SCI / IAT / IHT Seminar – Cases for and against hot mix road surfacings

Overview, including less common options

Presented by Dr Cliff Nicholls
Senior Academy Fellow – 15 Oct. 2009

Table of contents

Material Types

- Mixtures defined by standards
- BS 594 and BS 4987 replaced by BS EN 13108

Material Types

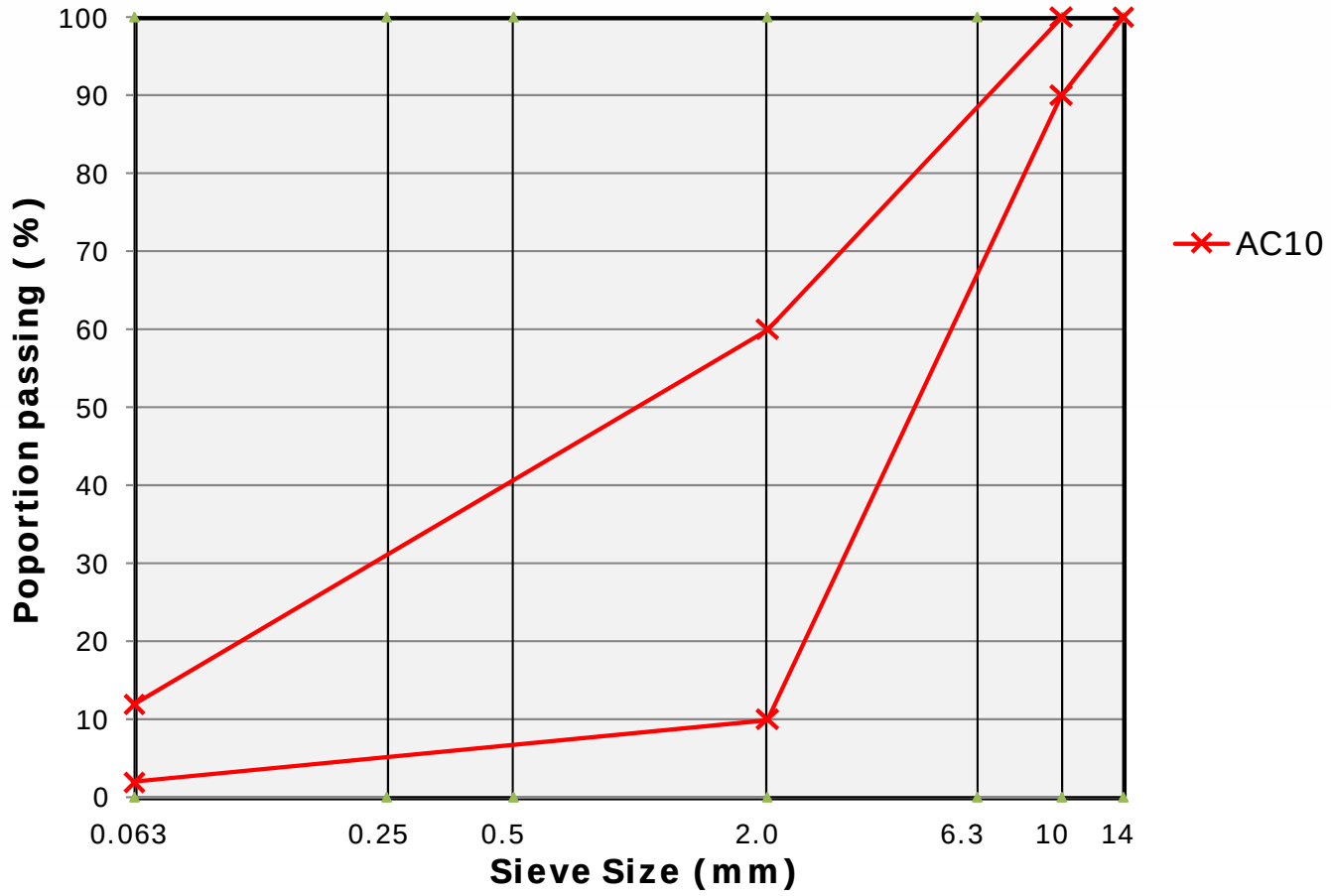
- BS EN 13108-1 Asphalt concrete (AC)
  - Includes macadams, Marshall asphalt ~~and EME2~~
- BS EN 13108-2 Asphalt concrete for very thin layers (BBTM)
- ~~BS EN 13108-3 Soft asphalt (SA)~~
- BS EN 13108-4 Hot rolled asphalt (HRA)
- BS EN 13108-5 Stone mastic asphalt (SMA)
- BS EN 13108-6 Mastic asphalt (MA)
- BS EN 13108-7 Porous asphalt (PA)
- prEN 13108-9 Ultra-thin layer asphalt concrete (UTLAC)

