HiMA Long-Term Pavement Performance Study

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Acknowledgements

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Outline of presentation

- Background
- HiMA implementation
- LTPP South Coast Road
  - Visual condition assessment
  - FWD and profilometer survey results
- Conclusions

Background: What is High Modulus Asphalt ?

Origin: France early 90s
"Enrobés à Module Elevé" (EME)

Typical characteristics:

- High binder content ≈ 6% by mass of aggregate
- Hard binder: Pen 10-25
- Low air voids content
- High Modulus > 14 GPa at 15°C, 10 Hz
- High resistance against permanent deformation
- Good fatigue resistance
- Impermeable
- Increased mixing temperature

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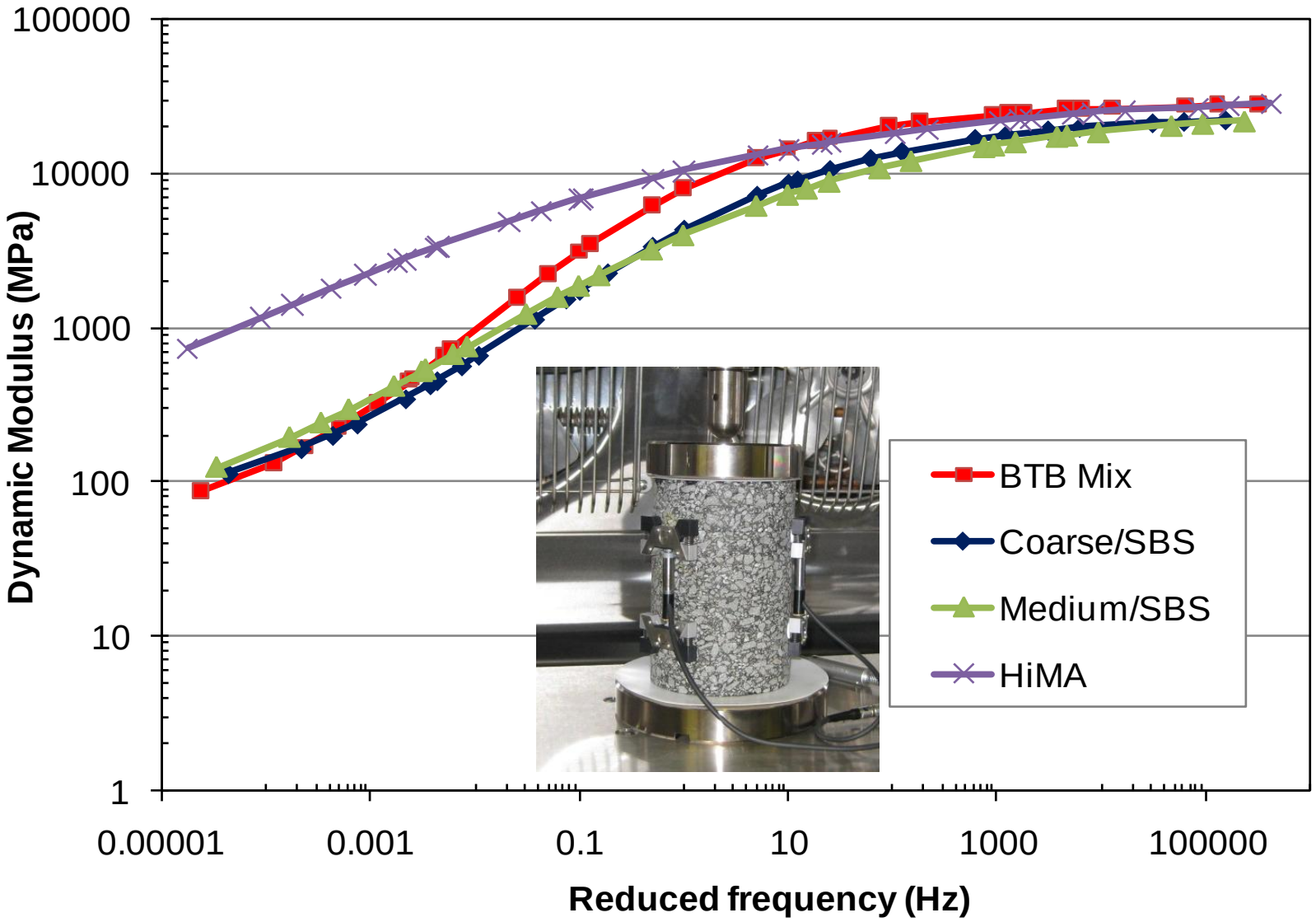
Background: The properties of HiMA



Background: The properties of HiMA

Permanent strain [%]

