

HiMA and EME

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SAT Seminar
Australian Delegation
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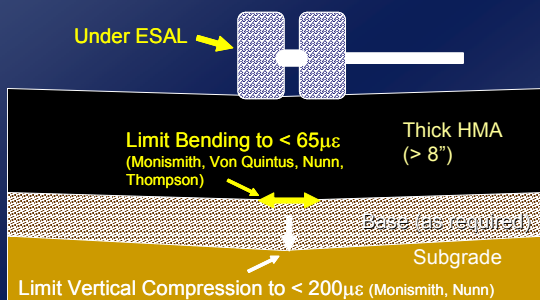
ellenbosch



Principle of HiMA

- A building block in providing Perpetual Pavement = Long lasting road = Revêtements durables = Duurzame verhardingen
- M Thomson (2004) Perpetual? "It's a hell of a long time"

Perpetual Pavements

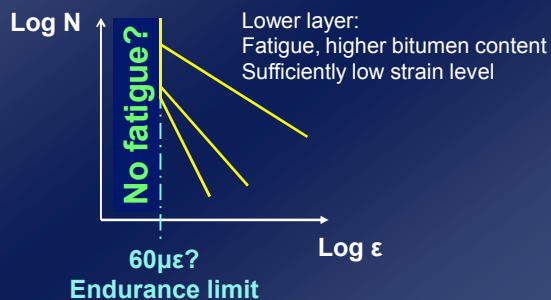


Principle Perpetual Pavement

- Multi-layer system function for asphalt mixtures
- Bottom layers: durable, high resistance against fatigue, good resistance to rutting
- Binder layer: durable, high resistance to rutting
- Top layer: specific requirements

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Perpetual pavements: is there a strain limit below which there is no fatigue???



EME: Enrobe a Module Eleve



- EME has the following specific properties:
 - Increased stiffness
 - Increased resistance against fatigue
 - Increased resistance against permanent deformation
- EME is used in base layers



Applications EME

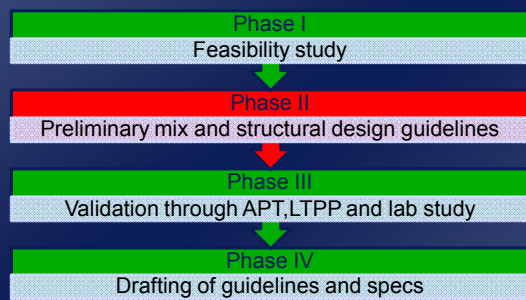
- Special heavy loaded lanes
- Bridge decks
- Industry areas
- Airport pavements
- Perpetual pavements

Important: check the low temperature cracking

EME

- The properties are achieved by:
 - Hard bitumen: special production process, special crudes (no polymers added)
 - Higher bitumen content
 - Optimised grain distribution
 - Low voids content
- Mix design according French norm NF P 98-140

