

NRA Pavement Standards Training

NRA Pavement Standards Training

Development of Pavement Specifications and
Standards: Reforms, Challenges and Safety

Introduction

- Welcome to Delegates
- Event Programme
 - Schedule in handouts
 - Workshop-type style presentation focussed on:
 - New Series 900 Specification
 - New Pavement standards
 - Two-way communication is crucial (and expected!)
 - Feedback and comment expected **from you** to help discussion
 - Panel to ask audience questions

Development of NRA MCDRW Series 900: Reforms, Challenges and Safety

- **New Pavement Specifications and Standards**

Why did we make the changes?

1. **Higher quality** materials to **improve durability** - traditional recipe mixes now performance mixes
2. **Consistency** at all stages – manufacturing through to inclusion in the works, testing ‘as laid’
3. **Improve safety** – higher PSV
4. Address **performance issues** – DWL for Surface Treatments
5. It is **Part 1 of a 2 stage process**

Introduction

- Two-way communication between panel and audience
- Ask questions
- Provide feedback and comment
- Panel members

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End of Part 1

Current Knowledge of Pavement Specifications and Standards

Audience Interaction, Group Discussion and Feedback

Current Knowledge

Pavement Specifications and Standards

Audience knowledge of new standards and specifications

Audience discussion

- The main changes to NRA Series 900 and NG 900
- The main changes to NRA Series NG 700
- The main changes to NRA Series 000 and NG 000
- The main changes to NRA DMRB Volume 7

Appoint spokesperson to report back with summary of discussion

Current Knowledge

Pavement Specifications and Standards

Main Changes to Series 900 and NG 900:

1. New layout / Easier navigation through the Series
2. Bituminous Mixes: No recipe mixes / Performance based specification
3. Clear distinction between materials/products and the Works
4. CE marking, DoP and Type Testing now a clear requirement
5. Increased Binder Contents
6. Introduces 'as laid' performance testing
7. Now have surface treatments and misc. processes
8. New look-up tables
9. Additional background information in NG 900 Annex A (GN 900)

Current Knowledge

Pavement Specifications and Standards

Main Changes to Series NG 700:

1. Appendix 7/1 updated to reflect
2. New Spec Appendices for Micro, SD, HFS, LEBM

Main Changes to Series 000 and NG 000:

1. Requirements for Construction Products to reflect CPR
2. Sample DoP and CE Mark in Series NG 000

Main Changes to NRA DMRB Volume 7:

1. New Standards HD 23, HD 300, etc.
2. Existing IANs now part of DMRB e.g., IAN 05/13 → NRA HD 36

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End of Part 2

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Bituminous Mixtures – Requirements for Constituent
Materials and Product Composition

Introduction

Design Issues - Empirical Mixes

In 1939 Road Research Laboratory in UK carried out a trial of 700 mixes with differing compositions

This led to BS 1241 for tar macadams in 1945 and BS 1621 for bitumen macadams in 1950

The specifications evolved into BS 4987 and BS 594 upon which old NRA Series 900 (2011) was based

Introduction

Design Issues - Empirical .v. Design Mixes

Based on experience accumulated in practice vs engineering principles of performance

Limited in scope to the circumstances included in the trial vs theoretical analysis of mechanical properties capable of dealing with any design situation

For instance:

Specifying recipe mixtures with requirements for grading and binder content does not give an indication whether rutting will occur or not

Bituminous Mixtures

Key Changes

Identification of the mechanical properties required for each of the mixtures is one of the key changes in NRA Series 900

Series 900 clearly shows:

- What are the required mechanical properties associated with each bituminous mixture
- What tests methods are required
- What are the limits on the results required