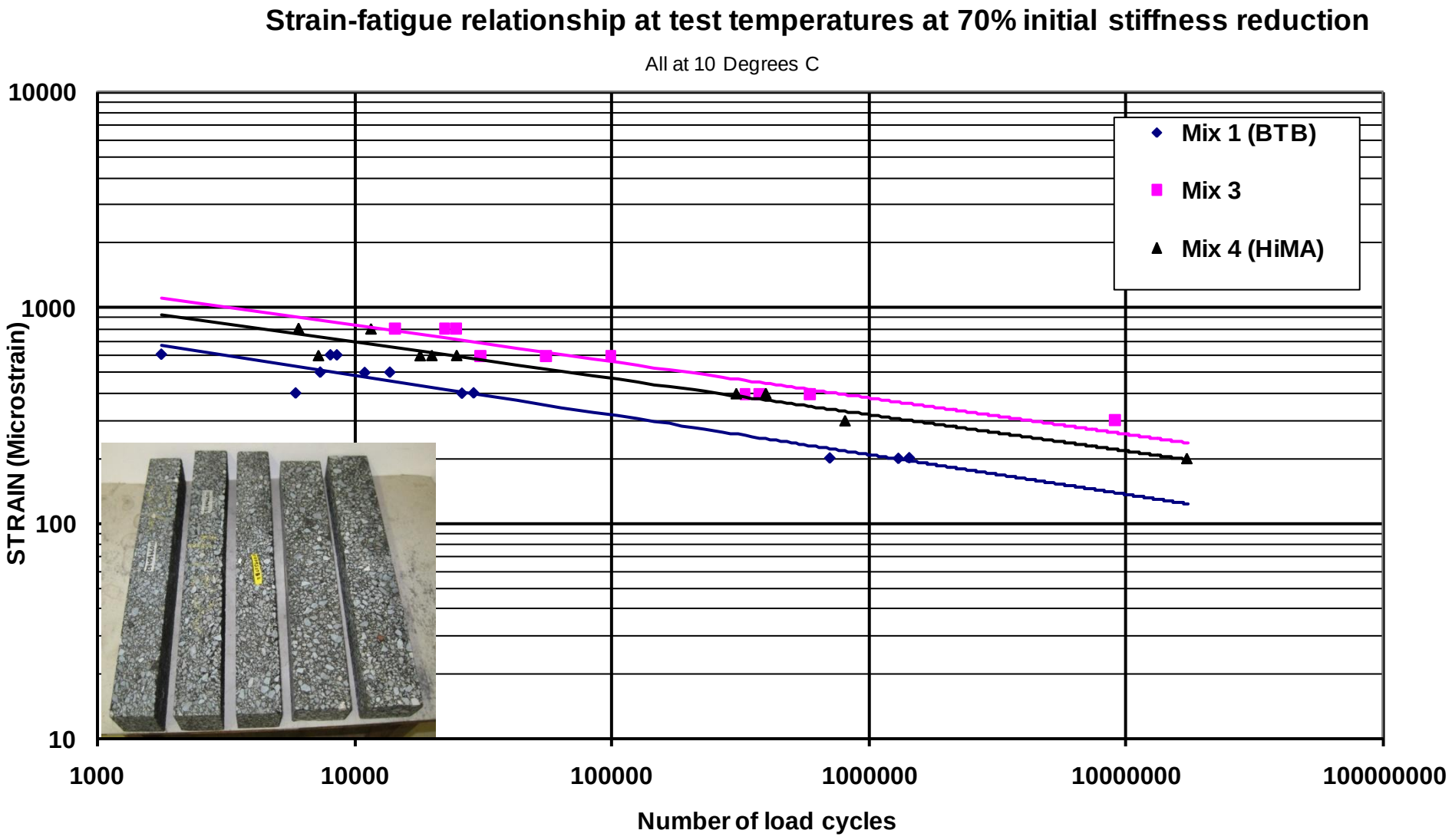
5.0%
4.5%
4.0%
3.5%
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%

