



## **IRF WORLD ROAD MEETING 2017**

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### **High Performances Asphalt Materials for Sustainable Pavement**

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- High Modulus Asphalt for Base Course
- Polymer Modified Binder Asphalt for Wearing Course
- Conclusion

# Introduction

## Asia Continent

- Inhabitants : 4,436 billion  
60 % world population
- GDP (2016) : 25 trillion USD  
33 % world GDP
- GDP Growth (2015) : 5 to 8 %  
3.8 % world



	Country	Road length (km)
1	United States	6,586,610
2	India	4,699,024
3	China	4,106,387
4	Brazil	1,580,964
5	Russia	1,283,387
6	Japan	1,218,772
7	Canada	1,042,300
8	France	1,028,446
9	Australia	823,217
10	South Africa	747,014
14	Indonesia	496,607
28	Vietnam	195,468
30	Thailand	180,053
35	Malaysia	144,403

# Introduction

Roads represent a predominant asset that needs to be developed and maintained

Roads contribute to the development of the economy

Roads must be effectively and efficiently

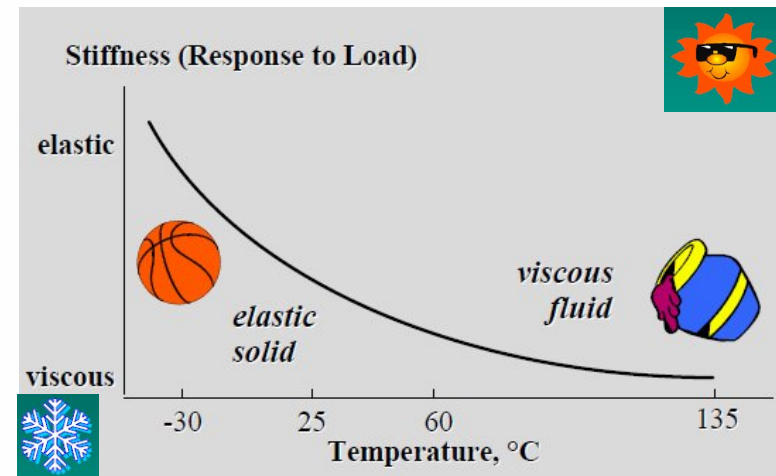
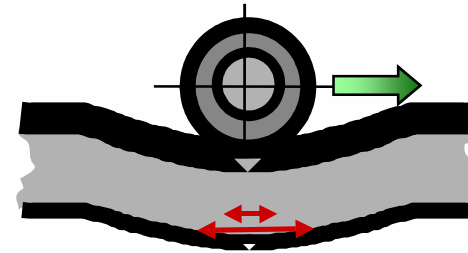
- **Designed**
- **Built**
- **Upgraded**
- **Preserved**



# Key Parameters for Sustainable Pavement

Use appropriate Structural Design Method which take into consideration

- The Real Axle Load
- The cumulated Traffic (ESAL)
- The climatic conditions
- The performance characteristics of asphalt materials