Bituminous Mixtures

Key Changes

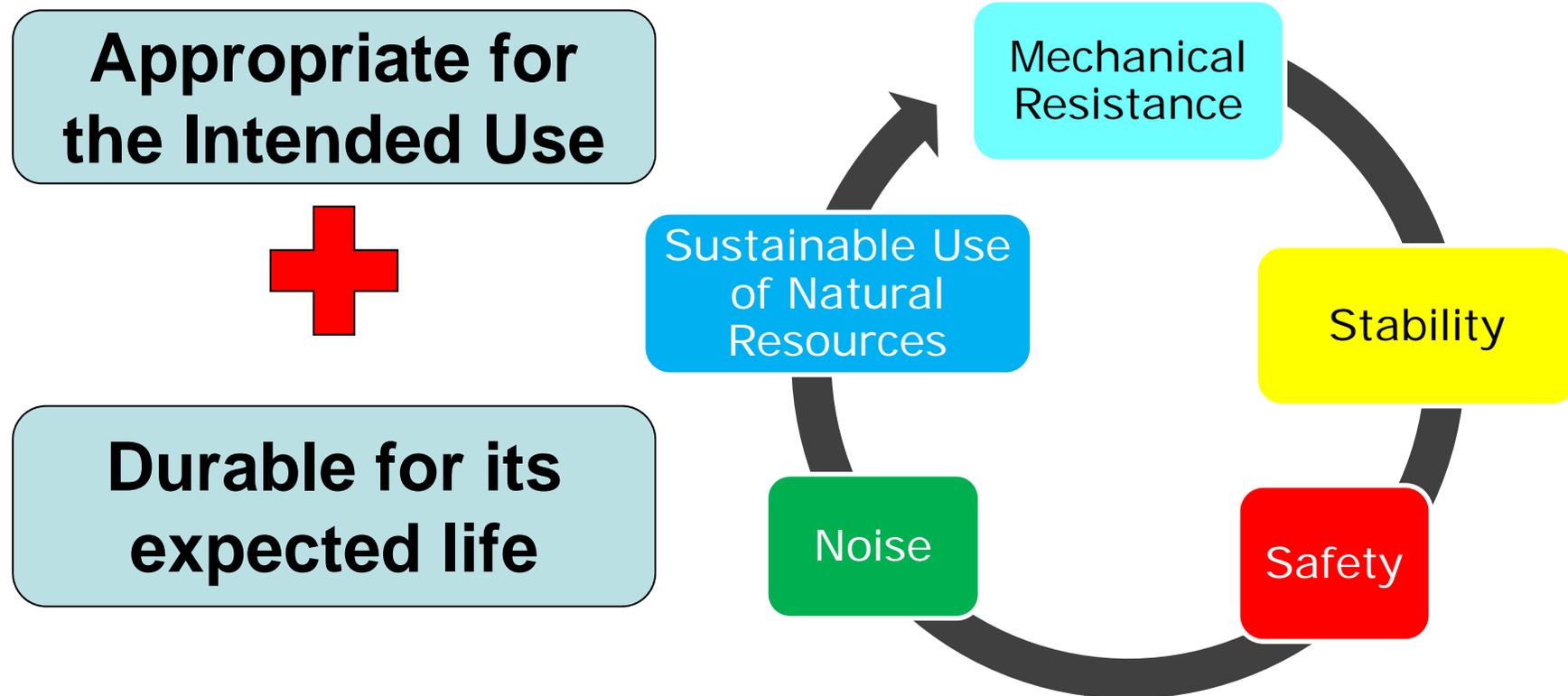
Updating to reflect move from CPD to CPR

- CE Marking
- DoP
- Making a declaration and compliance sits with the manufacturer
- CE Marking introduced to regulate mixtures (but not the Works)
- Role of RE in approving materials now reduced
- Legal requirement with penalties for non compliance
- Retrofitting Spec to new hEN's
- Families of Products

Bituminous Mixtures

Basic Requirements for Construction Works

Bituminous Mixtures should be...



Bituminous Mixtures

Key Changes

Contract Perspective

- Lack of transparency in test results → CE marking and Type Test Reports required
- Lack of understanding between “asphalt as a product” and “finished works incorporating an asphalt product” → Now a split between Clauses 3-6 ‘Products’ and Clause 10 ‘Works’
- Discontinuity between production and site → Testing of the Works ... ‘to be recorded’ items in Works tables

Bituminous Mixtures

Key Changes

Design Perspective

- Move from empirical design basis to analytical basis
 - Develop Site Specific Design
 - Develop suite of materials with common approach – the ‘family of products’
- Use of Design mixtures, no more recipe mixtures
- General requirements of Clauses 3-6 similar

