

MINIMISING WASTE & IMPROVING EFFICIENCY THROUGH MATERIALS INNOVATION

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CHALLENGES – MATERIAL SELECTION

HRA ?

ASPHALT CONCRETE ?

SMA ?

PCSM ?



SROH SPECIFIED MATERIALS – FIRST EDITION



HRAWC
CGWC



HRAWC
CGWC
DBWC
PCWC







HRABC
DBC



HRABC
DBC
PCBC

- HRAWC** – Hot rolled asphalt wearing course to BS 594: Part 1 1985. All roads – 30/14 Design Type F mix, 50 pen (2 to 8 stability) to Table 3, Column 9. Types 2, 3 and 4 roads – 30/14 Recipe Type F mix, 50 pen to Table 5, Column 21. Footways – 15/10 Recipe Type F mix to Table 5, Column 19.
- CGWC** – Close graded wearing course macadam to BS 4987: Part 1 1988. All roads – 10mm size close graded, 100 pen to Clause 7.4.
- DBWC** – Dense wearing course macadam to BS 4987: Part 1 1988. Types 3 and 4 roads – 6mm size dense, 100 pen to Clause 7.5. Footways – 6mm size dense, to Clause 7.5.
- HRABC** – Hot rolled asphalt basecourse to BS 594: Part 1 1985. All roads – 50/20 mix, 50 pen to Table 2, Column 3. Footways – 50/20 mix to Table 2, Column 3.
- DBC** – Dense basecourse macadam to BS 4987: Part 1 1988. All roads – 20mm size dense, 100 pen to Clause 6.5. Footways – 20mm size dense, to Clause 6.5.
- PCWC** } – In accordance with Appendix A10.
PCBC }





DSM	– Deferred set macadam 20mm basecourse or 10mm or 6mm wearing course macadam to BS 4987: Part 1 1988 minimum binder viscosity of 30 secs STV – approximately equivalent to 10 days deferred.		DSM PCSM
Concrete	– to SHW Clause 1001. All roads – C40 mix. Footways – C30 mix.		Concrete
CBM 3	– Cement Bound Material Category 3 to SHW Clause 1036.		CBM 3
GSB 1	– Granular Sub-base Material Type 1 to SHW Clause 803 used in accordance with Appendix A1.		GSB 1

Notes on HRAWC

1. Natural gravels not permitted as coarse aggregate in HRAWC for use in Type 1 and 2 roads.
2. A design mix may give better performance where queuing of heavy traffic is likely to occur. Also, a design mix may be more economical and easier to lay, compact and provide with surface chippings.
3. Chippings shall be 20mm or 14mm nominal size, pre-coated.

Note on Appendices A6 to A7 – All layer thicknesses in millimetres.

BACKFILL MATERIALS

Class A Graded Granular*		Class A
Class B Granular*		Class B
Class C Cohesive Granular*		Class C
Class D Cohesive*		Class D

* used in accordance with Appendix A1.

SROH SPECIFIED MATERIALS – AC 20 DENSE

- 20mm dense binder course was developed in the 1960s and originally described in Specification for Highway Works.

Table 25 $\frac{1}{2}$ inch () Nominal Size Material for Basecourse of $1\frac{1}{2}$ inch to 2 inch () Compacted Thickness

Aggregate grading	Type of aggregate
	Crushed rock, steel or electric-furnace slag, blastfurnace slag, gravel, and sand
Percentage by weight passing (as a percentage of the total aggregate excluding binder)	
B.S. sieve size	
1 in	100
$\frac{3}{4}$ in	100 – 6
$\frac{1}{2}$ in	70 ± 10
$\frac{3}{8}$ in	60 ± 10
$\frac{1}{4}$ in	47 ± 8
$\frac{1}{8}$ in	38 ± 7
No. 52	14 ± 7
No. 200	5 ± 3

- The specification incorporated in to the first edition of BS4987 for Coated Macadams in 1973
- Air voids requirements first appeared in SHW clause 929 in 1993 using test methods similar to those used today.
- Before 1993, compaction was measured as “Percentage Refusal Density”

SROH SPECIFIED MATERIALS – AC 10 CLOSE GRADED

Unspoiled by
progress?