Sabita HiMA T² project



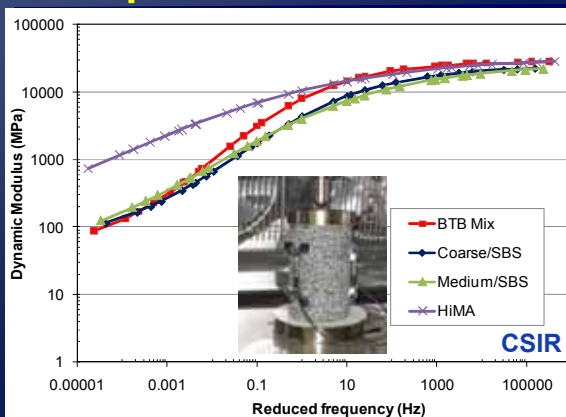
CSIR



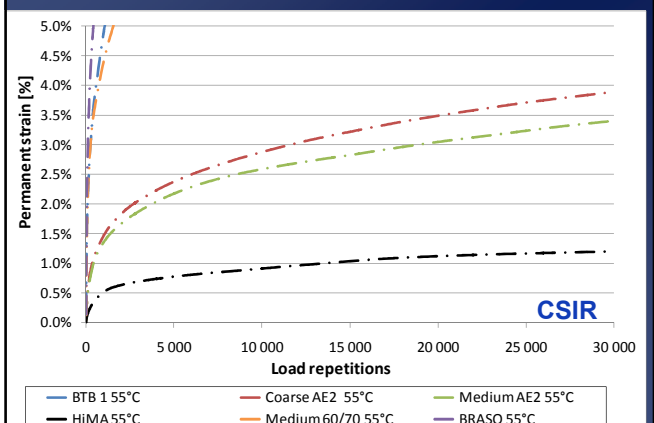
Flexural stiffness (Bending test) EU

	RM 0/20 C	RM 0/14 C
	Complex Modulus At 10 Hz [MPa]	Complex Modulus at 10 HZ [MPa]
Temperature	5	3.9
-10 C	22800	28000
0 C	21000	23100
10 C	17200	17200
15 C	15000	14100
20 C	12800	11100
30 C	8800	5900
40 C	4500	2600

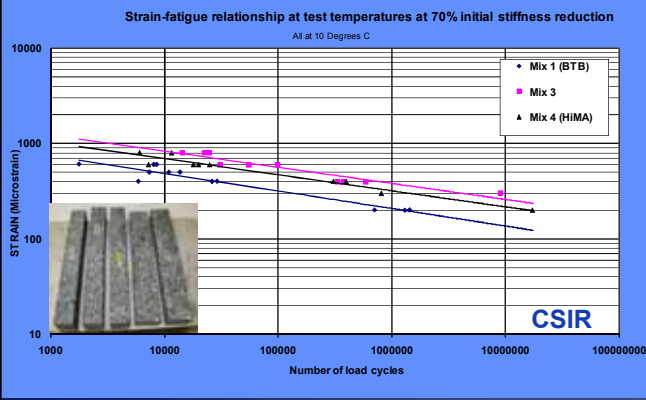
Comparison of HMA Moduli



Permanent deformation (RSST-CH)



Fatigue results (10 °C 25 Hz)



French mix design – to SA

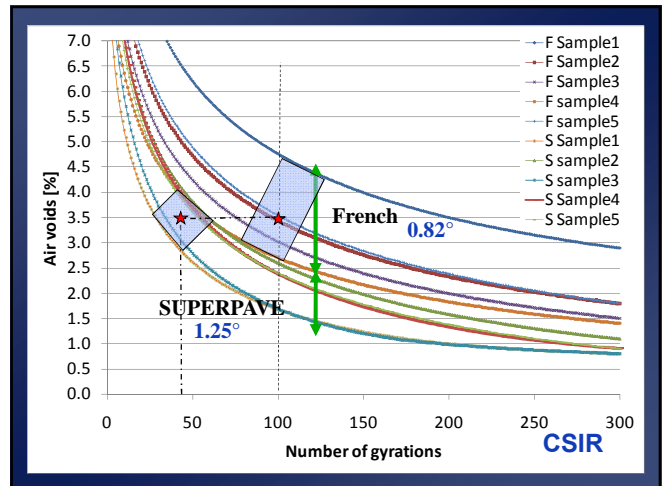
Parameter	Requirement	Result	SA equivalent test
Workability (Gyratory compactor)	Max 6% voids after 100 gyrations	5.7 %	Gyratory
Durability (Duriez test)	Retained strength: >0.7	0.9	Modified Lottmann
Rutting (Wheel tracker)	Rut depth after 30 000 cycles <7.5 mm	5.2 mm	RSST-CH, Wheel tracking
Beam dynamic modulus	15 °C-10 Hz: >14 GPa	17 GPa	Beam or cylinder dynamic modulus
Fatigue (Prism)	$\mu\epsilon$ for 10^6 fatigue life: >130	90 $\mu\epsilon$	Beam fatigue

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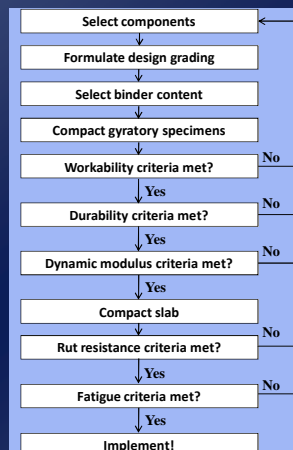
Gyratory study

