

2012 Study Tour Key Topics

1. Long life pavements
 - o Experience, design systems, use, durability & performance
2. High performance asphalt & binders
 - o High modulus asphalt (EME, HiMA), modifiers
3. Sustainability
 - o RAP/WMA, bitumen substitutes, carbon calculators & energy analysis
climate change impacts, societal concerns
4. Health & Safety
 - o Construction of road works, health considerations for bitumen and asphalt products
5. Procurement Systems
 - o Proprietary products (Avis Technique, HAPAS, etc.), "green" procurement, REACH, responsible sourcing, PPP and contract models

Topic 2: High performance asphalt & binders

Overview of reasons

- Bituminous binders – key component in the performance and service life of bituminous surfacings & asphalt pavements
- About 90% of the Australian all weather road network length is surfaced with sprayed seals – about 50% of binder usage
- Need to ensure optimum asphalt and seals performance in the field, and to promote best practices suitable to be adapted and adopted in Australia. Seeking details on:
 - o new developments and test methods in high performance asphalt and bituminous materials (e.g. HiMA /EME, PMB, Emulsion)
 - o actions taken by European and others (e.g. binder manufacturers, asphalt producers and researchers) to overcome field problems (e.g. climate change)
 - o correlation between laboratory test results and field trials

Topic 2: High performance asphalt & binders

What is High Performance Asphalt?

- What does it look like?
- How is this different to what we currently do?
- Isn't what we do good enough?
- For Heavy Duty roads – what's your pavement configuration?

Decreasing airvoids ↓	New Construction	Rehabilitation
	SMA 10	AC 10
	AC 14	AC 14
	AC 14	AC 20
	AC 14 HB	AC 20

Topic 2: High performance asphalt & binders

High Performance Asphalt is essentially High Modulus Asphalt

French Catalogue:

Topic 2: High performance asphalt & binders

High Performance Asphalt is essentially High Modulus Asphalt

French Catalogue:

	50 MPa PF 2	120 MPa PF 3	200 MPa PF 4
54 millions PL (25 millions HD)	CS 10 13 cm 13 cm	CS 12 12 cm 12 cm	
38 millions PL (26 millions HD)	CS 11 11 cm 12 cm	CS 10 10 cm 11 cm	
14 millions PL (21.5 millions HD)	CS 9 9 cm 10 cm	CS 8 8 cm 9 cm	



Topic 2: High performance asphalt & binders

Three French Methods of achieving High Modulus Asphalt:


- EME (Enrobés Module Elevé)
- GB5
- GAB II

All methods move asphalt bases to **Higher Modulus** resulting in increase in load spreading and hence increased capacity.

Topic 2: High performance asphalt & binders

EME: High Modulus Asphalt:

- Standard Dense mix gradings
- 10/14/20 mix sizes
- Special **Hard Binder**: ↑ Stiffness
↑ Rut Resistance
- Increased binder content:
↑ Fatigue Resistance
↑ Density:
↑ Stiffness
↑ Moisture Resistance



Topic 2: High performance asphalt & binders

GB5: High Modulus Asphalt:

- Double Gap graded gradings (using packing theory):
↑ Density:
↑ Stiffness
↑ Moisture Resistance
- Standard binder content (4.0%):
↑ Stiffness
↑ Rut Resistance
- Modified Binder:
↑ Fatigue Resistance

Topic 2: High performance asphalt & binders

GAB II: High Modulus Asphalt:

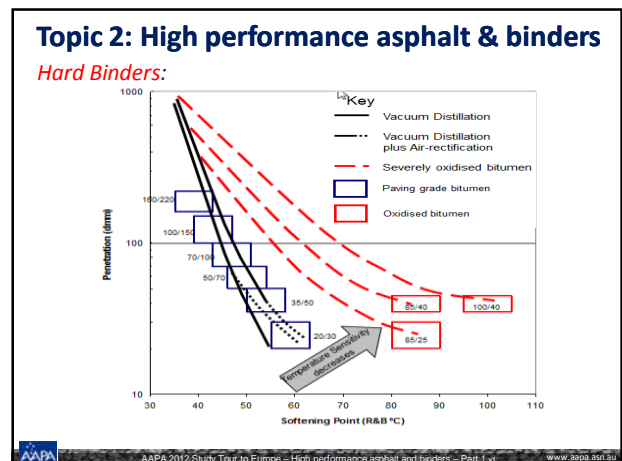
- 65% Sand (16/32 Aggregate acts as a filler):
↑ Density:
↑ Stiffness
↑ Moisture Resistance
↑ Fatigue Resistance
- Special **Hard Binder**: ↑ Stiffness
↑ Rut Resistance