Bituminous Mixtures Product Requirements

NRA Series 900 Clauses 3 - 6

Bituminous Mixtures → AC, HRA, SMA, and PA

Surface Treatments → Microsurfacing, Surface Dressing, and HFS

Miscellaneous Products → Geotextiles, Retexturing, LEBM, PRMS, LSRS & ERMS

NRA Series 900 Clause 9

Reclaimed Asphalt

Works

Bituminous Mixtures

Constituent Requirements - Asphalt Concrete

Clause 3.2.1 Binder

The binder shall be petroleum bitumen

Clause 3.2.2 Aggregates

General: Comply with the requirements of Table 1

Coarse Aggregate in Surface Course: PSV and AAV requirements

Clause 3.2.3 Filler

Comply with the requirements of Table 1

Clause 3.2.4 Reclaimed Asphalt

Additional requirements of Clause 9 and Table 13a

Maximum 30% RA permitted in AC base & binder mixtures

Clause 3.2.5 Additives

Additives may include: fibres, pigments and adhesion agents

Suitability shall be demonstrated (IS EN 13108-1)

Bituminous Mixtures

Product Requirements - Asphalt Concrete

AC → **Performance-based NOT** just grading & binder content for compliance

Clause 3.3.2 Compositional Grading

Grading presented as envelopes within which the manufacturer's declared target grading must fall

Clause 3.3.3 Binder Content

Minimum binder content → B_{\min} not B_{act}

Minimum of 70% virgin binder when reclaimed asphalt is used

Clause 3.3.4 Void Content

The void content at design reported as V_{\max} and V_{\min}

Value range from IS EN 13108-1

Bituminous Mixtures

Product Requirements - Asphalt Concrete

AC → **Performance-based NOT** just grading & binder content for compliance

Clause 3.3.5 Water Sensitivity

Indication of mixture durability: ratio of the indirect tensile strength of wet (water conditioned) specimens to that of dry specimens

Clause 3.3.6 Stiffness

Guide to relative performance of that material and the strength over lifecycle
Value 'to be recorded'

Clause 3.3.7 Temperature

Maximum temperature range detailed

Clause 3.3.8 Resistance to Permanent Deformation

Applicable for AC base and binder course mixtures

Values in Series 900 are the maximum permitted in EN 13108-1

Bituminous Mixtures

Points to Note - Hot Rolled Asphalt

Clause 4.2.2 Aggregates

Higher PSV in HRA at roundabouts

Clause 4.2.3 Filler

Reclaimed filler shall not be used for surface courses

Clause 4.2.4 Coated Chippings

PSV and AAV requirements: refer to Appendix 7/1

Clause 4.2.5 Reclaimed Asphalt

Not permitted in HRA surface courses

Clause 4.3.3 Binder Content

Design binder content

Minimum binder content increased

e.g., HRA 35/14 surf des ... was 6.5% - now 7%

Minimum binder volume

Bituminous Mixtures

Points to Note - Stone Mastic Asphalt

Clause 5.1 Mixture Designations

The mixture designations include:

5.1.1	SMA	10	surf	PMB 65/105-60	des
5.1.2	SMA	10	surf	40/60	des
5.1.3	SMA	14	surf	PMB 65/105-60	des
5.1.4	SMA	14	surf	40/60	des

NOTE: Mixture designations 5.1.2 and 5.1.4 above are not permitted on roads carrying greater than 100 commercial vehicles per lane per day.

Clause 5.2.2 Aggregates

Fine Aggregate in Surface Course: Crushed rock fines of PSV_{55} minimum

Course Aggregate in Surface Course: PSV and AAV requirements

Bituminous Mixtures

Points to Note - Stone Mastic Asphalt

Clause 5.2.3 Filler

Reclaimed filler shall not be used for surface courses

Clause 5.2.4 Reclaimed Asphalt

Not permitted in SMA

Clause 5.3.3 Binder Content

Minimum binder content increased

e.g., SMA 10 surf PMB des ... was 5.3% - now 5.8%

Clause 5.3.7 Binder Drainage

Binder Drainage value – lowest level permitted value in EN 13108-5

Where necessary stabilising additives (fibres) shall be added

These additives are mandatory in mixtures containing paving grade bitumen

Bituminous Mixtures

Points to Note - Porous Asphalt

Clause 6.2.3 Filler

Reclaimed filler shall not be used for surface courses

Clause 6.2.4 Reclaimed Asphalt

Not permitted in PA

Clause 6.3.3 Binder Content

Minimum binder content increased

e.g., PA 14 surf PMB des ... was 5.3% - now 6%

Clause 6.3.6 Particle Loss (Cantabro Wear Test)