Specification	Superpave	French
Gyratory angle	1.25	0.82
Pressure	600kPa	600kPa
Rate	30 gyrations/min	30 gyrations/min

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Guideline

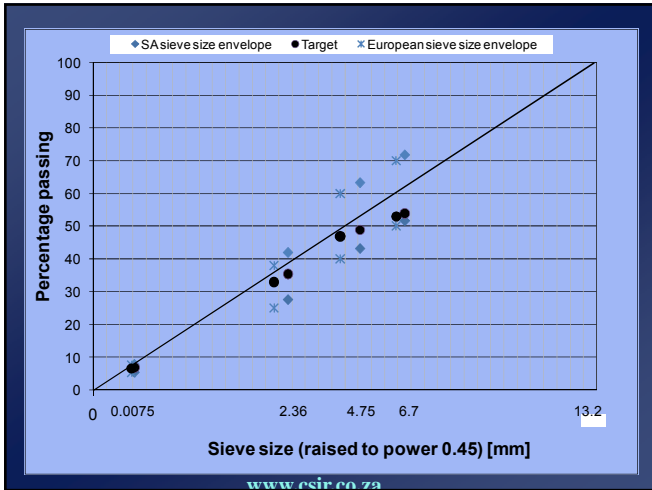


CSIR



Aggregate selection

Property	Test	Method	Criteria
Hardness	Fines aggregate crushing test: 10 %FACT	TMH1, B1	≥ 160 kN
	Aggregate crushing value ACV	TMH1, B1	$\leq 25\%$
Particle shape & texture	Flakiness Index test	SANS 3001	≤ 25
	Particle index test	ASTM D3398	>15
	Polished stone value	SANS 3848	$>50^a$
Water absorption	Water absorption coarse aggregate (>4.75mm)	TMH1, B14	≤ 1.0 %
	Water absorption fine aggregate	TMH1, B14	≤ 1.5 %
Cleanliness	Sand equivalency test	TMH1, B19	≥ 50



Test sites in UK for high trafficked areas (>80 MESA)

Table 1. Design and site mixture characteristics, Site B

Property	Design	Area 1	Results Area 2	S14 EME2 Specification	Remarks
Gradation	Generally within EME2 specification range				0.30mm sieve result was lower than that of design target
Binder content (%)	5.3	5.6	5.0	± 0.4	
Richters modulus, R	3.42	3.43	3.40	± 0.4	
Penetration (0.1mm)	16	-	-	10 - 20	No site data
Softening point (°C)	70.0	-	-	target 67.1	
Water sensitivity (%) [2]	0.10	-	-	± 0.25	
Laboratory WTT % at depth @ 60°C @ 30,000 cycles	5.3	-	-	± 7.6	
Laying temperature (°C)	-	173	177	150 - 170	Could be the cause for 'fading up' in Area 2
Temperature after compaction (°C)	-	138	133	± 140	Specification is for substantial compaction completion temperature

Table 2. Design and site mixture characteristics, Site B

Property	Design	Area 1	Results Area 2	S14 EME2 Specification	Remarks
Air voids content (%)	4.0	8.8	3.1	4.0-0	Low - could affect permanent deformation performance
ITSM stiffness (GPa)	-	5.04	5.41	± 0.5	
Deformation resistance (FNAT) (Mean %)	-	2.12	1.87	-	DMV Class N0902, Class 1 ± 1.5 & Class 2 ± 0.7
Strain rate (µm/cycle)	-	1.87	2.22	-	DMV Class N0902, Class 1 ± 1.5 & Class 2 ± 0.7
Lateral peak shear stress (MPa)	-	1.46	1.26	-	Adapted stress - peak shear stress ± 1
Bond between layers of 300mm diameter cores	-	60%	60%	good bond	Due to issues from curing equipment
Bond between layers of 150mm diameter cores	-	60%	60%	good bond	Depending on material
FWD back analysed stiffness (MPa)	-	-	satisfactory	-	-

Table 3. Design and site mixture characteristics, Site C

Property	Design	Total Results	S14 EME2 Specification	Remarks
Gradation	Generally within EME2 specification range			0.30mm sieve result was lower than that of design target
Binder content (%)	5.0	5.0	± 0.4	Satisfactory - when applying the 0.2% allowed tolerance
Water sensitivity (%) [2]	0.06	-	± 0.25	
Laboratory WTT % at depth @ 60°C @ 30,000 cycles	3.8	-	± 7.6	
Laying and compaction temperature (°C)	-	No data	-	