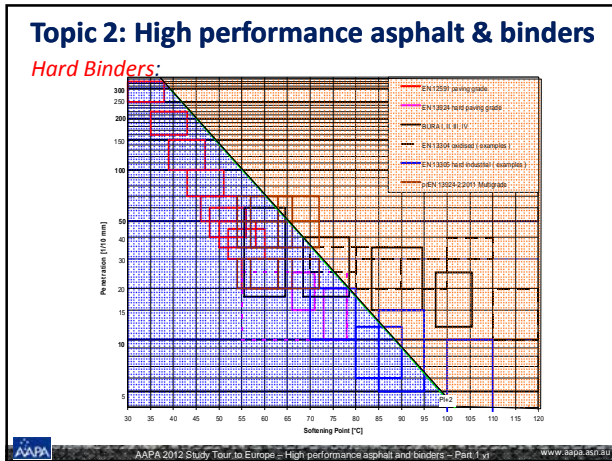


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Hard Binders:

Property	Test method	Unit	Penetration grade		
			10/20	15/25	20/30
Before RTFOT					
Penetration at 25 °C	EN 1426	0.1 mm	10-20	15-25	20-30
Softening point	EN 1427	°C	58-78	55-71	55-63
Viscosity at 60°C	EN12596	Pa.s	>700	>550	>440
After RTFOT					
Increase in softening point	EN 1427	°C	< 10	< 8	< 8
Retained penetration	EN 1426	%	-	> 55	> 55
Mass change		%		< 0.5	< 0.5





Topic 2: High performance asphalt & binders

EME Binder Content:

	HiMA base course	
	Class 1	Class 2
D (mm)	10,14,20	10,14, 20
P _{b min} ρ= 2.65 g/cm ³	3.8	5.1 5.0
P _{b min} ρ= 2.75 g/cm ³	3.8	4.9 4.9
Richness modulus K	2.5	3.4 3.4

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Topic 2: High performance asphalt & binders

Main specifications of HMA (fundamental method, only one)

Designation	Description	Norme NF EN	Masse volumique de référence	D (mm) ou épaisseur (mm) ou épaisseur de couche (mm) ou épaisseur de couche (mm)	Caractéristique granulométrique		Caractéristique mécanique		
					Classe	Classe	Essai de résistance à 40°C	Essai de module à 15°C	Essai de fatigue à 15°C
ES10-EME Class 2	Asiote	NF EN 12105-1	*	10	ITSR ₁₀₀	V _{max} 80	30 000 cycles (V=3% V ₀ =8%) P _{0.2}	(V=3% V ₀ =8%) P _{max}	(V=3% V ₀ =8%) S _{0.2}
ES14-EME Class 2	Asiote	NF EN 12105-1	*	14	ITSR ₁₀₀	V _{max} 100	30 000 cycles (V=3% V ₀ =8%) P _{0.2}	(V=3% V ₀ =8%) P _{max}	(V=3% V ₀ =8%) S _{0.2}
ES20-EME Class 2	Asiote	NF EN 12105-1	*	20	ITSR ₁₀₀	V _{max} 120	30 000 cycles (V=3% V ₀ =8%) P _{0.2}	(V=3% V ₀ =8%) P _{max}	(V=3% V ₀ =8%) S _{0.2}
				70			7.5 %	14 000 MPa	130 µdef

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Topic 2: High performance asphalt & binders

EME : main performances

Type of mix	empirical		fundamental	
	Granulometry (Voids % C100 (0.14 mm) C120 (0.20 mm))	Water sensitivity IFR ratio	Rut depth (60°C-100 mm) ** 30,000 cycles (%)	Stiffness modulus (15°C-10Hz) in MPa
GB Class 2	≤ 11	≥ 0.65	≤ 10*	≥ 9,000
GB Class 3	≤ 10	≥ 0.7	≤ 10*	≥ 9,000
GB Class 4	≤ 9	≥ 0.7	≤ 10**	≥ 11,000
EME Class 1	≤ 10	≥ 0.7	≤ 7.5**	≥ 14,000
EME class 2	≤ 6	≥ 0.75	≤ 7.5**	≥ 14,000