# Key Parameters for Sustainable Pavement

## Dissociation of Functions of layers in the structure

- Wearing Course
- Tack Coat
- Binder and Base Courses

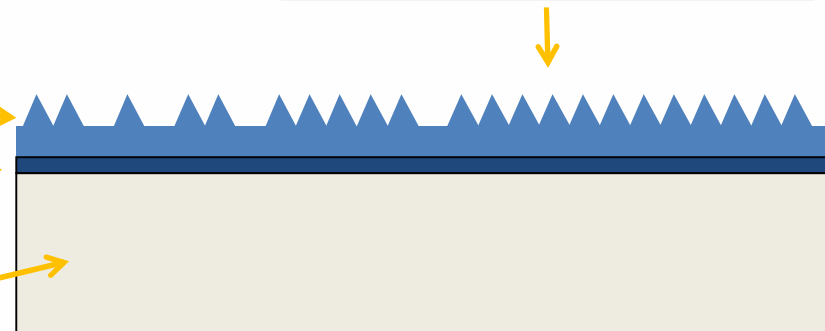
Skid resistance

Evenness - Drainage

Waterproofing - Bonding

Structure

High quality aggregates  
Modified Binder



Other aggregates  
Hard Grade Binder

# Key Parameters for Sustainable Pavement

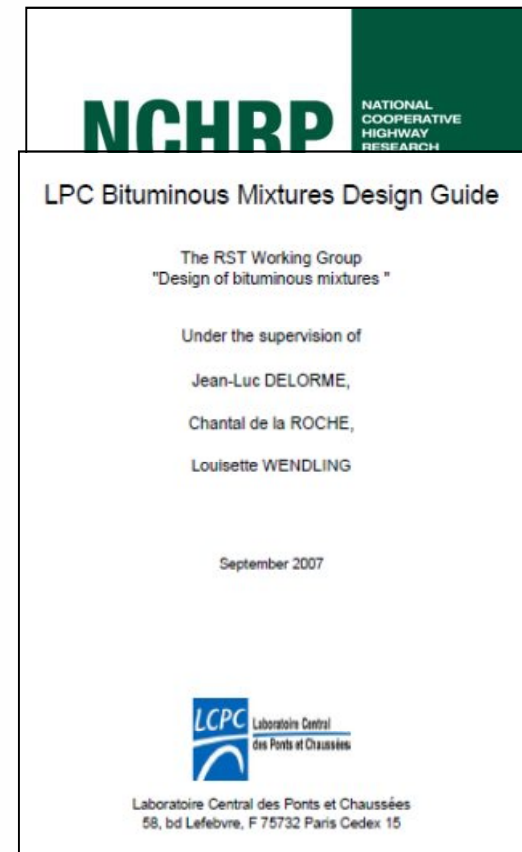
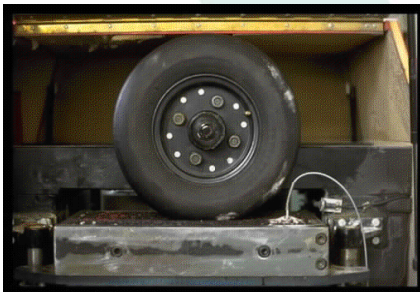
Assess the real performances of Asphalt Materials

Marshall based -> Obsolete Specifications

SUPERPAVE Mix Design Methodology

European Mix Design Methodology

- Rutting Resistance
- Stiffness Modulus
- Fatigue resistance



# High Modulus Asphalt for Base Course

## Improve characteristics of “Basic” Base Asphalt Concrete

- Optimizing thickness according to pavement design
- Saving cost and delay



## First introduction in France : mid 80's

- Reinforcement, Construction works, Heavy Structures

Development in Europe and Africa  
South Africa, Australia



# High Modulus Asphalt for Base Course

Standard specifications for « Enrobe à Module Elevé »