Table 4. Site mixture characteristics, Site C

Property	Total Results	S14 EME2 Specification	Remarks
Overall (mean) air voids content (%)	4.2	± 0.0	Variable data set
Air voids content at wheel tracks (%)	4.4	± 0.0	
Air voids content inside of wheel tracks (%)	2.2	± 0.0	Low - could affect permanent deformation performance
Air voids content near unexcavated edge (%)	7.6	± 7.0	High air voids content
Air voids content near excavated edge (%)	3.0	± 7.0	Low air voids content
Refined density (PND) (%)	90.4	-	Indicates mixture readily compacted

Table 5. Site mixture characteristics, Site C

Property	Total Results	S14 EME2 Specification	Remarks
ITSM stiffness (GPa)	7.5	± 0.5	
Deformation resistance (FNAT) (Mean %)	0.7	-	DMV Class N0902, Class 1 ± 1.5 & Class 2 ± 0.7
Deformation resistance (FNAT) (strain rate (µm/cycle))	0.3	-	DMV Class N0902, Class 1 ± 1.5 & Class 2 ± 0.7
Lateral peak shear stress (MPa)	0.46	-	Adapted (lab) peak shear stress ± 1
Bond between layers of 300mm diameter cores	62% bonded	good bond	
Bond between layers of 150mm diameter cores	96% bonded	good bond	
FWD back analysed stiffness (MPa)	satisfactory	-	-

Table 6. Design mixture characteristics, Site D

Property	Design	Results	S14 EME2 Specification
Target binder content (%)	6.7	6.3	± 0.4, ± 0.3
Richters modulus (R)	3.81	3.46	± 0.4
Air voids content (%)	4.4	3.2	± 0.2
Water sensitivity (%) [2]	0.08	0.08	± 0.25
Laboratory WTT % at depth @ 60°C @ 30,000 cycles	3.8	3.8	± 7.6
Laying temperature @ 10°C, 10m (°C)	160	157	± 130

* Discussed Richters modulus, R, is > 3.0
 * Discussed Richters modulus, R, is > 3.0

Table 7. Site mixture characteristics, Site D

Property	S14mm	Total results S14mm	S14 EME2 Specification	Remarks
Gradation	All within construction tolerance			
Binder content (%)	5.3	5.0	± 0.4, ± 0.3	Satisfactory - when applying the 0.2% allowed tolerance
Penetration @ 1mm	7	12	10 - 20	0.14 value considered very low for D14 EME2 mixture
Softening point (°C)	66.0	77.2	60 - 75 (avg ± 7)	Considered high

Table 8. Site mixture characteristics, Site D

Property	S14mm	Total results S14mm	S14 EME2 Specification	Remarks
Laying temperature (°C)	160	162	150 - 170	High temperature is for laying
Compaction temperature (°C)	165	173	± 140	Values variable
Air voids content (%)	6.2	5.3	± 0.0	High
Air voids content near joints (%)	8.9	7.6	± 7.0	
ITSM stiffness (GPa)	8.0	7.7	± 0.5	
Deformation resistance	No site information	-	-	
Bond between layers	well bonded	-	good bond	

Table 9. Design and site mixture characteristics, Site E

Property	Design	Total Results	S14 EME2 Specification	Remarks
Gradation	All within construction tolerance			
Binder content (%)	-	5.1	± 0.4	Satisfactory - when applying the 0.2% allowed tolerance
Penetration @ 1mm	12	-	10 - 20	0.14 value considered very low for D14 EME2 mixture
Softening point (°C)	67	-	60 - 75 (avg ± 7)	Considered high
Laying temperature (°C)	-	167 (avg 150)	150 - 170	Specification is for laying temperature

Table 10. Site mixture characteristics, Site E

Property	Total Results	S14 EME2 Specification	Remarks
Overall (mean) air voids content (%)	4.2	± 0.0	Variable data set
Air voids content - outside wheeltracks (%)	2.9	± 0.0	In the low end
Air voids content - wheeltracks (%)	2.1	± 0.0	
Air voids content - inside wheeltracks edge (%)	4.7	± 7.0	
Air voids content - 20 to 30mm from outside edge (SPa)	5.6	± 7.0	