Table of contents

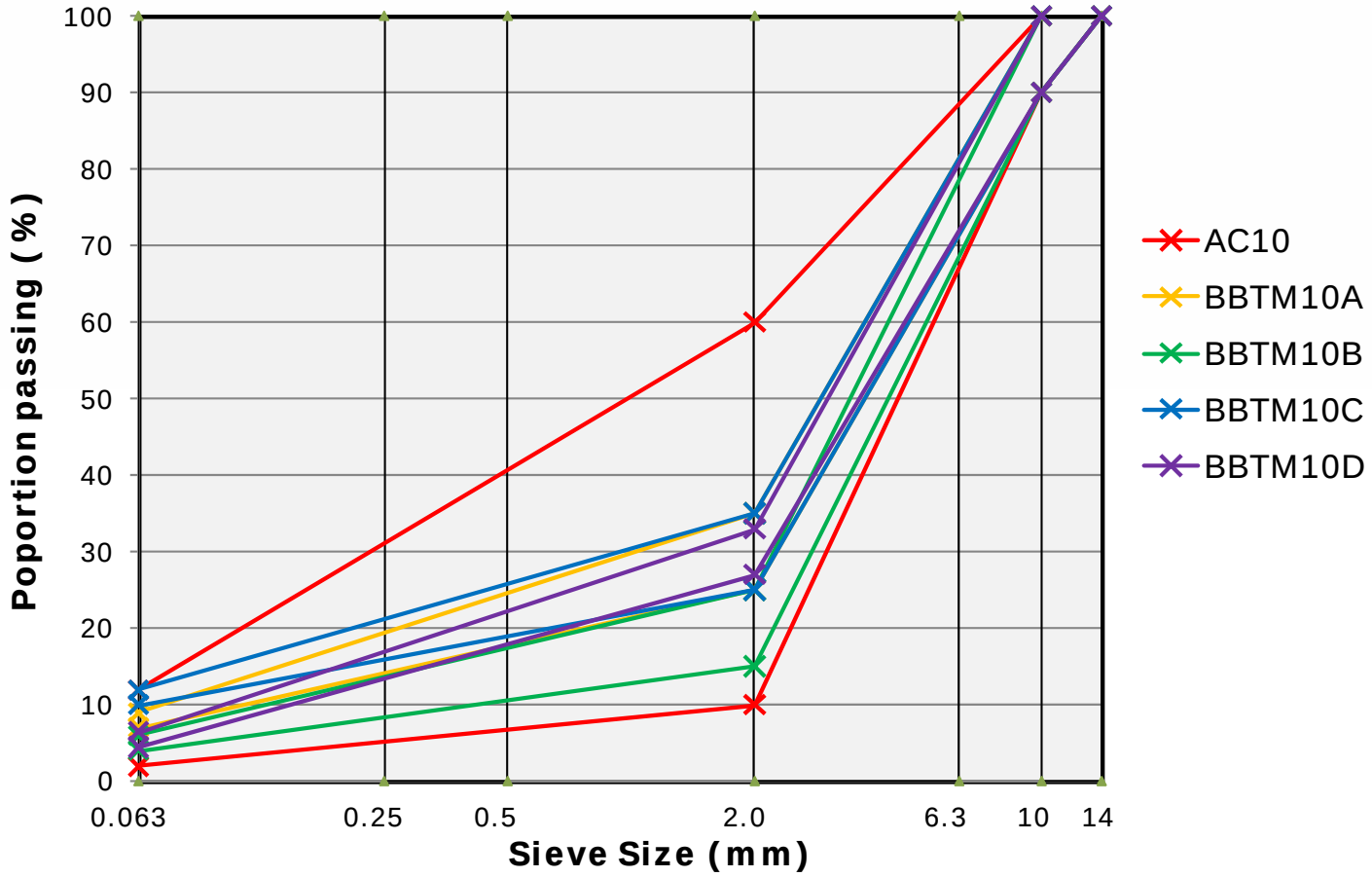
Similarities

- All made from the same component materials
- Different proportions
  - Aggregate gradings
  - Binder contents
- How different are the gradings?
- BS EN 13108 overall envelope for target gradings
  - 10 mm size for comparison