EN 13108-1 – SABITA - AAPA



An appropriate combination of

Aggregates -> Low void content

Bitumen

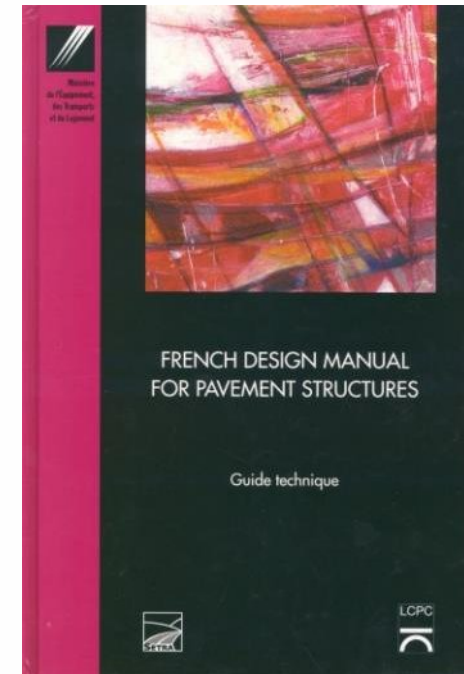
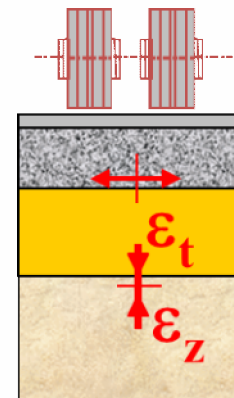
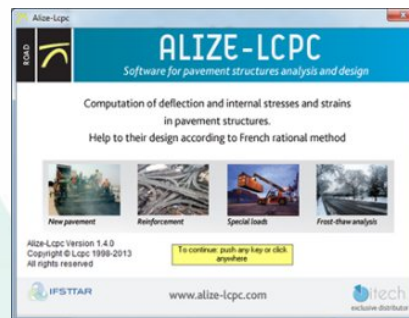
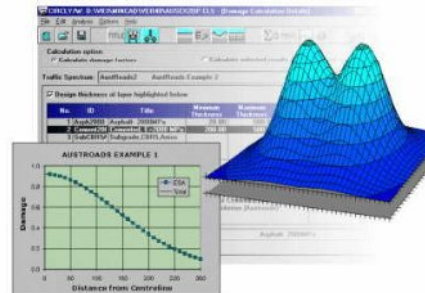
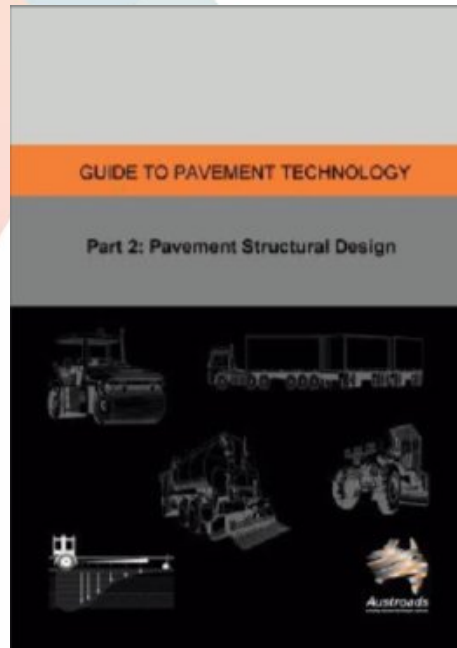
- A « hard » pen grade bitumen
- A high bitumen content

Table 3-1: EME2 laboratory performance criteria

Property	Test method	Unit	Limit	Value	
Air voids in specimens compacted by gyratory compactor at 100 cycles	AS/NZS 2891.2.2 <sup>(1)</sup>	%	Maximum (mensuration)	6.0 <sup>(2)</sup>	
Water sensitivity	AGPT/T232 <sup>(3)</sup>	%	Minimum	80	
Wheel tracking	At 60 °C and 30 000 cycles (60 000 passes)	AGPT/T231 <sup>(4,5)</sup>	mm	Maximum	4.0
	At 60 °C and 5 000 cycles (10 000 passes)	AGPT/T231 <sup>(4,5)</sup>	mm	Maximum	2.0
Minimum stiffness modulus at 50 ± 3 µε at 15 °C and 10Hz	AGPT/T274 <sup>(4)</sup>	MPa	Minimum	14 000	
Fatigue resistance at 20 °C, 10Hz and 10 <sup>6</sup> cycles	AGPT/T274 <sup>(4)</sup>	µε	Minimum	150	
Resilient modulus at 25°C, 0.04s rise time	AS 2891.13.1	MPa	N/A	report	

# High Modulus Asphalt for Base Course

Pavement design Rational method for roads  
French Design Manual for Pavement Structures / Alize LCPC  
Austroads Pavement Structural Design / CIRCLY