Table 11. Site mixture characteristics, Site E

Property	Total Results	S14 EME2 Specification	Remarks
Overall ITSM stiffness (GPa)	avg 6.5 - 12.2	± 0.5	Variable data set
ITSM stiffness - outside wheeltracks (GPa)	7.1	± 0.5	
ITSM stiffness - inside wheeltracks (GPa)	7.6	± 0.5	
ITSM stiffness - 20 to 30mm from outside edge (SPa)	8.8	± 0.5	
ITSM stiffness - 20 to 30mm from outside edge (SPa)	7.1	± 0.5	
Bond between layers	Asphalt binder layer over aggregate	good bond	Bonding between layers could be improved by the variable

Table 12. Site mixture characteristics, Site F

Property	Total results		0.14 EMB2 specification	Remarks
	Area 1	Area 2		
Gradation	Majority within construction tolerances			Test 0.2 mm sieve and over 0.300 mm sieve results were lower than that of design target
Binder content (%)	5.37	4.47	± 0.4	Satisfactory when applying the 0.3% allowed tolerance
Richness modulus, K	3.85	3.56	± 0.4	
Penetration @ 10mm	11.5	12.1	10 - 20	Considered low
Flowing point (°C)	76.3	80.9	60 - 70 target 67.5	Considered high