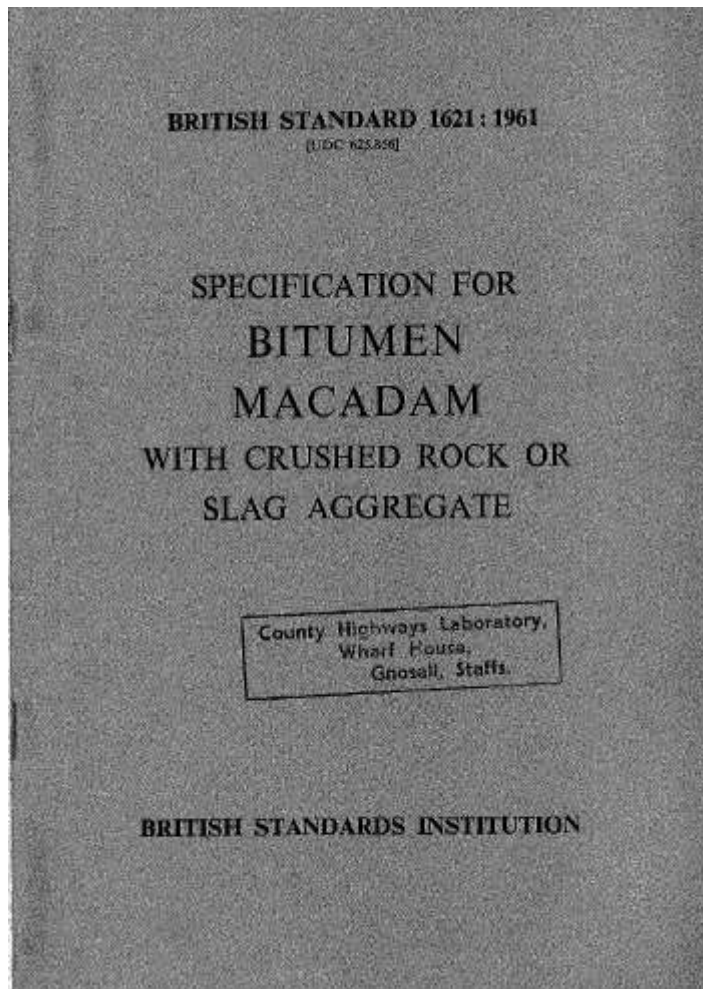


TABLE 5. DENSE BITUMEN MACADAM WEARING COURSES
A. Crushed rock types 1 to 7* aggregate

Passing B.S. sieve	¾ in (19 mm) nominal size	½ in (13 mm) nominal size	¾ in (10 mm) nominal size
in	Percentage by weight		
1	100	—	—
¾	95-100	100	—
½	70- 90	95-100	100
⅜	55- 75	65- 80	95-100
¼	40- 60	45- 65	50- 75
⅛	25- 40	25- 40	25- 40
No. 14	15- 30	15- 30	15- 30
No. 200	3- 6	3- 6	4- 8
Binder content as found by analysis:			
Category 2 traffic	4.4-5.4	4.4-5.4	4.6-5.6
Category 3 traffic	4.4-5.4	4.4-5.4	4.6-5.6
Type and viscosity of binder:	Straight-run bitumen, 90/220 pen.		
Category 2 traffic	Straight-run bitumen 180/320 pen, or cut-back bitumen, viscosity not less than 80 seconds at 40°C		
Category 3 traffic	Straight-run bitumen 180/320 pen, or cut-back bitumen, viscosity not less than 80 seconds at 40°C		

SROH SPECIFIED MATERIALS – AC 6 DENSE

- 6mm Dense was a proprietary material without a national specification until It finally made it into BS4987 in the 1988 revision. Before then 6mm Medium Graded was commonly used for footway construction.

Table 29. Aggregate grading for 6 mm size dense wearing course	
Test sieve aperture size	Aggregate: crushed rock or slag
	% by mass passing
10 mm	100
6.3 mm	90 to 100
3.35 mm	55 to 75
1.18 mm	30 to 50
300 µm	10 to 25
75 µm	2 to 10

Table 31. Grade of binder for 6 mm size dense wearing course	
Traffic category	Grade of binder
A	300 pen to 100 pen
B	100 s to 200 pen
NOTE. Experience with this material under category A traffic is limited.	