Value in Series 900 is mid-range of that permitted in EN 13108-7

Bituminous Mixtures

Constituent Requirements - Tables

Requirements for Bituminous Products

Table 1 Asphalt Concrete – Requirements for constituent materials

Test	Asphalt Concrete		Test Method
	Base & Binder	Surface Course	
Coarse Aggregate			
Aggregate of a single type and source	na	✓	EN 932-3
Type - Crushed Rock	✓	✓	na
		C1000	EN 933-5
		f ₁	EN 933-1
		FI ₃₀	EN 933-3
		LA ₃₀	EN 1097-2
		MS ₂₅	EN 1367-2
		W _{A20} ²	EN 1097-6
		see Appendix 7/1	EN 1097-8
		see Appendix 7/1	EN 1097-8
		0%	
	0/4	0/2 or 0/4	EN 933-1
		f ₂₂	EN 933-1
	crushed rock fines, mixture of both	crushed rock fines, sand or mixture of both	na
		yes	
	EN 13043 table 24	EN 13043 table 24	EN 933-10
	crushed rock, crushed slag, hydrated lime, CEM I or CEM II	crushed rock, crushed slag, hydrated lime, cement CEM I or CEM II	na
		EN 13043 Clause 5.5.5	EN 1097-3, annex B
			shall be deemed acceptable if the

Table 14 Binder Properties – Paving Grade and Polymer Modified Bitumens

hEN reference	Table column reference	Unit	EN 12591			EN 14023	
			1	2	3	4	5
Type			Paving grade	Paving grade	Paving grade	PMB	PMB
Use			General	General	General	SMA	Porous
Grade			40/60	70/100	160/220	PMB 65-105/60	PMB 65-105/70
Test	Test Method	Unit					
Initial Binder Characteristics							
Penetration at 25°C	EN 1426	0.1mm	40 to 60	70 to 100	160 to 220	65 to 105 (Class 6)	65 to 105 (Class 6)
Softening point	EN 1427	°C	48 to 56	43 to 51	35 to 43	≥ 60 (Class 6)	≥ 70 (Class 4)
Storage Stability Difference in softening point	EN 13399 EN 1427	°C				≤ 5 (Class 2)	≤ 5 (Class 2)
Fraass Breaking point, max	EN 12593	°C				≤ -12 (Class 6)	≤ -12 (Class 6)
Cohesion Force Ductility (50mm/min traction)	EN 13589 EN 13703	J/cm ²				≥ 1 (Class 4)	≥ 1 (Class 4)
Elastic Recovery @ 25°C	EN 13398	%				TBR (Class 1)	TBR (Class 1)
Flash Point minimum	EN ISO 2592	°C	≥ 230	≥ 230	≥ 220	≥ 220 (Class 4)	≥ 220 (Class 4)
Solubility, minimum	EN 12592	%(m/m)	≥ 99,0	≥ 99,0	≥ 99,0		
Binder Characteristics, after short term ageing to EN 12607-1 (RTFOT)							
Change of Mass, Max	EN 12607-1	%	≤ 0,5	≤ 0,8	≤ 1,0	≤ 1,0 (Class 5)	≤ 1,0 (Class 5)
Retained pen 25°C, min	EN 1426	%	≥ 50	≥ 46	≥ 37	≥ 60 (Class 7)	≥ 60 (Class 7)
Increase in softening point, maximum	EN 1427	°C	≤ 9	≤ 9	≤ 11	≤ 8 (Class 2)	≤ 8 (Class 2)
Decrease in softening point, maximum	EN 1427	°C				≤ 2 (Class 2)	≤ 2 (Class 2)
Notes							
Tests must be carried out within 10 days of sampling; Sampling should be taken at point of delivery only in accordance with IS EN 58 & IS EN 12594							