Table 13. Site mixture characteristics, Site F

Property	Total results		0.14 EMB2 specification	Remarks
	Area 1	Area 2		
Laying temperature (°C)	178	176	150 - 170	Considered high
Rolling temperature (°C)	173	171	150 - 170	
Rolling completion temperature (°C)	168	166	145 - 160	
Final temperature (°C)	163	161	145 - 160	
Final surface temperature (°C)	158	156	145 - 160	
Final subgrade temperature (°C)	153	151	145 - 160	
Final core temperature (°C)	148	146	145 - 160	
Final edge temperature (°C)	143	141	145 - 160	
Final surface to 10mm depth (°C)	138	136	145 - 160	
Final surface to 20mm depth (°C)	133	131	145 - 160	
Final surface to 30mm depth (°C)	128	126	145 - 160	
Final surface to 40mm depth (°C)	123	121	145 - 160	
Final surface to 50mm depth (°C)	118	116	145 - 160	
Final surface to 60mm depth (°C)	113	111	145 - 160	
Final surface to 70mm depth (°C)	108	106	145 - 160	
Final surface to 80mm depth (°C)	103	101	145 - 160	
Final surface to 90mm depth (°C)	98	96	145 - 160	
Final surface to 100mm depth (°C)	93	91	145 - 160	
Final surface to 110mm depth (°C)	88	86	145 - 160	
Final surface to 120mm depth (°C)	83	81	145 - 160	
Final surface to 130mm depth (°C)	78	76	145 - 160	
Final surface to 140mm depth (°C)	73	71	145 - 160	
Final surface to 150mm depth (°C)	68	66	145 - 160	
Final surface to 160mm depth (°C)	63	61	145 - 160	
Final surface to 170mm depth (°C)	58	56	145 - 160	
Final surface to 180mm depth (°C)	53	51	145 - 160	
Final surface to 190mm depth (°C)	48	46	145 - 160	
Final surface to 200mm depth (°C)	43	41	145 - 160	
Final surface to 210mm depth (°C)	38	36	145 - 160	
Final surface to 220mm depth (°C)	33	31	145 - 160	
Final surface to 230mm depth (°C)	28	26	145 - 160	
Final surface to 240mm depth (°C)	23	21	145 - 160	
Final surface to 250mm depth (°C)	18	16	145 - 160	
Final surface to 260mm depth (°C)	13	11	145 - 160	
Final surface to 270mm depth (°C)	8	6	145 - 160	
Final surface to 280mm depth (°C)	3	1	145 - 160	
Final surface to 290mm depth (°C)	0	0	145 - 160	
Final surface to 300mm depth (°C)	0	0	145 - 160	
Final surface to 310mm depth (°C)	0	0	145 - 160	
Final surface to 320mm depth (°C)	0	0	145 - 160	
Final surface to 330mm depth (°C)	0	0	145 - 160	
Final surface to 340mm depth (°C)	0	0	145 - 160	
Final surface to 350mm depth (°C)	0	0	145 - 160	
Final surface to 360mm depth (°C)	0	0	145 - 160	
Final surface to 370mm depth (°C)	0	0	145 - 160	
Final surface to 380mm depth (°C)	0	0	145 - 160	
Final surface to 390mm depth (°C)	0	0	145 - 160	
Final surface to 400mm depth (°C)	0	0	145 - 160	
Final surface to 410mm depth (°C)	0	0	145 - 160	
Final surface to 420mm depth (°C)	0	0	145 - 160	
Final surface to 430mm depth (°C)	0	0	145 - 160	
Final surface to 440mm depth (°C)	0	0	145 - 160	
Final surface to 450mm depth (°C)	0	0	145 - 160	
Final surface to 460mm depth (°C)	0	0	145 - 160	
Final surface to 470mm depth (°C)	0	0	145 - 160	
Final surface to 480mm depth (°C)	0	0	145 - 160	
Final surface to 490mm depth (°C)	0	0	145 - 160	
Final surface to 500mm depth (°C)	0	0	145 - 160	
Final surface to 510mm depth (°C)	0	0	145 - 160	
Final surface to 520mm depth (°C)	0	0	145 - 160	
Final surface to 530mm depth (°C)	0	0	145 - 160	
Final surface to 540mm depth (°C)	0	0	145 - 160	
Final surface to 550mm depth (°C)	0	0	145 - 160	
Final surface to 560mm depth (°C)	0	0	145 - 160	
Final surface to 570mm depth (°C)	0	0	145 - 160	
Final surface to 580mm depth (°C)	0	0	145 - 160	
Final surface to 590mm depth (°C)	0	0	145 - 160	
Final surface to 600mm depth (°C)	0	0	145 - 160	
Final surface to 610mm depth (°C)	0	0	145 - 160	
Final surface to 620mm depth (°C)	0	0	145 - 160	
Final surface to 630mm depth (°C)	0	0	145 - 160	
Final surface to 640mm depth (°C)	0	0	145 - 160	
Final surface to 650mm depth (°C)	0	0	145 - 160	