SMA was developed in Germany and arrived in UK in 1990s

SROH 2nd Edition introduced SMA.
No UK National Standard until 2007

Local Highway Authorities have their own requirements regarding Texture Depth and Air Voids



SROH AIR VOIDS SPECIFICATIONS

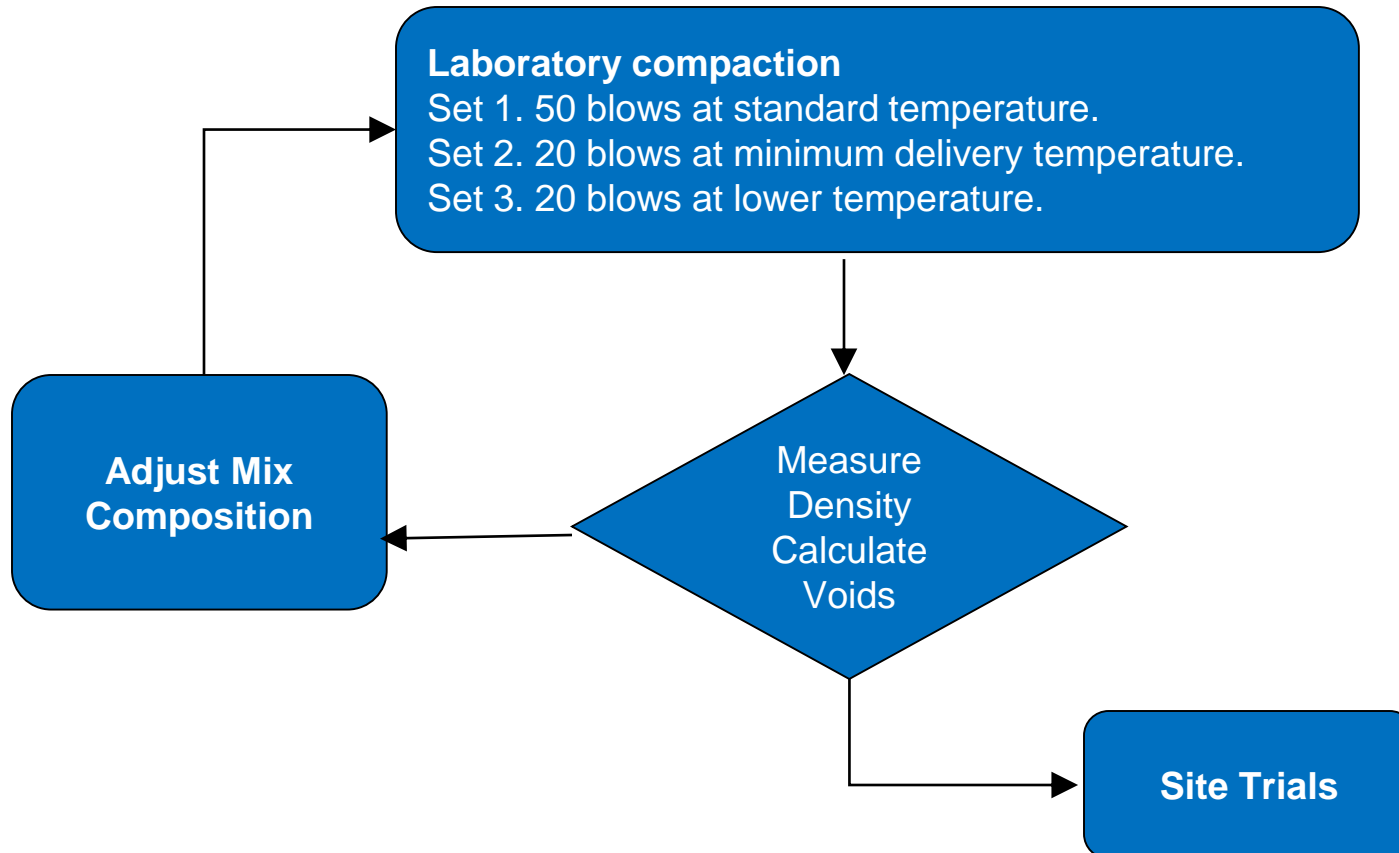
- SROH listed materials hardly changed since 1st edition was published in 1992.
- Air Voids Specifications to measure compaction were introduced to SROH 2nd edition in 2002. (Wales 2006)
- There was limited data on surface course materials at that time.
- Most data was for machine laid materials so an additional tolerance was included to allow for hand laying.
- Coring for air voids compliance has become more common in the last few years.
- Standard materials, fully compliant with specification can have a fairly high level of air voids, even when fully compacted.