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Topic 2: High performance asphalt & binders

New structure : national road (catalogue 1998)

Guide des structures types de chaussées neuves (SETRA/LCPC)

RRN structurant TC6* / PF 3** - duration 30 years

Fiche	N° 1 GB 2	- Fiche	N° 3 EME 2
VTAC:	2,5 cm		2,5 cm
BBSG binder course:	6,0 cm		6,0 cm
Base :	14,0 cm		9,0 cm EME 2
Fondation:	14,0 cm		10,0 cm EME 2
Total thickness :	36,5 cm		27,5 cm 25%

*Traffic 20 millions equivalent axle 130 kN, **capping layer PF 3 or E=120 MPa

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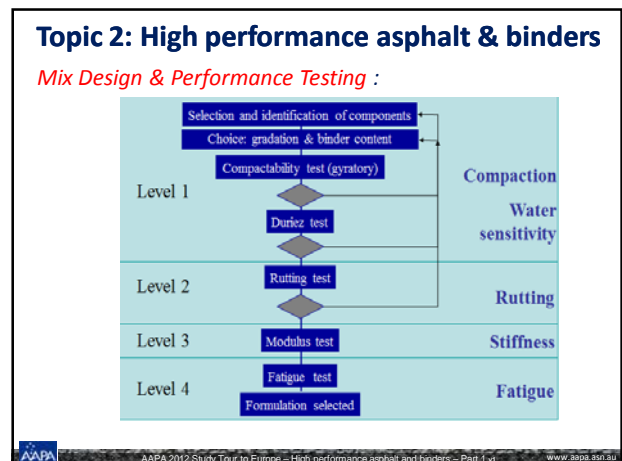
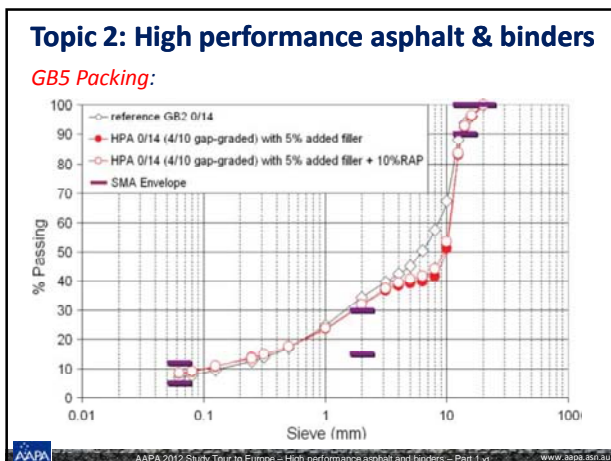
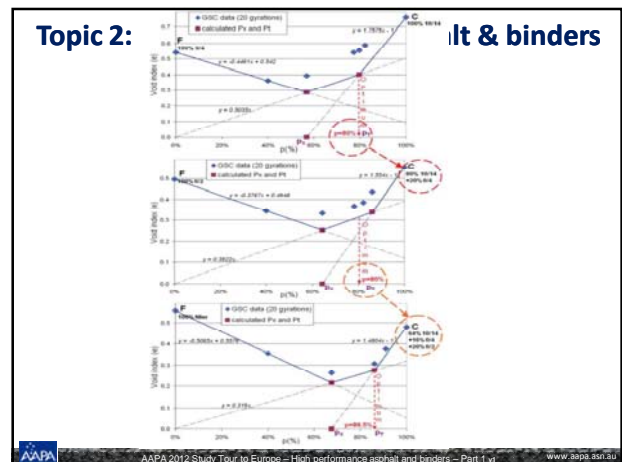
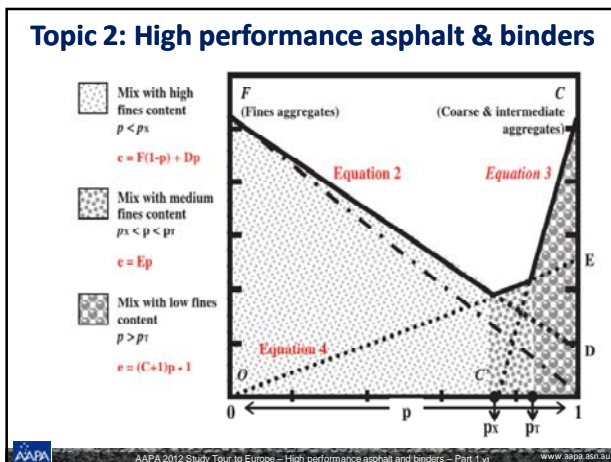
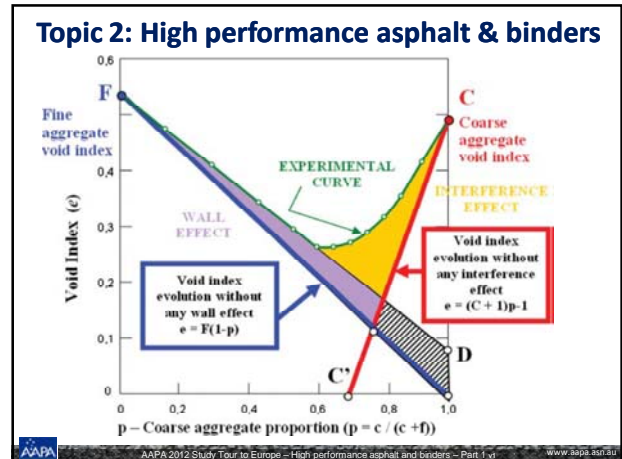
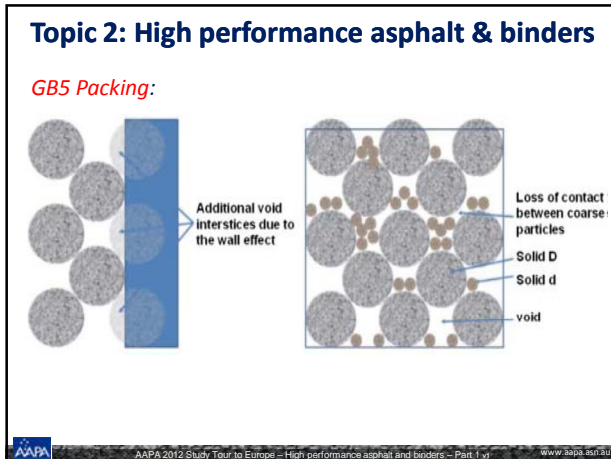
Performances ranking of Asphalt mixes for base course