0 5 000 10 000 15 000 20 000 25 000 30 000

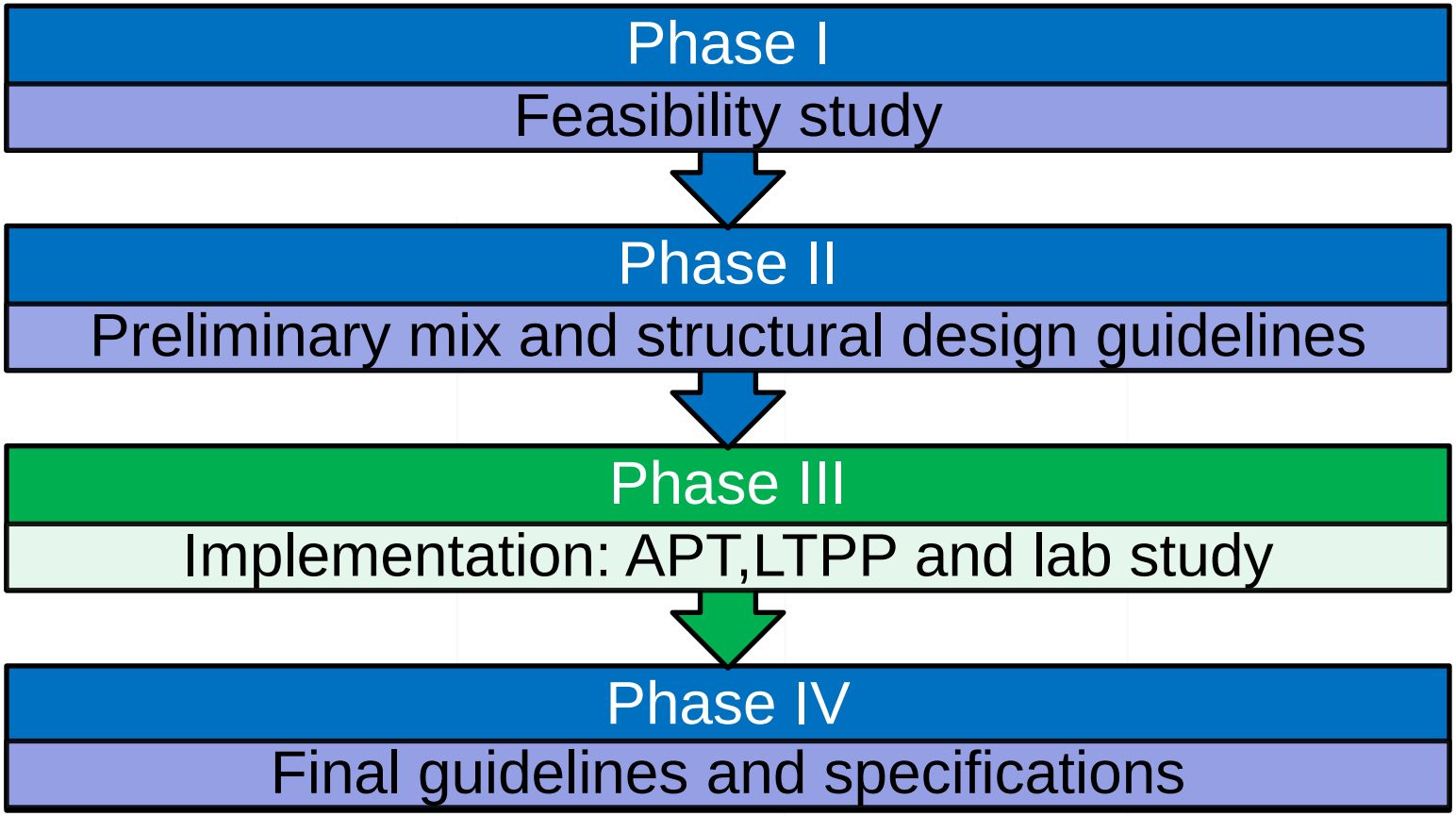
Load repetitions

BTB 1 55°C
Coarse AE2 55°C
Medium AE2 55°C
HiMA 55°C
Medium 60/70 55°C
BRASO 55°C

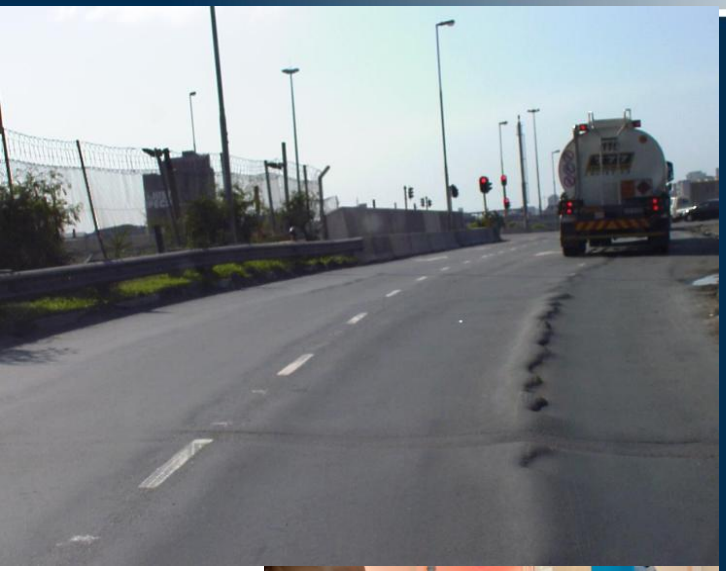
Background: The properties of HiMA



Background: Structure of SABITA T^2 project



Implementation: South Coast road



- Road owned by eThekwini municipality,
- Major access road to the Durban harbour,
- Estimated number of standard axels: 8000 per lane per day (60 Million E80s in 20 years),
- CSIR tasked by SABITA to provide implementation advice.
- Mix design:
  - Interim guideline used for mix design,
  - Mix included 20% Reclaimed Asphalt (RA),
  - 10-20 penetration grade binder,
  - Aggregate packing optimized,
  - Several iterations to optimise design,
  - Relatively lower binder content to optimise permanent deformation resistance.