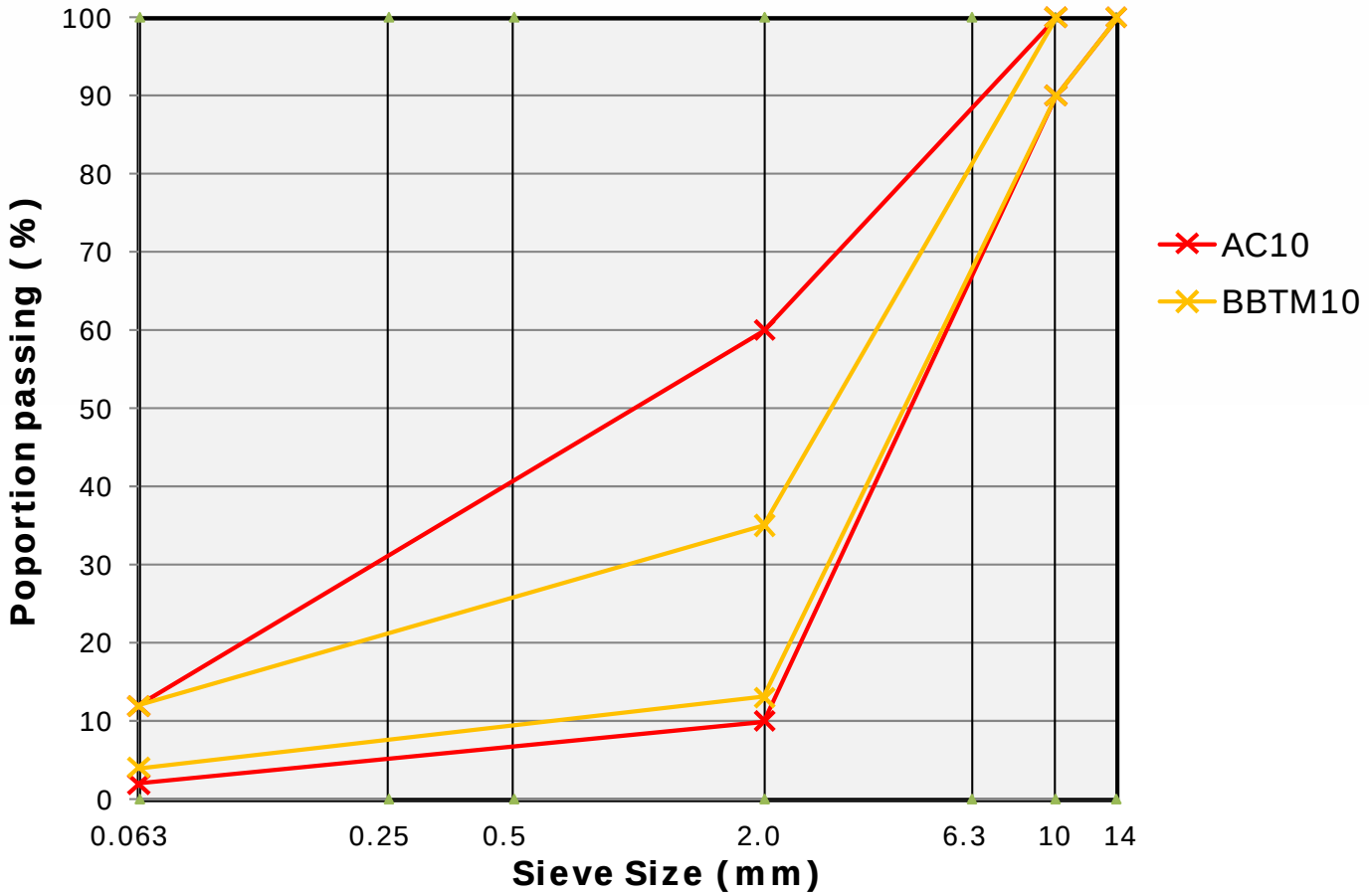
Asphalt concrete AC 10 gradings