Final surface to 660mm depth (°C)	0	0	145 - 160	
Final surface to 670mm depth (°C)	0	0	145 - 160	
Final surface to 680mm depth (°C)	0	0	145 - 160	
Final surface to 690mm depth (°C)	0	0	145 - 160	
Final surface to 700mm depth (°C)	0	0	145 - 160	
Final surface to 710mm depth (°C)	0	0	145 - 160	
Final surface to 720mm depth (°C)	0	0	145 - 160	
Final surface to 730mm depth (°C)	0	0	145 - 160	
Final surface to 740mm depth (°C)	0	0	145 - 160	
Final surface to 750mm depth (°C)	0	0	145 - 160	
Final surface to 760mm depth (°C)	0	0	145 - 160	
Final surface to 770mm depth (°C)	0	0	145 - 160	
Final surface to 780mm depth (°C)	0	0	145 - 160	
Final surface to 790mm depth (°C)	0	0	145 - 160	
Final surface to 800mm depth (°C)	0	0	145 - 160	
Final surface to 810mm depth (°C)	0	0	145 - 160	
Final surface to 820mm depth (°C)	0	0	145 - 160	
Final surface to 830mm depth (°C)	0	0	145 - 160	
Final surface to 840mm depth (°C)	0	0	145 - 160	
Final surface to 850mm depth (°C)	0	0	145 - 160	
Final surface to 860mm depth (°C)	0	0	145 - 160	
Final surface to 870mm depth (°C)	0	0	145 - 160	
Final surface to 880mm depth (°C)	0	0	145 - 160	
Final surface to 890mm depth (°C)	0	0	145 - 160	
Final surface to 900mm depth (°C)	0	0	145 - 160	
Final surface to 910mm depth (°C)	0	0	145 - 160	
Final surface to 920mm depth (°C)	0	0	145 - 160	
Final surface to 930mm depth (°C)	0	0	145 - 160	
Final surface to 940mm depth (°C)	0	0	145 - 160	
Final surface to 950mm depth (°C)	0	0	145 - 160	
Final surface to 960mm depth (°C)	0	0	145 - 160	
Final surface to 970mm depth (°C)	0	0	145 - 160	
Final surface to 980mm depth (°C)	0	0	145 - 160	
Final surface to 990mm depth (°C)	0	0	145 - 160	
Final surface to 1000mm depth (°C)	0	0	145 - 160	
Final surface to 1010mm depth (°C)	0	0	145 - 160	
Final surface to 1020mm depth (°C)	0	0	145 - 160	
Final surface to 1030mm depth (°C)	0	0	145 - 160	
Final surface to 1040mm depth (°C)	0	0	145 - 160	
Final surface to 1050mm depth (°C)	0	0	145 - 160	
Final surface to 1060mm depth (°C)	0	0	145 - 160	
Final surface to 1070mm depth (°C)	0	0	145 - 160	
Final surface to 1080mm depth (°C)	0	0	145 - 160	
Final surface to 1090mm depth (°C)	0	0	145 - 160	
Final surface to 1100mm depth (°C)	0	0	145 - 160	
Final surface to 1110mm depth (°C)	0	0	145 - 160	
Final surface to 1120mm depth (°C)	0	0	145 - 160	
Final surface to 1130mm depth (°C)	0	0	145 - 160	
Final surface to 1140mm depth (°C)	0	0	145 - 160	
Final surface to 1150mm depth (°C)	0	0	145 - 160	
Final surface to 1160mm depth (°C)	0	0	145 - 160	
Final surface to 1170mm depth (°C)	0	0	145 - 160	
Final surface to 1180mm depth (°C)	0	0	145 - 160	
Final surface to 1190mm depth (°C)	0	0	145 - 160	
Final surface to 1200mm depth (°C)	0	0	145 - 160	
Final surface to 1210mm depth (°C)	0	0	145 - 160	
Final surface to 1220mm depth (°C)	0	0	145 - 160	
Final surface to 1230mm depth (°C)	0	0	145 - 160	
Final surface to 1240mm depth (°C)	0	0	145 - 160	
Final surface to 1250mm depth (°C)	0	0	145 - 160	
Final surface to 1260mm depth (°C)	0	0	145 - 160	
Final surface to 1270mm depth (°C)	0	0	145 - 160	
Final surface to 1280mm depth (°C)	0	0	145 - 160	
Final surface to 1290mm depth (°C)	0	0	145 - 160	
Final surface to 1300mm depth (°C)	0	0	145 - 160	
Final surface to 1310mm depth (°C)	0	0	145 - 160	
Final surface to 1320mm depth (°C)	0	0	145 - 160	
Final surface to 1330mm depth (°C)	0	0	145 - 160	
Final surface to 1340mm depth (°C)	0	0	145 - 160	
Final surface to 1350mm depth (°C)	0	0	145 - 160	
Final surface to 1360mm depth (°C)	0	0	145 - 160	
Final surface to 1370mm depth (°C)	0	0	145 - 160	
Final surface to 1380mm depth (°C)	0	0	145 - 160	
Final surface to 1390mm depth (°C)	0	0	145 - 160	
Final surface to 1400mm depth (°C)	0	0	145 - 160	

