- OVERALL PERFORMANCE OF STEELSLAG ASPHALT ON THE N3 2003 - 2012

- PERFORMANCE OF STEELSLAG ASPHALT: TEST SECTION BETWEEN HOWICK IC AND NOTTINGHAM ROAD IC

N3 Toll Concession (Pty) Ltd
SAFETY. CONVENIENCE. MOBILITY.

THE SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LTD
Reg. No.1998/009584/06

UNITED BY OUR DIFFERENCE
WSP

Background

- History of Steelslag in South Africa
  - 1960: Newcastle (ISCOR) Plant
  - 1999: Ilanga Steelphalt (Shislanga)
  - Used in 2003 – Emergency Repairs N3
  - September 2004 – Van Reenen's Pass
  - Over 280 000t Steelslag Asphalt used on N3 to date

Challenges

- Challenges Facing Concessionaire in 2002

Shoving

Disintegration

Rutting

Heavy Truck Traffic

2-3 million E80s per annum (33% of AADT)

New Approach

- Steelslag Aggregate

- SBS Binder (2002)

Steelslag Aggregate

- Steelslag comprises silicates and oxides
- Further processing requires de-metalising, weathering, crushing and screening
- Weathering process enables the hydration of any uncombined free lime (CaO) present in the material

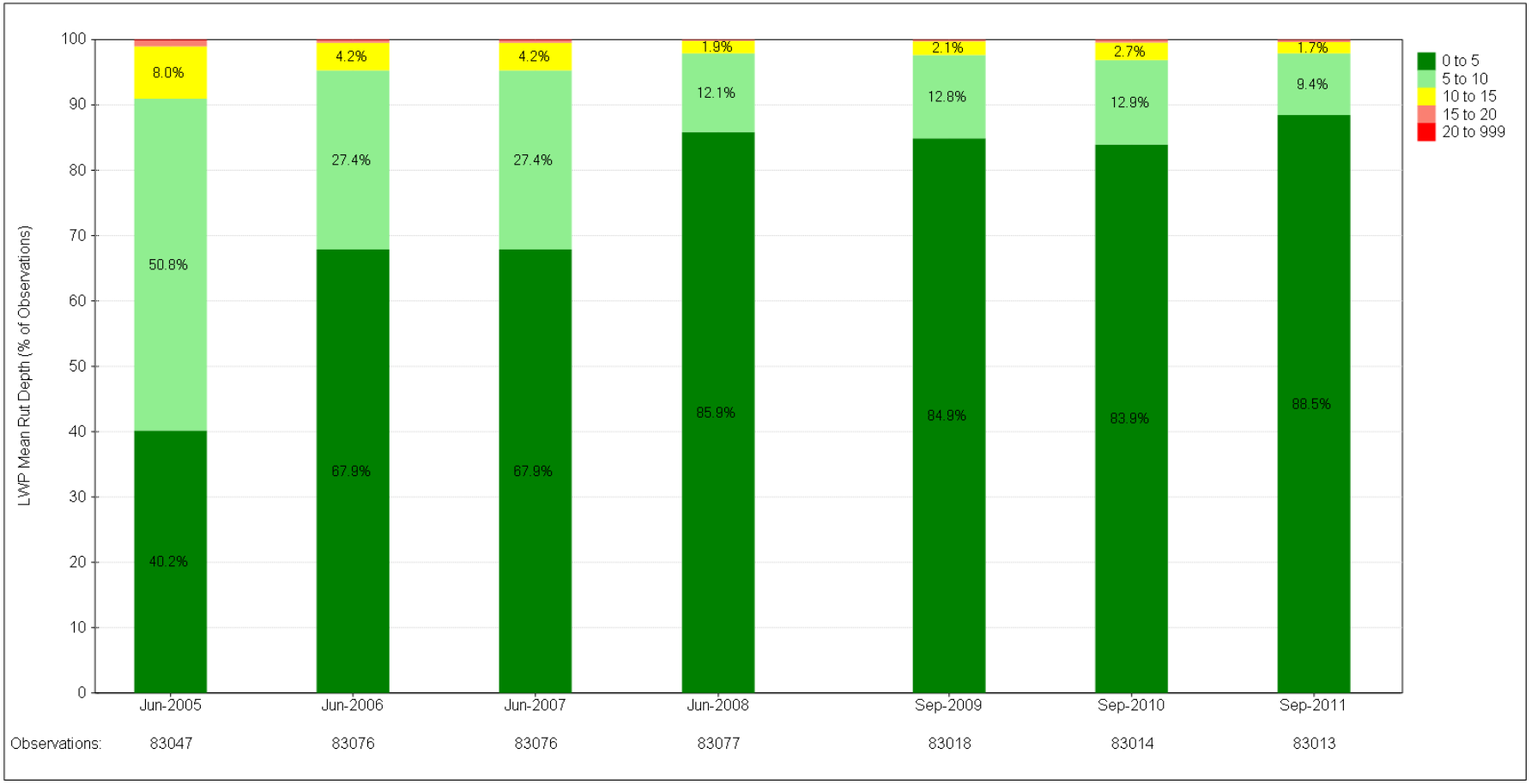
Steelslag Aggregate

- Cubical shape – low FI
- Rough surface texture – Improves stripping resistance
- Particle density of the steelslag aggregate compared to natural aggregates is heavier material by approximately 10%
- Has a higher water absorption than dolerite and quartzite
- Steelslag, with a pH of greater than 10, has a strong affinity to bitumen and therefore displays a greater degree of binder retention