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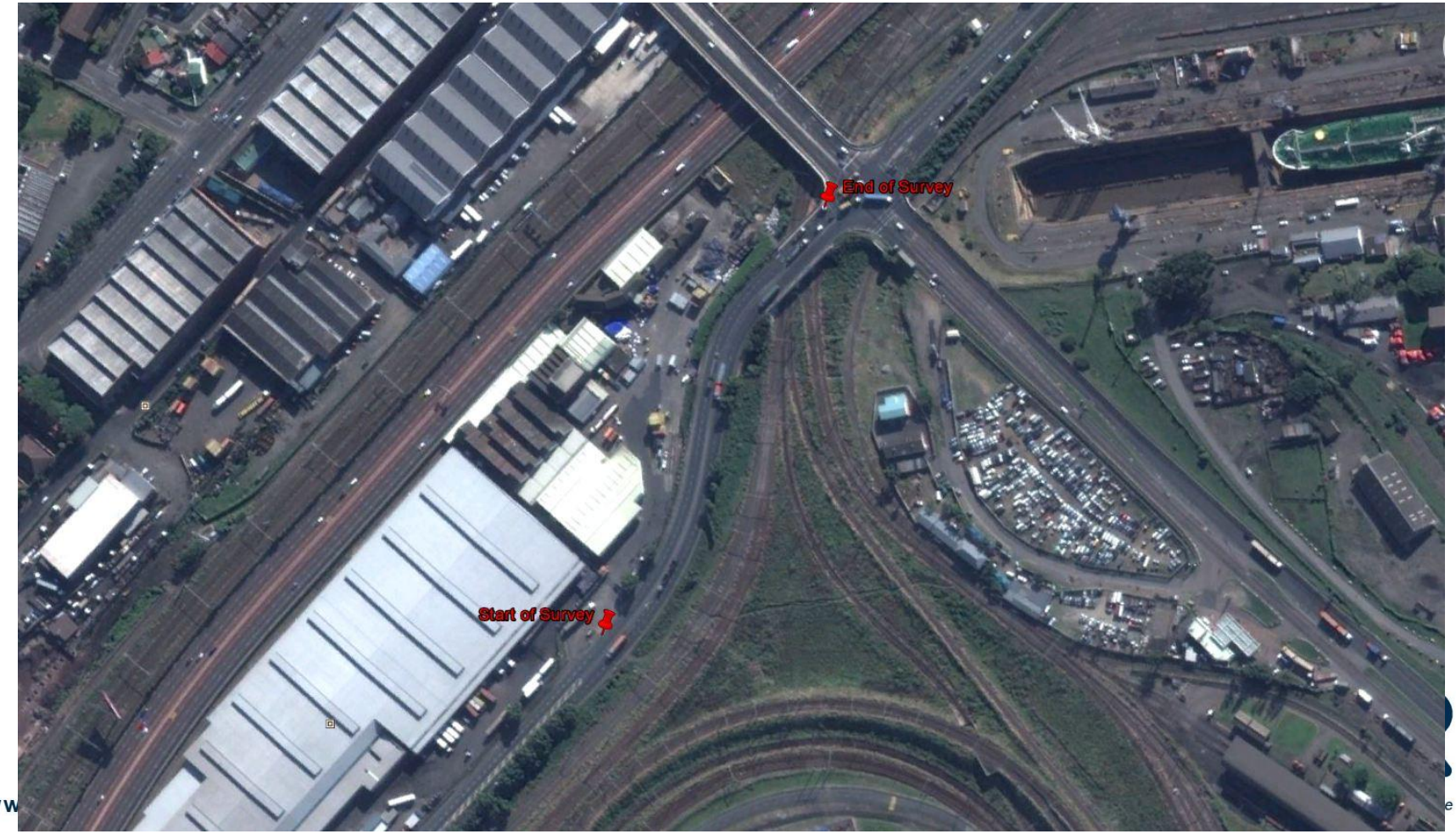
Long Term Pavement Performance study

- Visual inspections every 6 months for two years (TMH 9)
- FWD and profilometer survey every 6 months



Example of visual assessment rating

VISUAL ASSESSMENT															
Date	21/08/2012														
Surface Type	SMA														
Lane / Direction	Slow NorthBound														
Panel / Chainage	260 - 240 metres from intersection														
Texture	Fine														
Voids	Varying - None to Few														
	Degree						Extent					Length	Width	Number	
	Slight					Severe	Slight				Severe				
Mechanical Failure	0	1	2	3	4	5	1	2	3	4	5				
Other Failure	0	1	2	3	4	5	1	2	3	4	5	Skid marks			
Bleeding/Flushing	0	1	2	3	4	5	1	2	3	4	5	Centre of lane			
Surface Cracks	0	1	2	3	4	5	1	2	3	4	5				
Binder Condition	0	1	2	3	4	5	1	2	3	4	5				
Aggregate Loss	0	1	2	3	4	5	1	2	3	4	5				
Cracks Blocks	0	1	2	3	4	5	1	2	3	4	5				
Cracks Longitudinal	0	1	2	3	4	5	1	2	3	4	5				
Cracks Transverse	0	1	2	3	4	5	1	2	3	4	5				
Cracks Crocodile	0	1	2	3	4	5	1	2	3	4	5				
Cracks Parabolic	0	1	2	3	4	5	1	2	3	4	5				
Pumping	0	1	2	3	4	5	1	2	3	4	5				
Rutting	0	1	2	3	4	5	1	2	3	4	5				
Undulation/Settlement	0	1	2	3	4	5	1	2	3	4	5				
Edgebreak	0	1	2	3	4	5	1	2	3	4	5				
Potholes	0	1	2	3	4	5	1	2	3	4	5				
Delamination	0	1	2	3	4	5	1	2	3	4	5				
												Number of Patchs & size			
Patching	0	1	2	3	4	5	1	2	3	4	5				
												Influencing Factors			
Riding Quality	0	1	2	3	4	5	1	2	3	4	5				
Skid Resistance	0	1	2	3	4	5	1	2	3	4	5	Bleeding/ fine texture			
Surface Drainage	0	1	2	3	4	5	1	2	3	4	5				
Side Drainage	0	1	2	3	4	5	1	2	3	4	5	Drainage not effective			

Photos Taken (reference)	Number	Description		Number	Description
	1186	General			
	1189 &1190	Bleeding			

Comments :-

Skid marks in the wheel paths

12 Months inspection (August 2012)

- Overall condition of the pavement is rated good
- Few defects of degree not more than 3 (condition not yet warning)
- SMA is flushing in places, almost voidless, loss of texture
- Fuel spillages are a frequent occurrence on section
- Drainage issues especially on the bridge
- No indication of damage to the HiMA layer yet