materials	Modulus at 15°C 10 Hz	Epsi 6 µdef 10°C, 25 Hz
GB2	9000	80
GB3	11000	90
GB4	11000	100
GB4	12500	110
EME2	14000	130
	17000	140

Limits of performances determined in laboratory, used in pavement design

If modulus of bitumen too high, the rigidity of bituminous mixes increase so much, and the risk of thermal cracking increase too.

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Topic 2: High performance asphalt & binders
Mix Design & Performance Testing:

Workability
Water resistance
Rutting resistance
Modulus
Fatigue resistance

Level 1
Level 2
Level 3
Level 4

Level 1 + Level 2
General requirement

Fundamental Approach
In EN 13108-1

>14000 MPa
15° C -10Hz
>130 µdefs (10° C 25Hz)

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Mix Design & Performance Testing:

EME2 specimen

50 100 (mm) 150 200 250

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High Modulus Asphalt

Fatigue
Stiffness
Rut

Topic 2: High performance asphalt & binders
High Modulus Asphalt Production:

Country	HiMA production (million tonnes)	RAP in HiMA (%)
Spain	39	3
France	39	7
Austria	8	5
USA	327	17
Germany	45	26
The Netherlands	10	32

Topic 2: High performance asphalt & binders
Questions

- Asphalt
 - o EME/ HiMA - specification, testing, field links, pavement & subgrade requirement, binder selection & processing
 - o Performance & Construction
 - o Reinforced, Modified Binders & SMA – design & composition, service life, pros & cons
 - o Moisture Susceptibility: measures, tests & approaches
 - o PGA/PA: maintenance & performance
- Specifications and Test Methods
 - o Approaches to proprietary mix design, types of modifiers used, low temperature test methods, control of segregation & degradation, etc

Topic 2: High performance asphalt & binders
Questions

- Binders
 - o concerns: climate change, quality & characteristic of imported material
 - o testing level, lab-field correlation, stabilisation of unbound material
- Emulsions
 - o test methods
 - o types used in sprayed chip sealing
 - o performance based specifications
- Surfacings
 - o cost benefit of thin surfacings, reasons of application & modelling