Bituminous Mixtures

Product Requirements - Tables

Table 19 Test Methods and Conditions – Products

Property	Test method	Sample Preparation
		Note ¹
Grading	EN 12697-2	EN 12697-28
Binder content	EN 12697-1 or 39	EN 12697-28
Binder Volume	EN 12697-8 Using bulk density to EN 12697-6 procedure B SSD and maximum density to EN 12697-5 procedure A in water	EN 12697-30 Impact compaction 2 × 50 blows or EN 12697-31 gyratory compaction
Binder drainage	EN 12697-18	EN 12697-27
Void content	EN 12697-8 Using bulk density to EN 12697-6 procedure B SSD ² and maximum density to EN 12697-5 procedure A in water	EN 12697-30 Impact compaction 2 × 50 blows or EN 12697-31 gyratory compaction
Void content at refusal	EN 12697-8 Using bulk density to EN 12697-6 procedure B SSD ² (same specimens as used for void content) and maximum density to EN 12697-5 procedure A in water	EN 12697-32
Particle Loss (Cantabro Wear Test)	EN 12697-17 at 25°C	EN 12697-30 Impact compaction 2 × 50 blows or EN 12697-31 gyratory compaction The specimen compaction shall achieve maximum air voids up to 28% without causing significant crushing of the coarse aggregate
Water sensitivity	EN 12697-12 method A	EN 12697-31 gyratory compaction
Resistance to permanent deformation	EN 12697-22 procedure B 60°C small device	EN 12697-33 305mm square slabs compacted by a laboratory roller compactor
Resistance to permanent deformation HRA	EN 12697-22 procedure A 60°C small device	EN 12697-33 305mm square slabs compacted by a laboratory roller compactor
Stiffness	EN 12697-26 IT-CY 20°C	150mm diameter cores extracted from slabs compacted by a laboratory roller compactor
Stiffness LEBM	EN 12697-26 IT-CY 20°C	150mm cylindrical specimens, thickness 75 mm
Hot Rolled Asphalt Design Binder content	BS 594987 Annex K	BS 594987 Annex K
Notes		
¹ Unless otherwise stated, tests shall be carried out on specimens at the target composition manufactured by laboratory mixing in accordance with EN 12697-35		
² For Porous Asphalt and other materials with a void content greater than 10%, procedure D by dimensions shall be used		

properties

EN 13108 – 5 Stone Mastic Asphalt					
2	3	4	5	6	7
Binder	Binder	Surface	Surface	Surface	Surface
SMA 10 bin des	SMA 6 bin des	SMA 14 surf des	SMA 10 surf des	SMA 14 surf des	SMA 10 surf des
% by mass passing					
	100		100	100	
100		90 to 100	100	90 to 100	100
90 to 100	100	35 to 60	90 to 100	35 to 60	90 to 100
30 to 55	90 to 100	20 to 45	30 to 55	20 to 45	30 to 55
	22 to 45				
20 to 35	20 to 34	15 to 30	20 to 35	15 to 30	20 to 35
6 to 12	8 to 14	6 to 12	6 to 12	6 to 12	6 to 12
minimum	minimum	minimum	minimum	minimum	minimum
5,8	6,0			5,6	5,8
5,6	5,8	5,6	5,8		
✓	✓			✓	✓
✓	✓				
✓	✓	✓	✓		
0,3 to 1,5	0,3 to 1,5			0,3 to 1,5	0,3 to 1,5
D _{0,3}	D _{0,3}	D _{0,3}	D _{0,3}	D _{0,3}	D _{0,3}
V _{min 2,0}	V _{min 2,0}	V _{min 2,0}	V _{min 2,0}	V _{min 2,0}	V _{min 2,0}
V _{max 8,0}	V _{max 8,0}	V _{max 5,0}	V _{max 5,0}	V _{max 5,0}	V _{max 5,0}
ITSR ₈₀	ITSR ₈₀	ITSR ₈₀	ITSR ₈₀	ITSR ₈₀	ITSR ₈₀
WTS _{Air1,0}	WTS _{Air1,0}	WTS _{Air1,0}	WTS _{Air1,0}	WTS _{Air1,0}	WTS _{Air1,0}
PRD _{Air}	PRD _{Air}	PRD _{Air}	PRD _{Air}	PRD _{Air}	PRD _{Air}
190	190			190	190
180	180				
2	2	2	2		
be reported					

Bituminous Mixtures

Conclusion

- Aim of Series 900 requirements is to improve durability
- Products with longer life cycle
 - Future Standards – reduced thicknesses based on more durable products
- Individual producers need to develop mixes to best optimise and meet the requirements

For instance:

Specifying recipe mixtures with requirements for grading and binder content does not give an indication whether rutting will occur or not

Specifying design mixtures with Series 900 requirements now gives a clear indication whether rutting will occur or not

Debate and Interaction

Audience Debate on Material requirements for
Bituminous Mixtures

Panel to ask questions on testing

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