Table 15. Plant and site mixture characteristics, Site G

Property	Total results		0.14 EMB2 specification	Remarks
	Plant	Total		
Gradation	All values within EMB2 specification range			
Binder content (%)	5.3	5.1	± 0.4	Satisfactory when applying the 0.3% allowed tolerance
Discharge temperature (°C)		180	160 - 170	Specification is for laying temperature
Paving temperature (°C)		174	160-170	Specification is for laying temperature
Rolling completion temperature (°C)		168	145 - 160	Generally satisfactory with low lower than a 145 - 160°C (substantial completion temperature)
Final surface temperature (°C)		163	145 - 160	
Final subgrade temperature (°C)		158	145 - 160	
Final core temperature (°C)		153	145 - 160	
Final edge temperature (°C)		148	145 - 160	
Final surface to 10mm depth (°C)		143	145 - 160	
Final surface to 20mm depth (°C)		138	145 - 160	
Final surface to 30mm depth (°C)		133	145 - 160	
Final surface to 40mm depth (°C)		128	145 - 160	
Final surface to 50mm depth (°C)		123	145 - 160	
Final surface to 60mm depth (°C)		118	145 - 160	
Final surface to 70mm depth (°C)		113	145 - 160	
Final surface to 80mm depth (°C)		108	145 - 160	
Final surface to 90mm depth (°C)		103	145 - 160	
Final surface to 100mm depth (°C)		98	145 - 160	
Final surface to 110mm depth (°C)		93	145 - 160	
Final surface to 120mm depth (°C)		88	145 - 160	
Final surface to 130mm depth (°C)		83	145 - 160	
Final surface to 140mm depth (°C)		78	145 - 160	
Final surface to 150mm depth (°C)		73	145 - 160	
Final surface to 160mm depth (°C)		68	145 - 160	
Final surface to 170mm depth (°C)		63	145 - 160	
Final surface to 180mm depth (°C)		58	145 - 160	
Final surface to 190mm depth (°C)		53	145 - 160	
Final surface to 200mm depth (°C)		48	145 - 160	
Final surface to 210mm depth (°C)		43	145 - 160	
Final surface to 220mm depth (°C)		38	145 - 160	
Final surface to 230mm depth (°C)		33	145 - 160	
Final surface to 240mm depth (°C)		28	145 - 160	
Final surface to 250mm depth (°C)		23	145 - 160	
Final surface to 260mm depth (°C)		18	145 - 160	
Final surface to 270mm depth (°C)		13	145 - 160	
Final surface to 280mm depth (°C)		8	145 - 160	
Final surface to 290mm depth (°C)		3	145 - 160	
Final surface to 300mm depth (°C)		0	145 - 160	

Table 16. Site mixture characteristics, Site G

Property	Total results		0.14 EMB2 specification	Remarks
	Plant	Total		
Densities at voids content (%)		2.0	2.0	
Air voids content - nearside wheel-track (%)		range 1.2 - 3.2	4.0	Generally low - could affect permanent deformation performance
Air voids content - offside wheel-track (%)		1.7	4.0	
Air voids content - overall wheel-track (%)		3.3	4.0	
Overall ITSM stiffness (MPa)		7.7	3.5	
ITSM stiffness - nearside wheel-track (MPa)		range 6.35 - 9.22	4.5	
ITSM stiffness - offside wheel-track (MPa)		7.5	3.5	
ITSM stiffness - overall wheel-track (MPa)		7.8	3.5	

Property	Test	Method	Performance requirements				
			HIMA base course		HIMA binder course		
			Class 1	Class 2	Class 1	Class 2	Class 3
Workability	Gyratory compactor, air voids after 100 gyrations	ASTM D6926	≤ 6.3%	≤ 3.8 %	3.2 to 6.3 % for D = 10, 2.5 to 5.7 % for D = 14		
Moisture sensitivity	Modified Lottman	ASTM D4867	Refer Table 10	Refer Table 10	Refer Table 10	Refer Table 10	Refer Table 10
Permanent deformation	RSST-CH, 55°C, 30 000 reps	AASHTO 320	≤ 1.7% strain	≤ 1.7% strain	≤ 2.3% strain	≤ 1.7% strain	≤ 1.1% strain
Dynamic modulus	Dynamic modulus test at 10 Hz, 15°C	AASHTO TP 62	≥ 14 GPa	≥ 14 GPa	≥ 9 GPa	≥ 14 GPa	≥ 14 GPa
Fatigue	Beam fatigue test at 10 Hz, 10°C, to 70% stiffness reduction	AASHTO T 321	≥ 330 με for 10 E ⁵ reps	≥ 430 με for 10 E ⁵ reps	≥ 360 με for 10 E ⁵ reps	≥ 330 με for 10 E ⁵ reps	≥ 330 με for 10 E ⁵ reps

Conclusions

- HiMA is recognised as having potential for application in SA
- EU tests adapted for SA
- Special grade of binder needed
- Mix design procedure & guide in place
- APT and LTPP still required
- Field adaptations in SA still needed

Way forward in SA

- Validate improved mix design,
- Perform APT and LTPP,
- Finalize mix design and structural design guidelines



Get it right!!!!....or
You'll have to dig deep to
escape your potholes

Thank you!

