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
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 vs. 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
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 are 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…

- Appropriate for the Intended Use
- Durable for its expected life
- Mechanical Resistance
- Sustainable Use of Natural Resources
- Stability
- Safety
- Noise
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
  - Use of Design mixtures, no more recipe mixtures
- Develop Site Specific Design
- Develop suite of materials with common approach – the ‘family of products’
  - 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)
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 → $B_{\text{min}}$ not $B_{\text{act}}$
Minimum of 70% virgin binder when reclaimed asphalt is used

**Clause 3.3.4 Void Content**
The void content at design reported as $V_{\text{max}}$ and $V_{\text{min}}$
Value range from IS EN 13108-1
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:

<table>
<thead>
<tr>
<th>Clause</th>
<th>Type</th>
<th>Thickness</th>
<th>Course</th>
<th>Aggregate</th>
<th>Gradation</th>
<th>Description</th>
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<tbody>
<tr>
<td>5.1.1</td>
<td>SMA</td>
<td>10</td>
<td>surf</td>
<td>PMB 65/105-60</td>
<td>des</td>
<td></td>
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<tr>
<td>5.1.2</td>
<td>SMA</td>
<td>10</td>
<td>surf</td>
<td>40/60</td>
<td>des</td>
<td></td>
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<tr>
<td>5.1.3</td>
<td>SMA</td>
<td>14</td>
<td>surf</td>
<td>PMB 65/105-60</td>
<td>des</td>
<td></td>
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<tr>
<td>5.1.4</td>
<td>SMA</td>
<td>14</td>
<td>surf</td>
<td>40/60</td>
<td>des</td>
<td></td>
</tr>
</tbody>
</table>

**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 \( \ldots \) 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 14 Binder Properties – Paving Grade and Polymer Modified Bitumen

<table>
<thead>
<tr>
<th>EN reference</th>
<th>EN 12501</th>
<th>EN 14223</th>
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</thead>
<tbody>
<tr>
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<td>2</td>
</tr>
<tr>
<td>Type</td>
<td>Paving grade</td>
<td>Paving grade</td>
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<tr>
<td>Use</td>
<td>General</td>
<td>General</td>
</tr>
<tr>
<td>Grade</td>
<td>40/60</td>
<td>70/100</td>
</tr>
<tr>
<td>Test</td>
<td>Test Method</td>
<td>Unit</td>
</tr>
</tbody>
</table>

Initial binder characteristics:
- Penetration at 25°C: EN 1426
- Softening point: EN 1427
- Steady state difference in softening point: EN 13190
- Fracture point, max: EN 12193
- Cohesion force, ductility (50mm/min traction): EN 13103
- Elastic recovery @ 25°C: EN 13190
- Flash Point minimum: EN ISO 2592
- Solubility minimum: EN 12392

Binder characteristics after short term ageing to EN 13690-1 (RTFOT):
- Change of Mass, max: EN 12597-1
- Remained after 25°C min: EN 1426
- Increase in softening point, maximum: EN 1427
- Decrease in softening point, maximum: EN 1427

Notes:
- Tests must be carried out within 10 days of sampling. Sampling should be taken at point of delivery only in accordance with EN 58 & EN 12594.
# Bituminous Mixtures

## Product Requirements - Tables

### Table 19 Test Methods and Conditions – Product:

<table>
<thead>
<tr>
<th>Property</th>
<th>Test method</th>
<th>Sample Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grading</strong></td>
<td>EN 12697-2</td>
<td>Note 1</td>
</tr>
<tr>
<td><strong>Binder content</strong></td>
<td>EN 12697-1 or 19</td>
<td></td>
</tr>
<tr>
<td><strong>Binder Volume</strong></td>
<td>EN 12697-8</td>
<td></td>
</tr>
<tr>
<td><strong>Binder drainage</strong></td>
<td>EN 12697-27</td>
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</tr>
<tr>
<td><strong>Void content</strong></td>
<td>EN 12697-30</td>
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<tr>
<td><strong>Void content at refusal</strong></td>
<td>EN 12697-31</td>
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</tr>
<tr>
<td><strong>Particle Loss (Cansobre Wear Test)</strong></td>
<td>EN 12697-17 at 23°C</td>
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<tr>
<td><strong>Water sensitivity</strong></td>
<td>EN 12697-11 method A</td>
<td></td>
</tr>
<tr>
<td><strong>Resistance to permanent deformation</strong></td>
<td>EN 12697-23 procedure A 50°C small device</td>
<td></td>
</tr>
<tr>
<td><strong>Resistance to permanent deformation HRA</strong></td>
<td>EN 12697-33 365mm square slabs compacted by a laboratory roller compactor</td>
<td></td>
</tr>
<tr>
<td><strong>Stiffness</strong></td>
<td>EN 12697-26 IT-CT 20°C</td>
<td></td>
</tr>
<tr>
<td><strong>Stiffness LEBM</strong></td>
<td>EN 12697-26 IT-CT 20°C</td>
<td></td>
</tr>
<tr>
<td><strong>Hot Reidentified Binder content</strong></td>
<td>BS 594087 Annex K</td>
<td></td>
</tr>
<tr>
<td><strong>Notes</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes**

- Unless otherwise stated, tests shall be carried out on specimens at the target composition manufactured by laboratory mixing in accordance with EN 12697-35.
- For Porous Asphalt and other materials with a void content greater than 10%, procedure D by dimensions shall be used.
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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