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 $\approx 6\%$ 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



Background: The properties of HiMA



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Background: The properties of HiMA



Background: The properties of HiMA



Background: Structure of SABITA T² 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.



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

				V	SUAL A	SSES	<u>SME</u> N	Т					
Date		21	1/08/2012										
Surface Type	SMA												
Lane / Direction	Slow North	nBound											
Panel / Chainage	260 - 240 ı	metres from i	ntersection										
Texture	Fine												
Voids	Varying - N	None to Few											
			Degree	e					Extent		Length	Width	Numbe
	Slight				Sever	ə Sli	ght			Severe	Longin	width	Numbe
Mechanical Failure	0	1	2	3	4	5	1	2	3	4 5	i		
Other Failure	0	1	2	3	4	5	1	2	3	4 5	Skid mark	S	
Bleeding/Flushing	0	1	2	3	4	5	1	2	3	4 5	Centre of I	ane	
Surface Cracks	0	1	2	3	4	5	1	2	3	4 5			<u> </u>
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			<u> </u>
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	6		
Cracks Crocodile	0	1	2	3	4	5	1	2	3	4 5	i		
Cracks Parabolic	0	1	2	3	4	5	1	2	3	4 5	i		
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	5		
Edgebreak	0	1	2	3	4	5	1	2	3	4 5	5		
Potholes	0	1	2	3	4	5	1	2	3	4 5	5		
Delamination	0	1	2	3	4	5	1	2	3	4 5	i i		
											Number of	Patchs &	size
Patching	0	1	2	3	4	5	1	2	3	4 5	6		
											Influ	uencing Fac	ctors
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 r	not effective)
Photos Taken (reference)	Number		De	scription				Number		Description	า		
	1186	General											
	1189 &1190	Bleeding										-	
Comments :-													
Skid marks in the wheel pa	aths												

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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



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Pics taken during inspection



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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				
SEDTEMBED 2012	Slow lane	7465	27482	16093	217	197				
SEPTEIVIDER 2012	Fast lane	3178	12561	13633	547	187				
	Slow lane	832	10256	9238	503	160				
FEDRUART 2012	Fast lane	772	8600	10416	414	185				
	Slow lane	10085	23002	6562	1261	185				
OCTOBER 2011	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	Sou	ith Coast R	oad		l	ocation.	H	IiMA Trial Se	ection	DATA COM				
	Start Chainage			0.000			Region			Durban		DATA COMPILED BY:		Surface Profile Data						
End Chainage			0.304			DC			-					Surface Frome Data						
	Total Length Surveyed (km)		0.304			District Municipality			eThekwini Municipality											
			Lane		Left Lane		К		KZ	-					Courth Courte Doord					
1		Ň	Date Surveyed					10-09-2012	2	Local Municipality		icipality	eThekwini Metropolitan Municipality			CONSU	LTING	South Coast Road		
mu	JAIGIFAL		Time			09:51									Left Lane					
	Rutting SMTD Texture			Texture	MPDT			exture			Roughness			Co-ordinates						
Chainage				SMTD	SPTD	SMTD	SPTD	MPD	ETD	MPD	ETD							5 mm to		
(km)	Rut Right	Rut Left	Rut Lane	Texture	Texture	Texture	Texture	Texture	Texture	Texture	Texture	IRI Right	IRI Left	IRI Avg	Latitude (deg)	Longitude (deg)	Altitude (m)	Events		
				Right	Right	Left	Left	Right	Right	Left	Left									
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	Х	Х	Х	-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	Û.8	0.3	0.7	0.4	Û.Ó	Û.4	Û.Ó	5.6	3.5	4.ó						
A		Road			South Coast Road		Location			HiMA Trial Section		B.474 60140								
			Start Chainage End Chainage			0.000			Region DC		Region	Durban -			DATA COMPILED BY:		Surface Profile Data			
											DC					Surface Profile Data				
	$I \perp \Lambda$		Total Length Surveyed (km)				0.305		District Municipality		eThekwini Municipality		<u> </u>							
					lana	Left Lane										TM				
31	ETHEKWINI					Lane		Left Lane				KZ		-						
MU	NIOIDE!!				Date Su	rveyed		Left Lane 10-09-2012		Lo	cal Muni	KZ cipality	eThekwini	- Metropolita	an Municipality	CONSU		South Coast Road		
	NICIPALI	TΥ			Date Su	rveyed Time		Left Lane 10-09-2012 09:58		Lo	cal Muni	KZ cipality	eThekwini	- Metropolita	an Municipality	CONSU		South Coast Road		
	NICIPALI	NI ITY			Date Su	rveyed Time		Left Lane 10-09-2012 09:58		Lo	cal Muni	KZ icipality	eThekwini	- Metropolita	an Municipality	CONSU		South Coast Road		
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Chainage (km)	Rut Right	Rutting	Rut Lane	SMTD Texture	Date Sur SMTD1 SPTD Texture	rveyed Time fexture SMTD Texture	SPTD Texture	Left Lane 10-09-2012 09:58 MPD Texture	MPD To ETD Texture	Lo exture MPD Texture	Cal Muni ETD Texture	KZ icipality	eThekwini Roughness	- Metropolita	an Municipality	Co-ordinates	Altitude (m)	South Coast Road Left Lane Events		
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Chainage (km) 0.100 0.200	Rut Right 3.320 1.600	Rutting Rut Left 5.420 1.840	Rut Lane 5.750 2.180	SMTD Texture Right 0.296 0.339	SMTD1 SPTD Texture Right 0.745 0.851	Time Time Fexture SMTD Texture Left 0.384 0.342	SPTD Texture Left 0.961 0.859	Left Lane 10-09-2012 09:58 MPD Texture Right 0.435 0.516	MPD To ETD Texture Right 0.548 0.613	Lo exture MPD Texture Left 0.569 0.555	ETD Texture Left 0.656 0.644	KZ icipality IRI Right 3.11 1.05	eThekwini Roughness IRI Left 3.67 1.27	- Metropolita IRI Avg 3.39 1.16	an Municipality Latitude (deg) -29.88735601 -29.88649142	Co-ordinates Longitude (deg) 30.98941036 30.98964474	Altitude (m) 8.1 11.7	South Coast Road Left Lane Events TWO LANES		
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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!





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