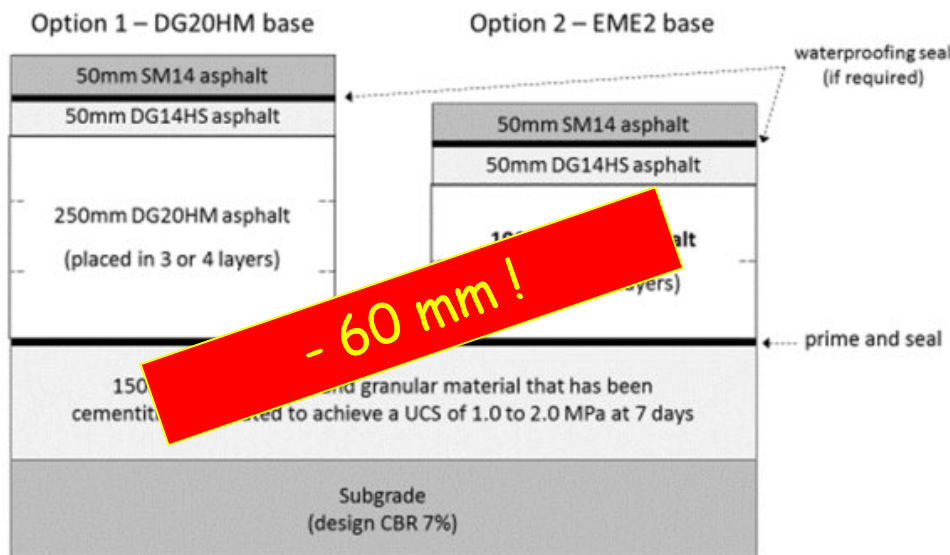


# High Modulus Asphalt for Base Course

Pavement design Rational method for roads

French Design Manual for Pavement Structures / Alize LCPC

Austrroads Pavement Structural Design / CIRCLY



Layers	Thickness (mm)	Modulus (MPa)
RUFLEX M ® 0/10	40	50
EME 2 0/14	150	8500
Crusher 0/10	150	360
Crusher 0/1.5	150	150
Soil or platform	...	50

**- 90 mm !**

# High Modulus Asphalt for Base Course

Compared to conventional asphalt mixes

- Higher Manufacturing temperature
- Precautions regarding compaction
- Same Quality control procedure



Field of use:

- Special lane for very heavy traffic
- Wharf, Industrial and multimodal platform
- Urban and peri-urban roads, highways
- Re-enforcement with height limitation
- Re-enforcement on expressway

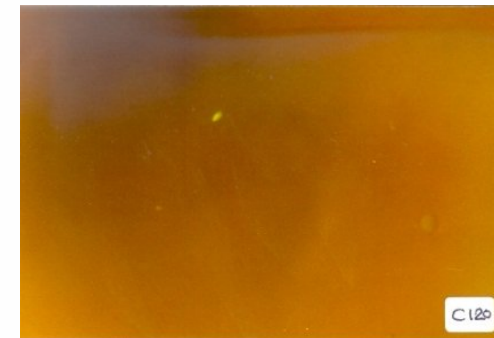
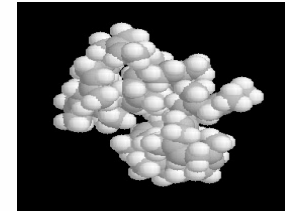




# Polymer Modified Binder for Wearing Course

## SBS Polymer Modified Bitumen

- Best effective polymer
- Homogeneous and stable blend
- (Almost) Worldwide available



PARAMETERS	INDICATOR	PURE BITUMEN	SBS-MODIFIED BINDER 1.5 %	SBS-MODIFIED BINDER 4%
Adhesion	% of covered surface	50%	90%	90%
Complex modulus	T(°C) for $G^*/\sin\delta = 1\text{kPa}$ (DSR SHRP)	71.5°C	72.1°C	76.5°C
Flexibility - Cracking at low temperature	T(°C) for breaking elongation 1 % direct tension (SHRP)	-16.1°C	-19.5°C	-26.4°C
Fatigue Resistance Auto recovery	Elastic recovery at 10°C	Fragile	59.8%	89.0%
Resistance to Ageing	Residual penetration at 25°C after RTFOT + PAV	38%	43%	57%