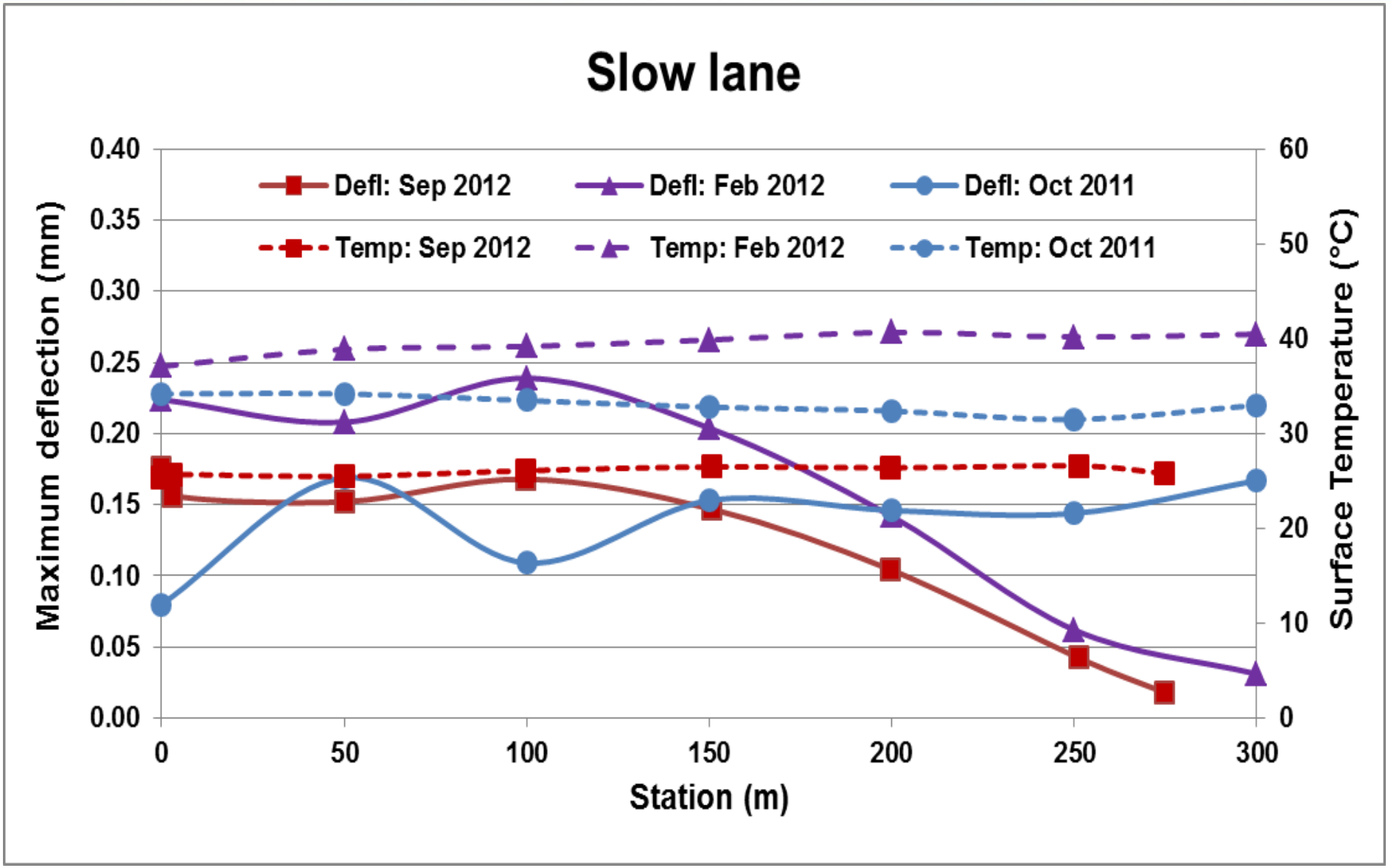
Pics taken during inspection

Pics taken during inspection

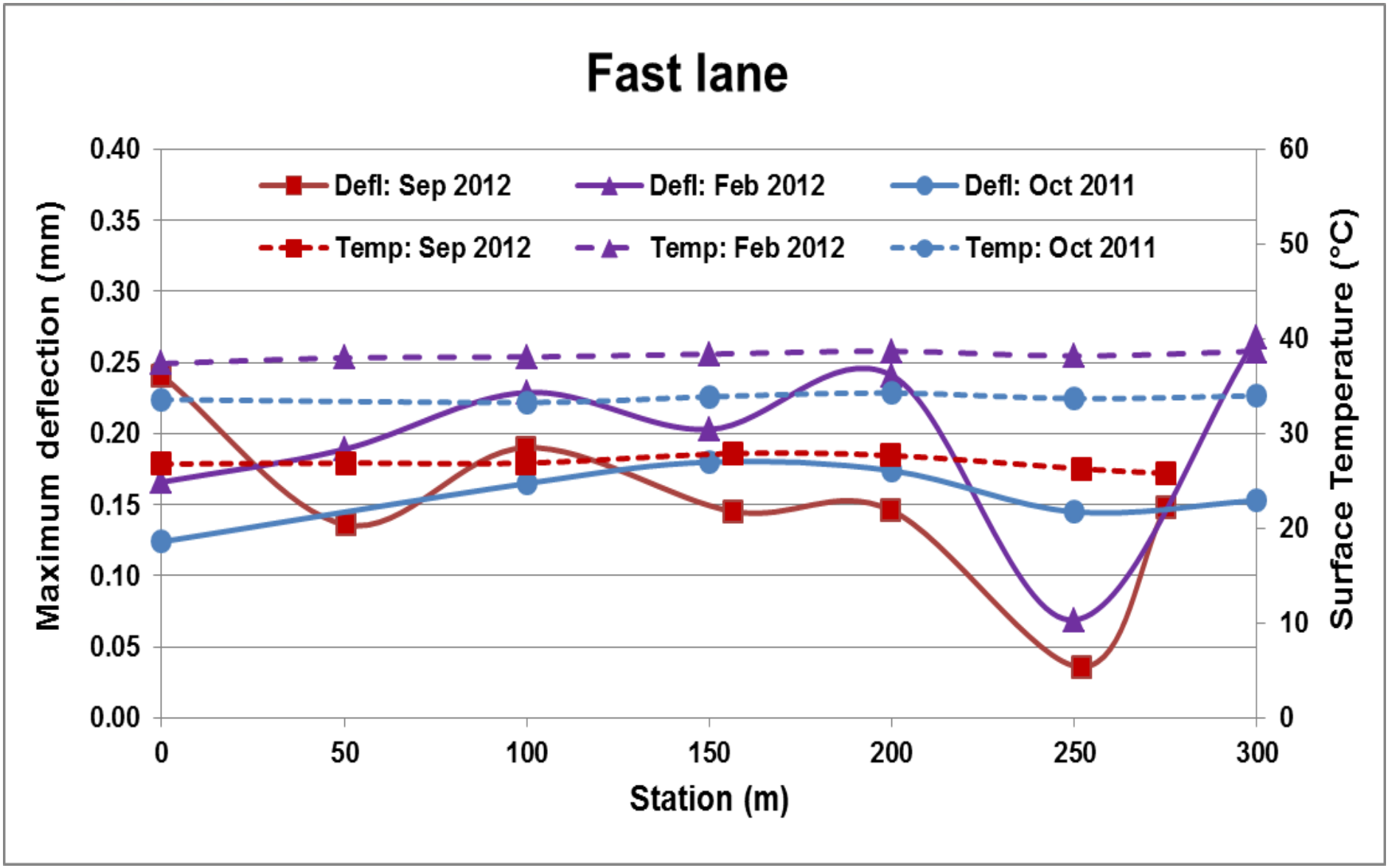
FWD Measurements

- Available data