QUALITY CONTROL - 2003

Overall Performance after 8 years

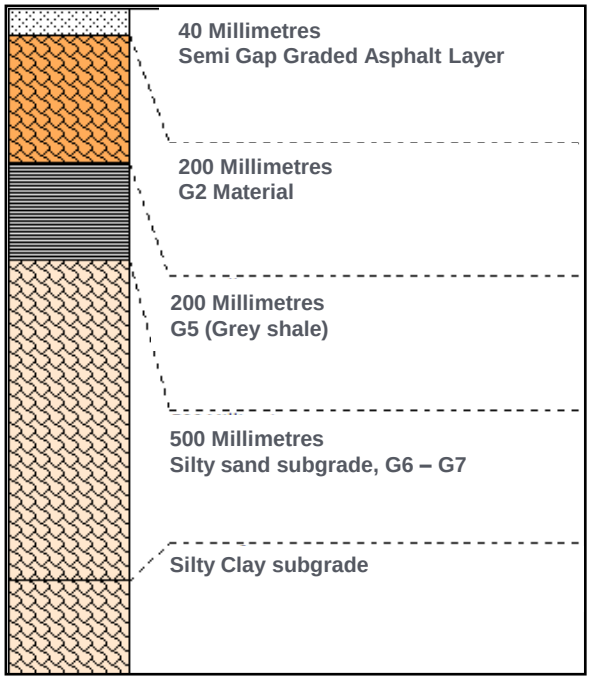
- Change in the severity of rut depth on the N3 toll road



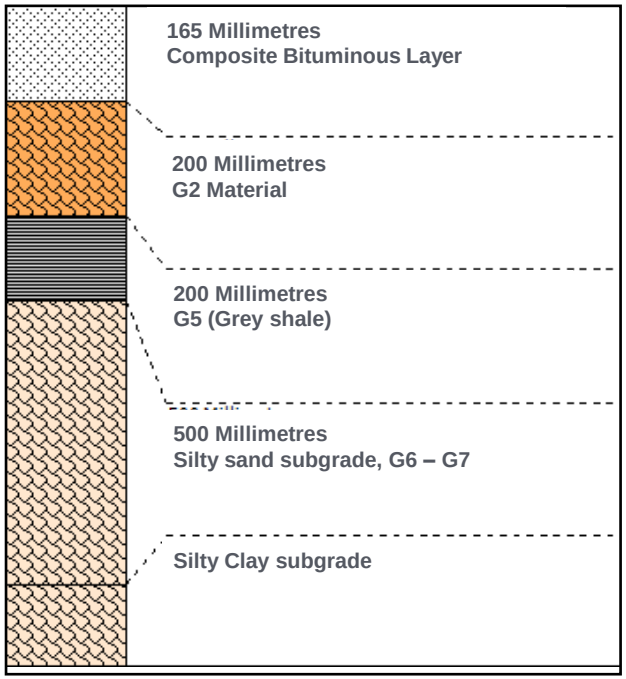
TEST SECTION

- Howick IC – Nottingham Road IC

Original Pavement Structure (1972)

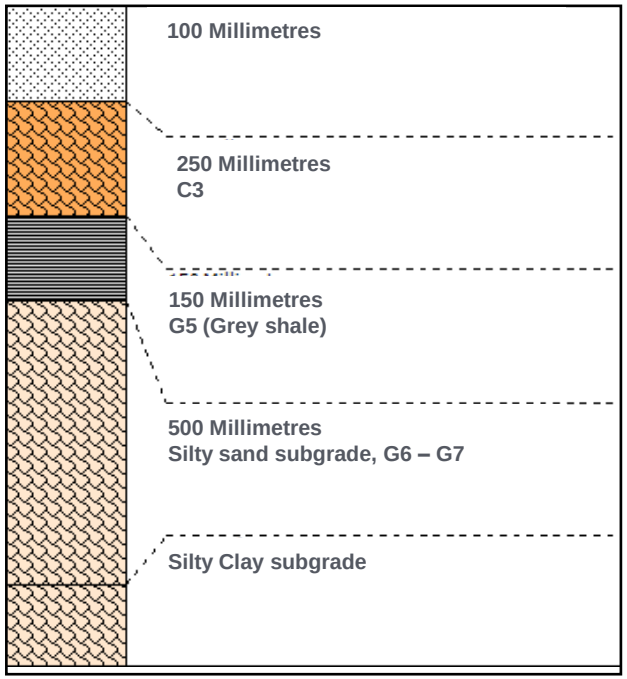


Pavement Structure (2005)