# Polymer Modified Binder for Wearing Course

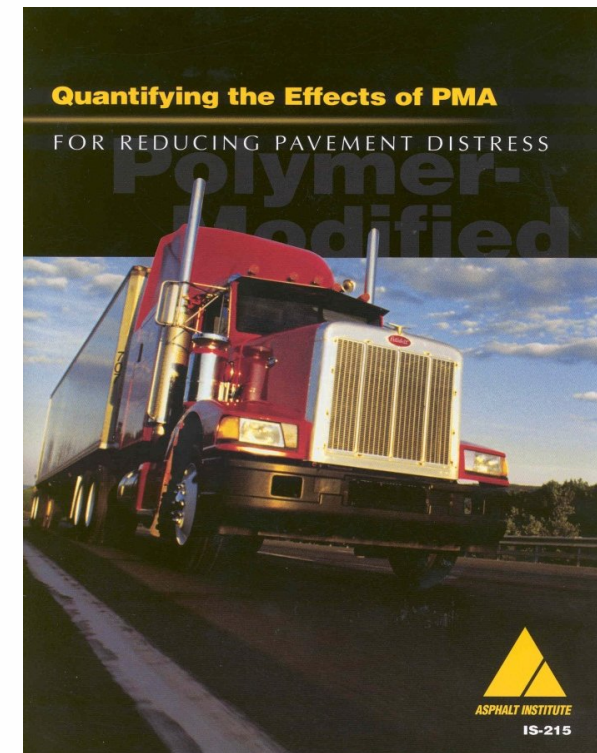
## SBS Polymer Modified Bitumen Properties

- Able to resist to (very) cold and (very) hot climatic conditions
- Improve rutting resistance
- Improve cohesion
- Improve cracking resistance

Expanded life span / less maintenance

Field of use :

- High rutting resistance Asphalt
- Thin and Ultra Thin wearing course



# Polymer Modified Binder for Wearing Course

## High Skid Resistance and Noise Reduction

- UTFC – Porous Asphalt
- Gap graded mix – Thickness below 40 mm
- Need Cohesive bonding -> PMB emulsion



# Polymer Modified Binder for Wearing Course

## High Rutting Resistance & Reinforcement

- Dense Graded & Premium quality Aggregate
- Thickness above 40 mm

## Suitable also for specific areas

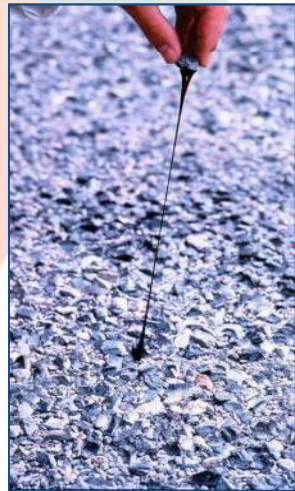
- Turnpad and Taxiway for Airport
- Industrial Platform
- Steel Bridge Deck



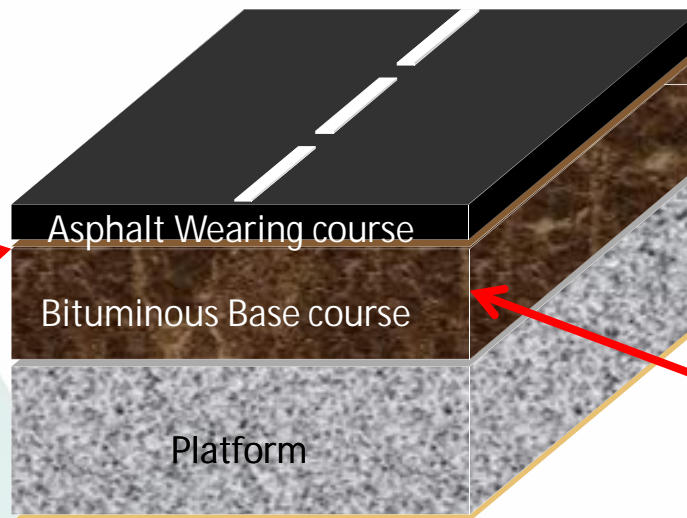
# Conclusion

## Technical recommendation for durable pavement

AC Wearing Course  
Using High Performance SBS PMB



Tack coat using  
Polymer Modified  
Emulsion



High Modulus Base Course  
Using Hard Grade Binder