  - Just after construction (October 2011)
  - 6 months (February 2012)
  - 12 months (September 2012)

FWD Measurements: (40 kN load)

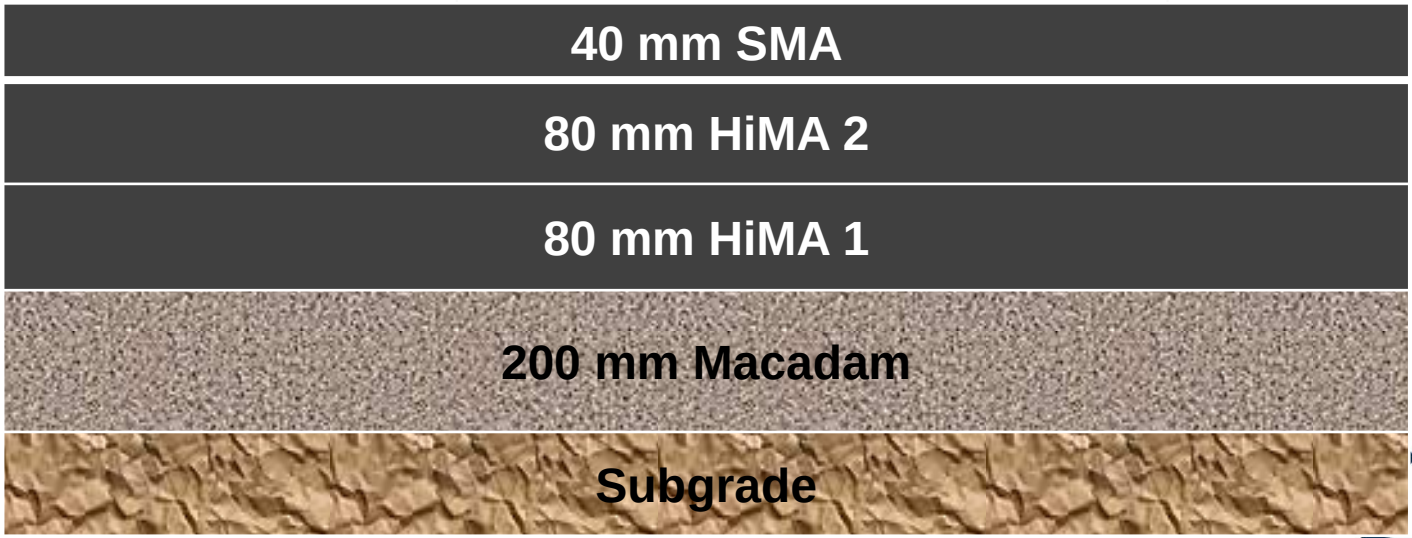


FWD Measurements(40 kN load)