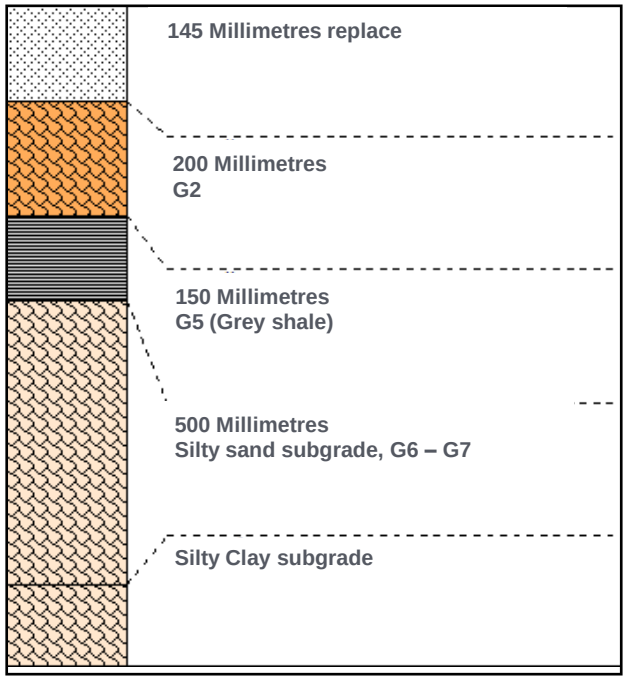
Composite Asphalt Layer (1972 – 2004)

Alternative No. 1 Deflection > 450 µm



(20km)

Alternative No. 2 Deflection < 450 µm

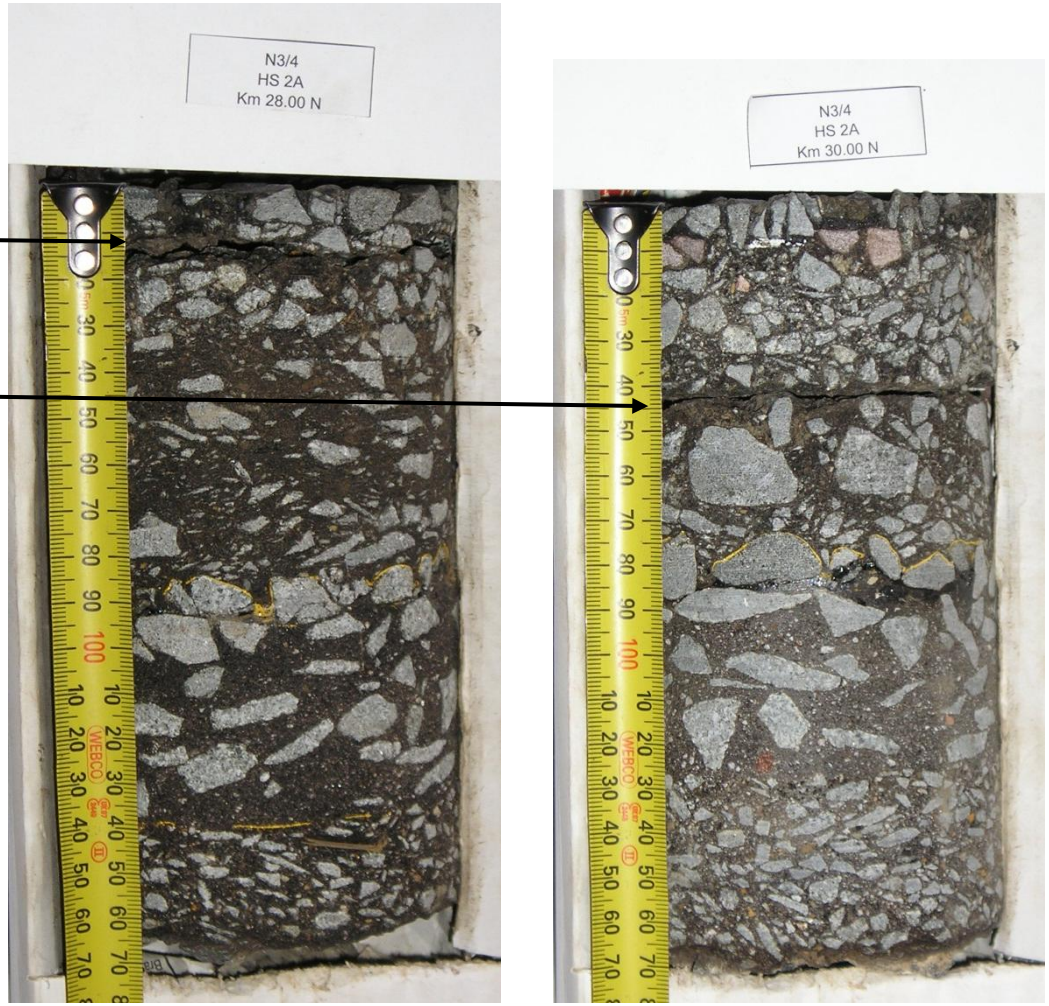


(36km)