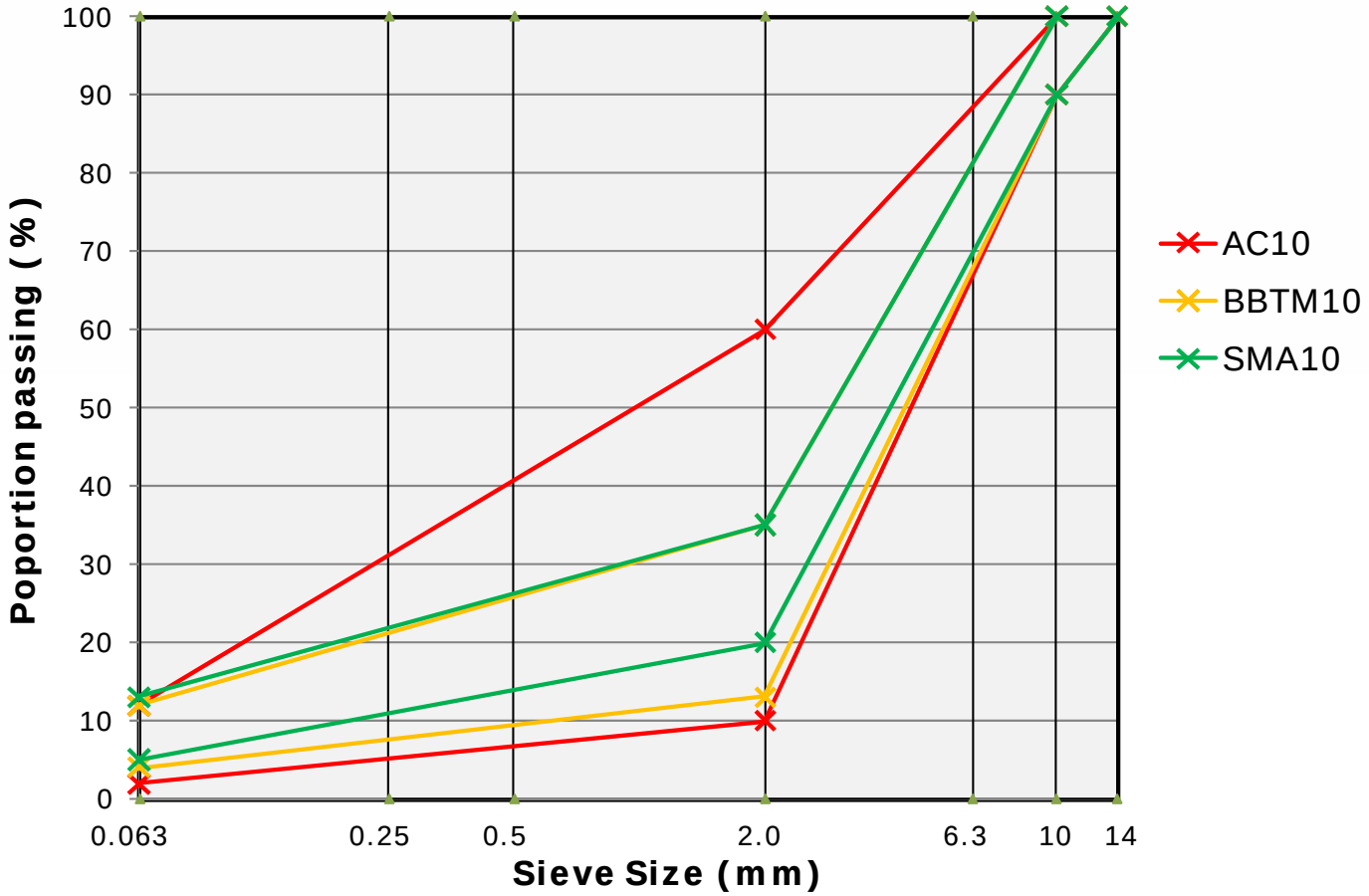
AC 10 and BBTM 10 gradings