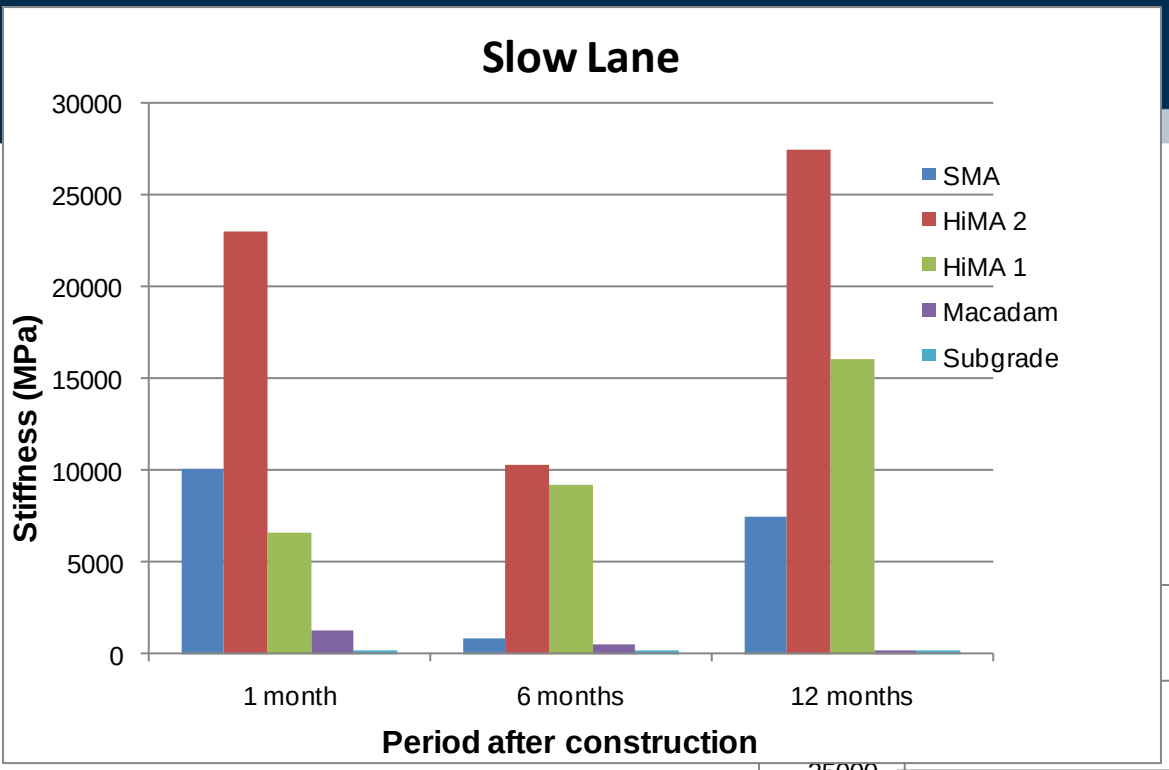


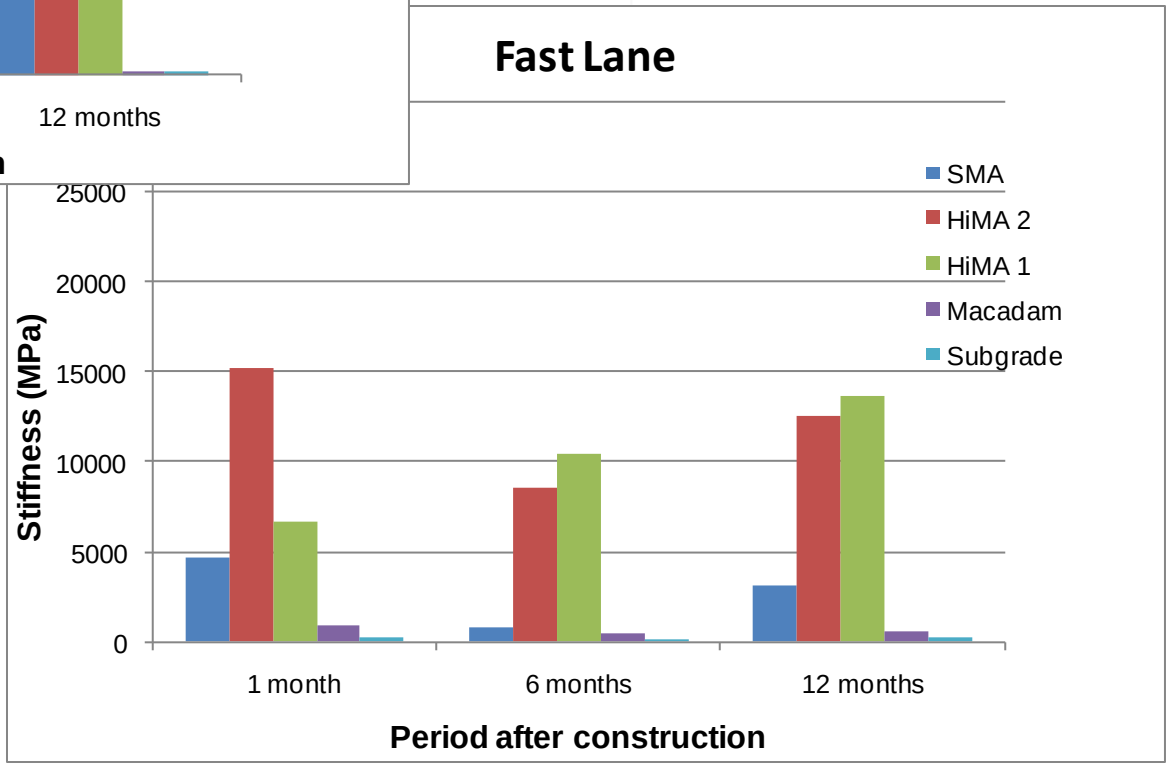
Back calculation results

		Average Stiffness (MPa)				
		SMA	HIMA2	HIMA1	Macadam	Subgrade
SEPTEMBER 2012	Slow lane	7465	27482	16093	217	197
	Fast lane	3178	12561	13633	547	187
FEBRUARY 2012	Slow lane	832	10256	9238	503	160
	Fast lane	772	8600	10416	414	185
OCTOBER 2011	Slow lane	10085	23002	6562	1261	185
	Fast lane	4730	15246	6706	891	191



Back calculation: Comparison of stiffness





Profilometer survey

- Several millimetres of rutting recorded (approximately 1 to 6 mm)

Road	South Coast Road	Location	HiMA Trial Section
Start Chainage	0.000	Region	Durban
End Chainage	0.304	DC	-
Total Length Surveyed (km)	0.304	District Municipality	eThekwini Municipality
Lane	Left Lane	KZ	-
Date Surveyed	10-09-2012	Local Municipality	eThekwini Metropolitan Municipality
Time	09:51		

DATA COMPILED BY:

Surface Profile Data

South Coast Road

Left Lane

Chainage (km)	Rutting			SMTD Texture				MPD Texture				Roughness			Co-ordinates			Events
	Rut Right	Rut Left	Rut Lane	SMTD Texture Right	SPTD Texture Right	SMTD Texture Left	SPTD Texture Left	MPD Texture Right	ETD Texture Right	MPD Texture Left	ETD Texture Left	IRI Right	IRI Left	IRI Avg	Latitude (deg)	Longitude (deg)	Altitude (m)	
0.100	2.960	2.740	3.940	0.361	0.904	0.316	0.793	0.511	0.608	0.467	0.574	2.58	2.25	2.42	-29.88733272	30.98937905	7.6	ASPHALT, TWO LANES
0.200	1.270	5.640	5.660	0.322	0.810	0.374	0.936	0.426	0.540	0.554	0.643	1.51	1.47	1.49	-29.88646709	30.98960814	11.5	
0.300	4.130	4.070	4.960	0.256	0.647	0.248	0.627	0.417	0.533	0.388	0.510	X	X	X	-29.88576961	30.99024747	12.5	NO LINES, BRIDGE ABUTMENT
0.304	3.130	1.980	3.190	0.269	0.679	0.229	0.581	0.418	0.534	0.342	0.474	12.83	6.73	9.78	-29.88574562	30.99027351	12.5	