Identified Problems: Delamination

Delamination between single seal and upper asphalt layer

Delamination between upper and middle asphalt layers



Identified Problems: Shoving and Disintegration

Asphalt Design

Aggregate / Aggregaat

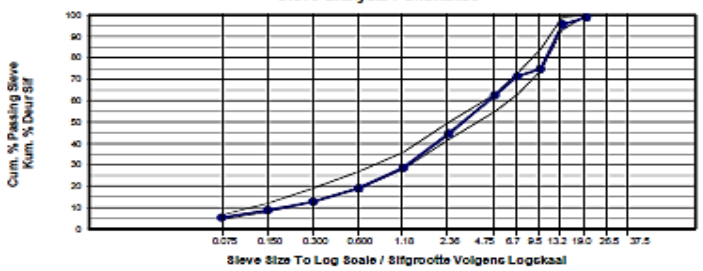
Sample No. / Monster Nr.	Nom. Size / Grootte	Type & Source / Soort & Bron
1	13.2mm	Steel Slag ex Iscor (Newcastle)
2	9.5mm	Steel Slag ex Iscor (Newcastle)
3	-3.00mm	Steel Slag ex Iscor (Newcastle)
4	AG LIME	Dolomite dust
5		
6		
7		

NOTE / NOTA: Test Methods Refer To TMH 1 [ ], SABS { } / Toets Metodes Verwys Na TMH 1 [ ], SABS { }

Sieve Analysis [B4] - % Passing Sieves / Sifanalise [B4] - % Deur Siwwe

	Sample No. / Monster Nr.	1	2	3	4	5			Design Mix / Ontwerp Mengs.	Working Min.	Working Max.
	% In Mix / Mengsel	28.0%	15.0%	55.0%	1.0%						
Sifgrootte (mm) / Sieve Size (mm)	37.5										
	26.5							AV TESTS			
	19.0	100						100	99	100	100
	13.2	88						98	96	93	99
	9.5	14	100					82	75	74	84
	6.7	3.5	96		100			67	71	63	73
	4.75	1.9	40	100	99			61	63	55	63
	2.36	1.5	10.1	76	96			45	45	42	50
	1.18	1.1	3.6	49	90			29	29	28	36
	0.600	1	3.2	32	74			19	19	19	27
	0.300	0.9	2.6	21	65			13	13	13	19
	0.150	0.8	2.4	14	53			8.4	9	8	12
	0.075	0.4	1.4	8.4	51			5.2	5	4.6	6.6
BRD	[B14÷15]	3.483	3.430	3.530	2.869				3.460		
Sand Eqv. / Ekw.	[B19]			60.8					50 min		
Water Absorp.	[B14÷15]	1.700	1.800	1.500					1.0/1.5 max	N/A STEEL SLAG	
ACV / AVW	[B1]	15.2							21 max		
10% FACT	[B1]	270.0							210 min		
Flak. Index	[B3]	6.1	11.9						30 max		
PSV / KPW	{848}			63.0					50 min		
AIV / AIW	[ ]										

