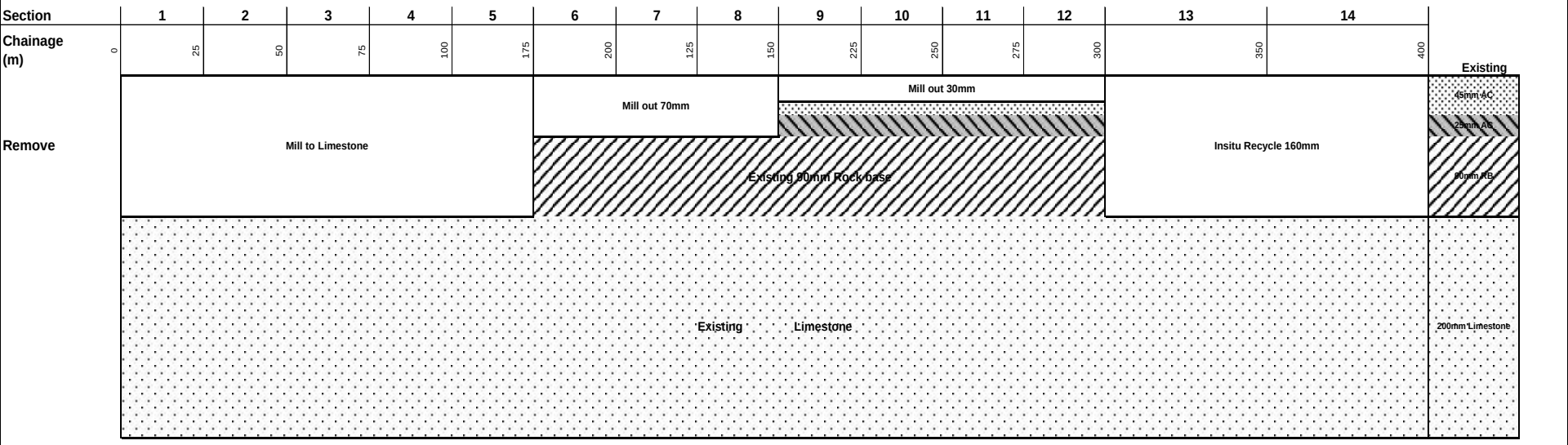
The viscosity of the SMA is lower than the dense grade and gap grade indicating that the durability of the SMA is highly likely to be better.

ARRB estimate shows the existing bitumen at about 6 year old equivalent

DOUBLE SMA

ALEXANDER DRIVE PAVEMENT TRIAL





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