Average	2.9	3.6	4.4	0.3	0.8	0.3	0.7	0.4	0.6	0.4	0.6	5.6	3.5	4.6				

Road	South Coast Road	Location	HiMA Trial Section
Start Chainage	0.000	Region	Durban
End Chainage	0.305	DC	-
Total Length Surveyed (km)	0.305	District Municipality	eThekwini Municipality
Lane	Left Lane	KZ	-
Date Surveyed	10-09-2012	Local Municipality	eThekwini Metropolitan Municipality
Time	09:58		

DATA COMPILED BY:

Surface Profile Data

South Coast Road

Left Lane

Chainage (km)	Rutting			SMTD Texture				MPD Texture				Roughness			Co-ordinates			Events
	Rut Right	Rut Left	Rut Lane	SMTD Texture Right	SPTD Texture Right	SMTD Texture Left	SPTD Texture Left	MPD Texture Right	ETD Texture Right	MPD Texture Left	ETD Texture Left	IRI Right	IRI Left	IRI Avg	Latitude (deg)	Longitude (deg)	Altitude (m)	
0.100	3.320	5.420	5.750	0.296	0.745	0.384	0.961	0.435	0.548	0.569	0.656	3.11	3.67	3.39	-29.88735601	30.98941036	8.1	TWO LANES
0.200	1.600	1.840	2.180	0.339	0.851	0.342	0.859	0.516	0.613	0.555	0.644	1.05	1.27	1.16	-29.88649142	30.98964474	11.7	ASPHALT, NO LINES
0.300	2.110	1.690	2.340	0.323	0.810	0.299	0.752	0.556	0.645	0.467	0.573	X	X	X	-29.88577294	30.99030232	13.1	BRIDGE ABUTMENT
0.305	6.030	0.990	6.030	0.586	1.456	0.285	0.718	0.856	0.885	0.506	0.605	X	X	X	-29.88574318	30.99033446	13.1	
Average	3.3	2.5	4.1	0.4	1.0	0.3	0.8	0.6	0.7	0.5	0.6	2.1	2.5	2.3				

Conclusions

- HiMA technology successfully transferred,
- Interim performance related mix design guidelines available
- The use of HiMA being investigated for various road construction projects,
- Laboratory trials with warm mixed HiMA underway,
- The experience gained with performance related mix design will be used in the development of the South African Asphalt Mix Design Manual,
- Main challenge: supply/manufacturing of HiMA binder in the country

Thank You!