Sieve analysis / Sifanalise

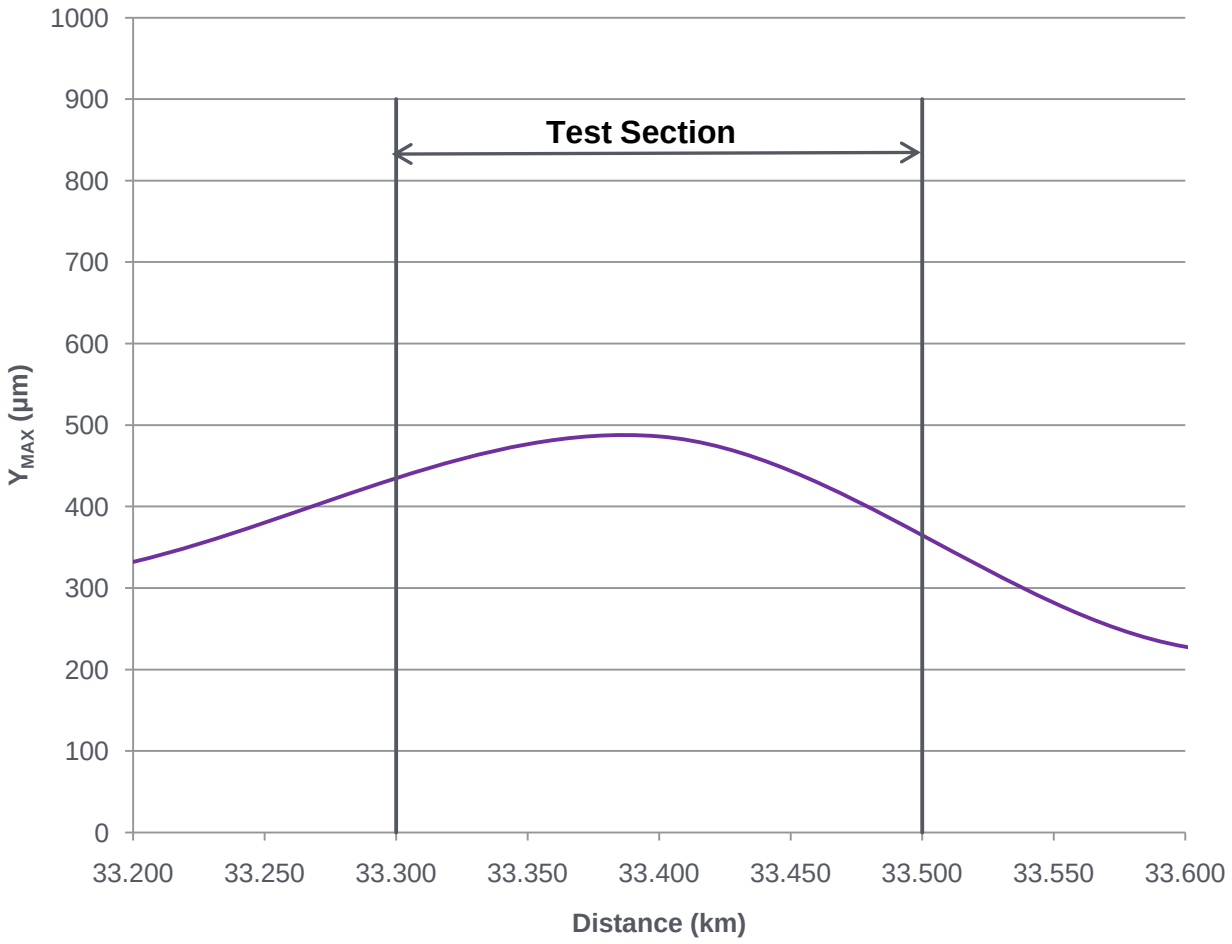


Filler / Vulstof	Type / Soort	% in Mix / Mengsel
1	-	-
2	-	-
3	-	-

Notes / Notas :

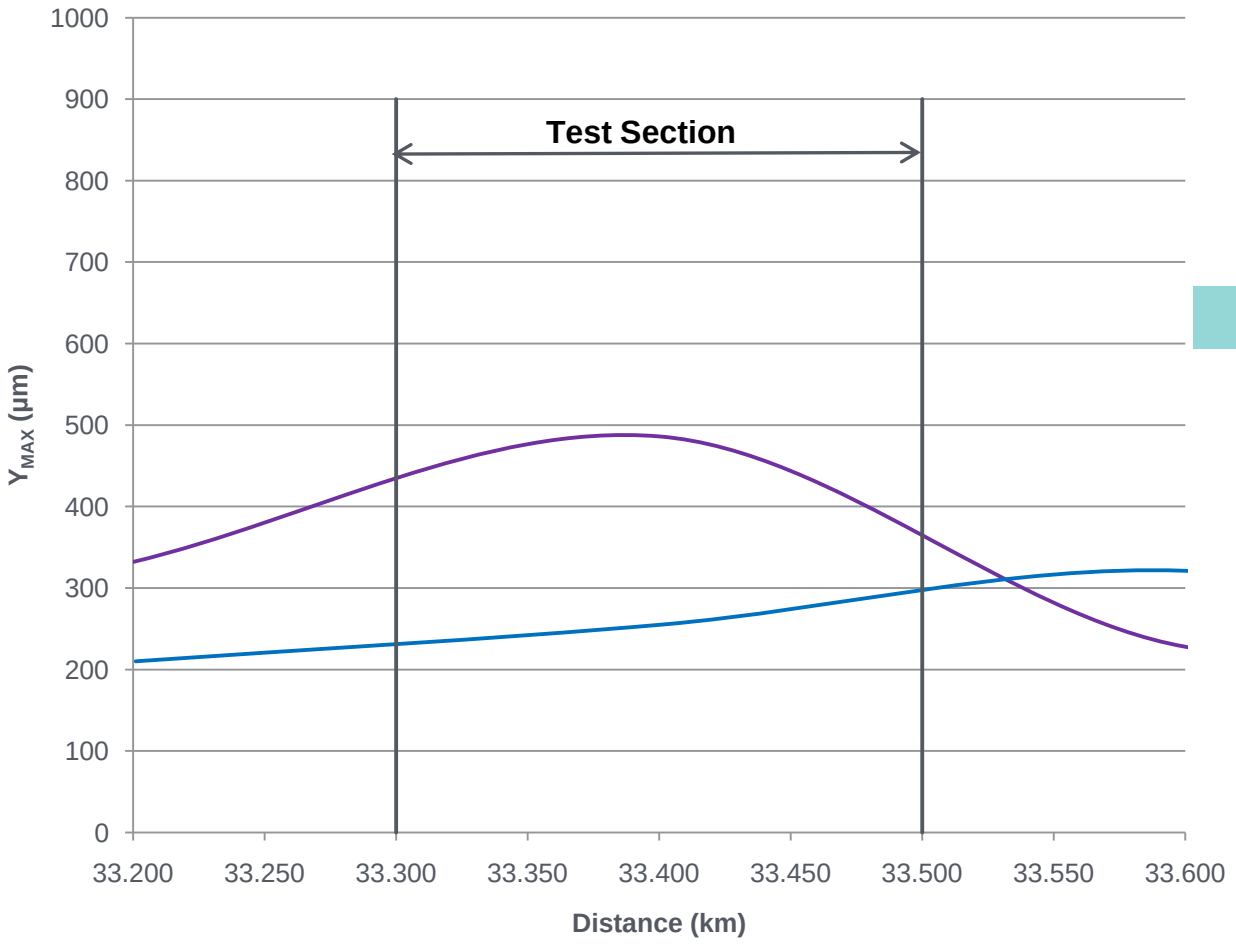
Design / Ontwerp							Spec. / Spes.	Proposal / Voorstel
Binder / Bindmiddel	(%)	4.8%	5.1%	5.4%	5.7%	-	4.9% - 5.5%	5.2%
Max. / Maks. TRD (Rice's)		3.095	3.108	3.072	3.051	-	-	
BRD (Marshall)	(kg/m^3)	2.986	2.969	2.995	2.931	-	-	
Voids in Mix / Ruimtes in Mengsel	(%)	5.8%	5.1%	4.3%	3.1%	-	3.5 - 5.5	4.7%
Stability / Stabiliteit (Marshall)	(kN)	12.1	13.8	14.5	15.8	-	10.0 - 18.0	17.0
Flow / Vloei (Marshall)	(mm)	4.4	4.3	4.8	4.4	-	2.0 - 6.0	3.7
Stab./Flow Ratio / Stab./Vloei Verhouding		2.8	3.2	3	3.6	-	2.5 - 5.0	4.1
ITS	(kPa)	1233	1103	1122	1069	-	Min 1000	1200.0
Creep / Kruip : Dynamic / Static	(MPa)	- -	- -	- -	- -	- -	20 0	
Air Permeability / Lugdeurlaatbaarheid	($x\ 10^{-8}\ cm^2$)	-	-	-	-	-	Max 1.0	
VMA / RMA	(%)	13.3	14	13.6	15.6	-	Min 14.0	17.5
VFB / RGB	(%)	73.2	76.9	81.6	85	-	65.0 - 75.0	75.0
Immersion Index / Dompelindeks	(%)	84	89	96	91	-	Min 75	82.0
Absorp. (Binder / Bindmiddel)	(%)	-	-	-	-	-	-	0.700
Film Thickness / Filmdikte	(µm)	-	-	-	-	-	Min 7.0	7.000