Can air voids compliance be achieved without going outside SROH ?



PRODUCT DEVELOPMENT – ENHANCED AC MATERIALS

Mix optimisation process showed significant improvement possible. This was validated by site trials.



ENHANCED AC MATERIALS

- Enhanced materials have replaced standard materials in North-West as a result of high levels of coring revealing air voids failures and subsequent costs of rectification.
- Use increasing in other parts of England and now in Wales

ENHANCED Material Options:

- AC 6 Dense Surf 160/220 Pen, or 100/150 Pen for Footways
- AC 10 Close Surf 100/150 Pen for Carriageways
- AC 20 Dense Binder Course 100/150 Pen

CHALLENGES

Materials availability

Too many materials required
for reinstatements?

Waste and inefficiency



HOT ASPHALT OPTIONS



Collect from Asphalt Plant



Asphalt delivered into Depot Hotboxes

Mobile Hotboxes can reduce wastage due to materials cooling



HOT ASPHALT – COLLECT FROM PLANT

Pros

- Quick collect turnarounds for standard materials in storage bins.
- Wider range of materials can be mixed to order
- UK network of plants - dedicated Collect plants
- Collect the quantity required for the planned work?

Cons

- Location – travel time.
- Plant opening hours
- Service / Loading Delays
- Cold material waste
- Unused material waste



HOT ASPHALT – DEPOT HOTBOX

Pros

- Quick loading
- No travel to collect material
- 24/7 availability ?

Cons

- Limited materials available
- **Storage life – Waste**



ULTILIFE HOTBOX

- Increased workability through use of additive
- Supplied & stored at 20 degrees below conventional temperature
- Increased storage life – reduced waste
- Energy savings on hotbox heating

CHALLENGES – TOO MANY MATERIAL TYPES

HRA ?

ASPHALT CONCRETE ?

SMA ?

PCSM ?



ASPHALT PERFORMANCE REQUIREMENTS

Safety

- Skid resistance – High Speed and Low Speed
- Polished Stone Value (PSV)
- Texture Depth – important at higher speeds

Durability

- Voids - Low voids – trade off against texture depth
- Binder Content
- Aggregate Quality – *Highest PSV may not be best.*
- Good joints and surface finish – *ease of laying!*

Resistance to Rutting / Deformation

- Binder Grade / Mixture Type
- Wheel tracking testing ?

SINGLE MATERIAL FOR FOOTWAY AND CARRIAGEWAY?

SROH barriers / HA attitude

- Safety
- Performance
- Aesthetics - *is this important for most sites?*



SINGLE MATERIAL FOR FOOTWAY AND CARRIAGEWAY?

6mm SMA ?

- Air voids / texture depth trade-off
- Local acceptability in Devon – hard to make national
- Walton ULTIPRO – developed 2013
- Enhanced 6mm SMA – Trials in South Wales.
- Standard 6mm aggregates in Collect Asphalt plants may not be suitable for SMA

SINGLE MATERIAL FOR FOOTWAY AND CARRIAGEWAY?

HRA ?

SROH permitted materials :

- 30/14 or 35/14 for Carriageways
- 15/10 for Footways
- 30/10 could be a good compromise?
- Hand chipped in carriageways
- Unchipped or lightly chipped in Footways
- Reliability of Hand Chipping?

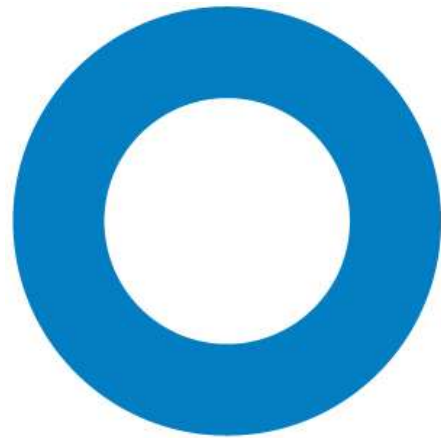
SINGLE MATERIAL FOR FOOTWAY AND CARRIAGEWAY?

AC 10 Close Graded ?

- Enhanced (Designed) variant gives reduced Air Voids
- 10mm materials becoming more common for surfacing of Footways to take advantage of speed of construction
- 10mm binder course materials (EME2) are in increasing use on Strategic Road Network. (60-100mm thickness)

ENGAGEMENT





TARMAC
A CRH COMPANY