Pavement Strategy for 30 Years



Deflection at km 33.4 (µm)	
2004	486

Pavement Strategy for 30 Years



Deflection at km 33.4 (µm)

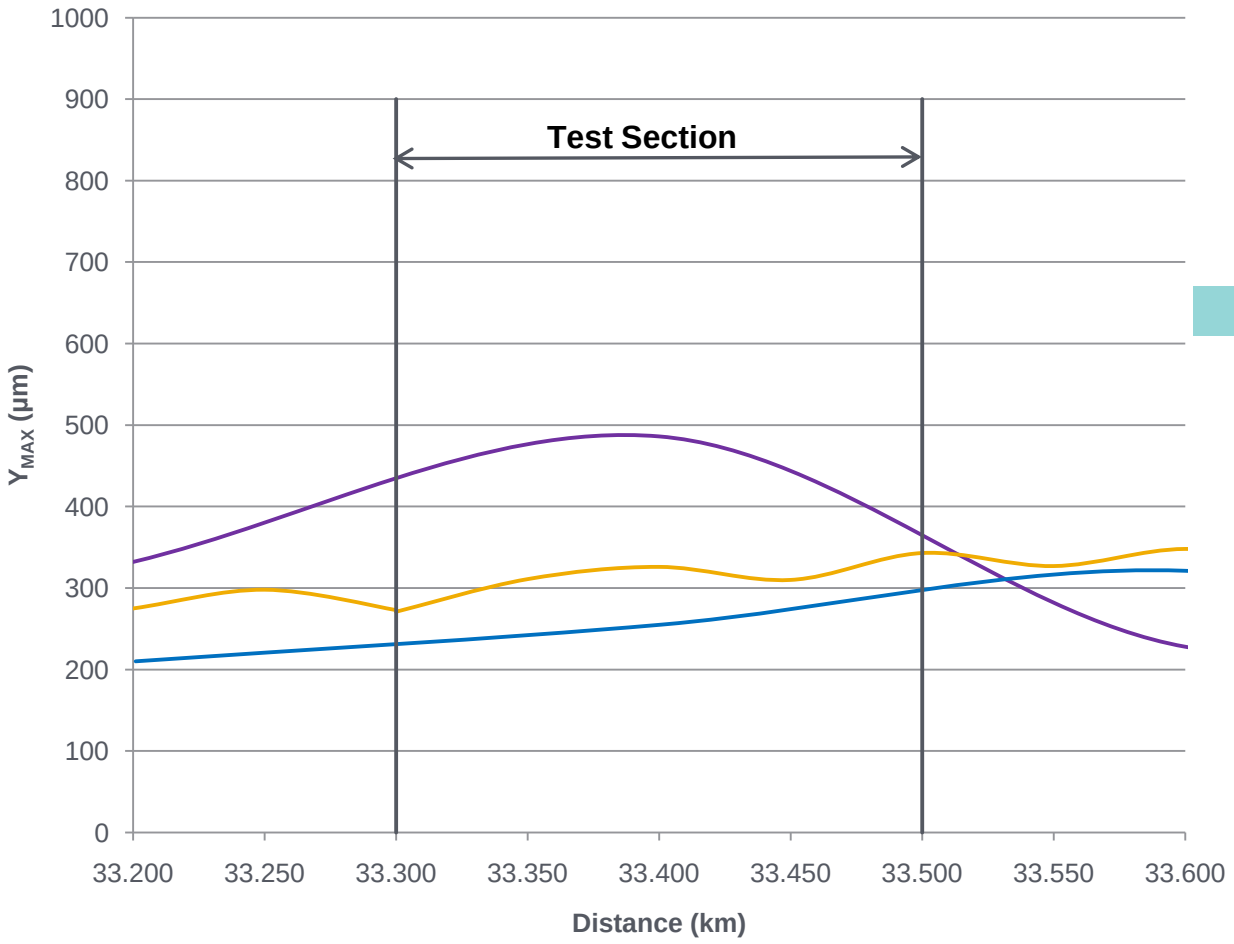
2004 **486**

2005: SUBOIL DRAIN INSTALLED

2007 **255**

230

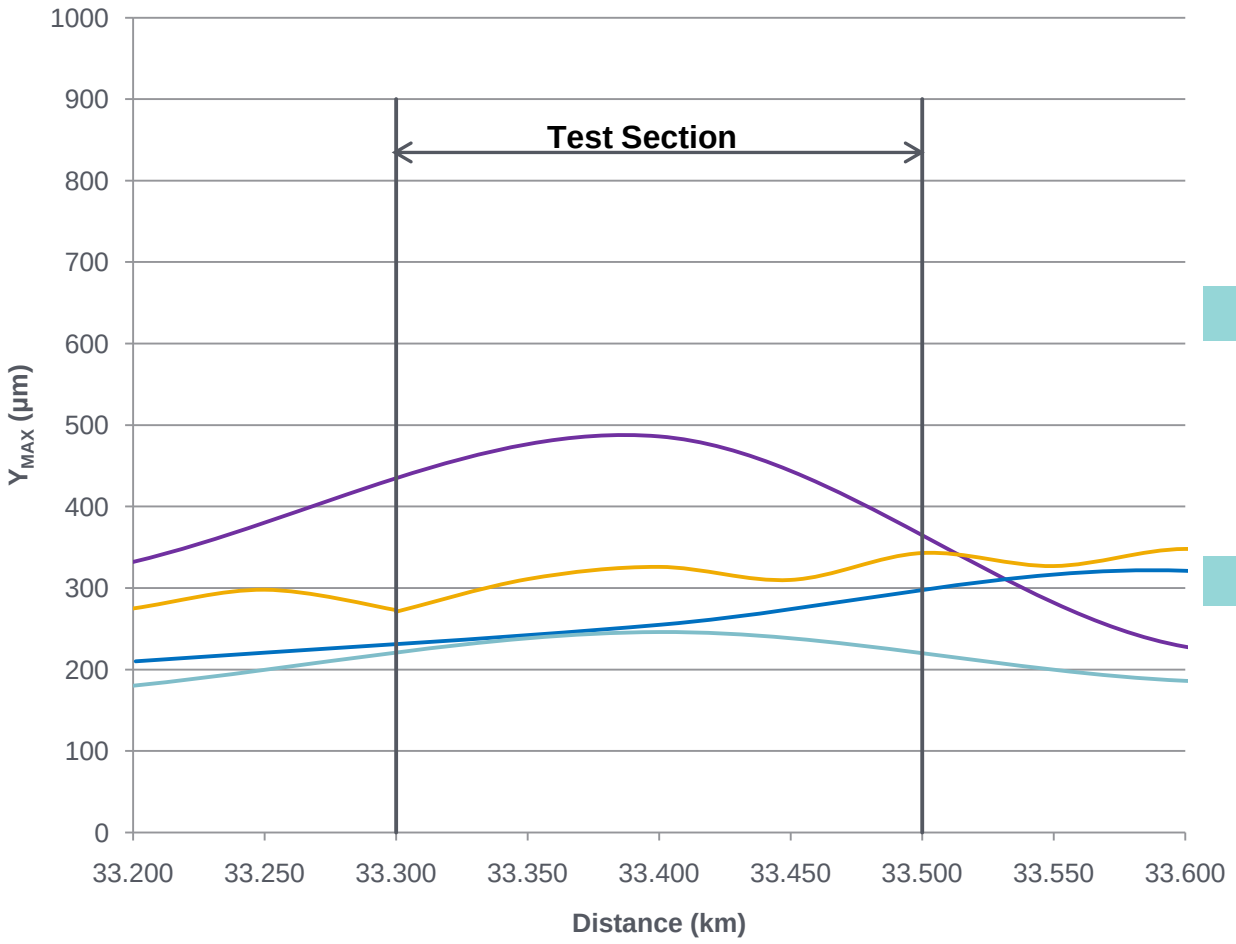
Pavement Strategy for 30 Years



Deflection at km 33.4 (µm)	
2004	486
2005: SUBOIL DRAIN INSTALLED	
2007	255
2008	326

230

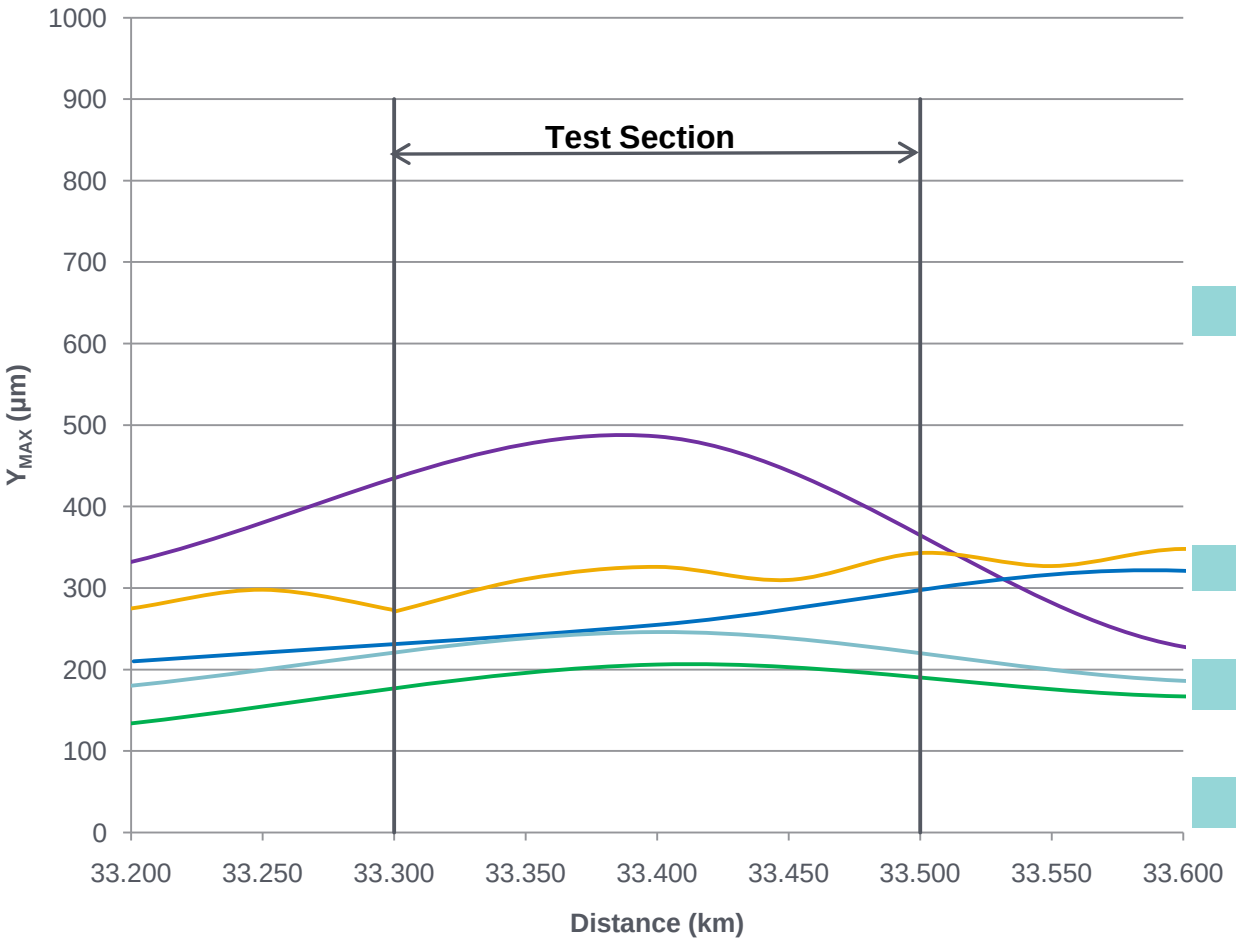
Pavement Strategy for 30 Years



Deflection at km 33.4 (µm)

2004	486
2005: SUBOIL DRAIN INSTALLED	
2007	255
	230
2008	326
2009: 140 STEELSLAG AC INLAY	
2010	246
	80

Pavement Strategy for 30 Years



Deflection at km 33.4 (µm)

2004	486
2005: SUBOIL DRAIN INSTALLED	
2007	255
	230
2008	326
2009: 140 AC INLAY	
2010	246
	80
40 AC TEST SECTION	
2012	206
	40
40 AC FUTURE OVERLAY ±2026	

End Spec Required: 220 µm

THANK YOU!!