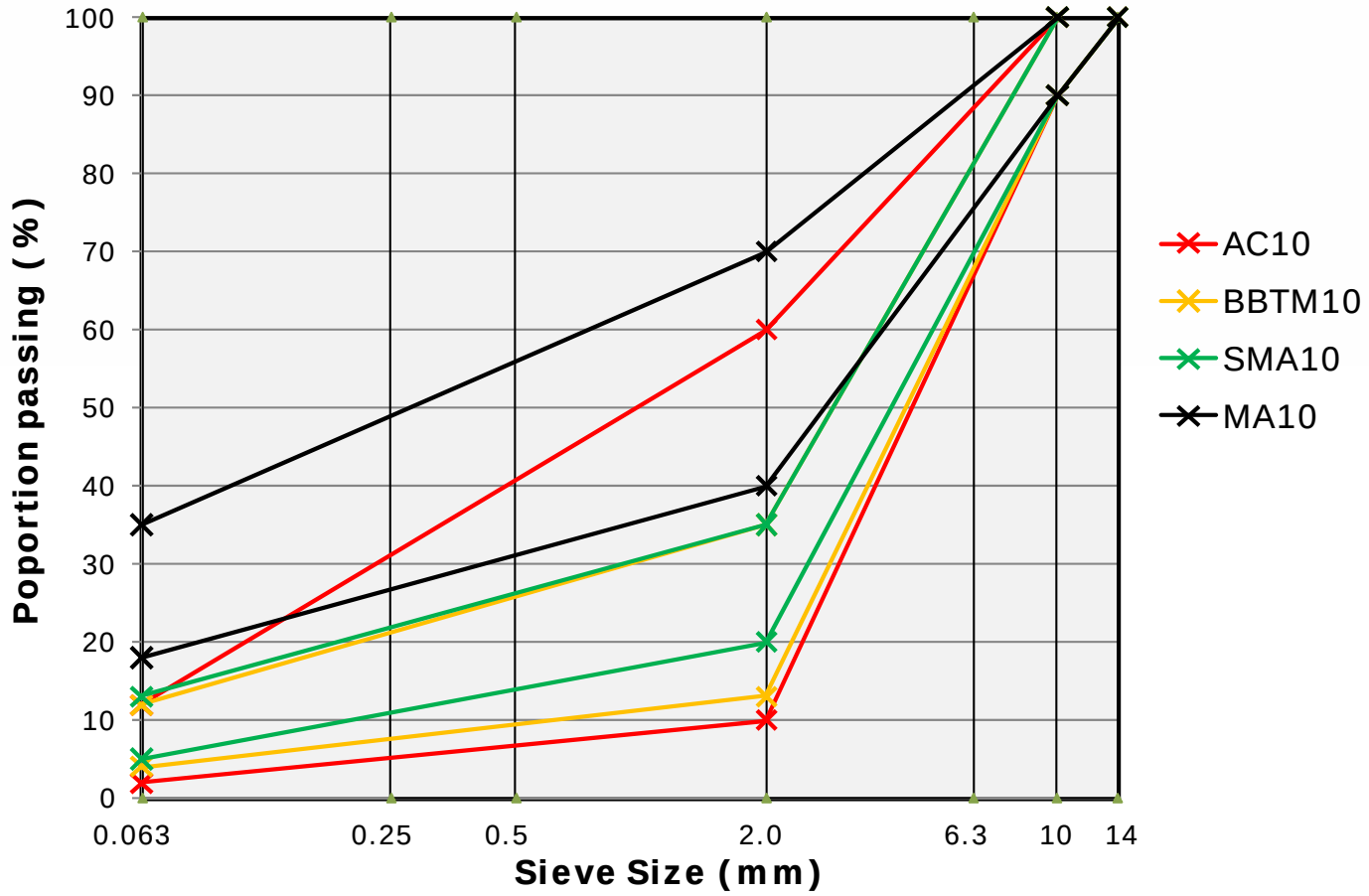
AC 10 and BBTM 10 gradings



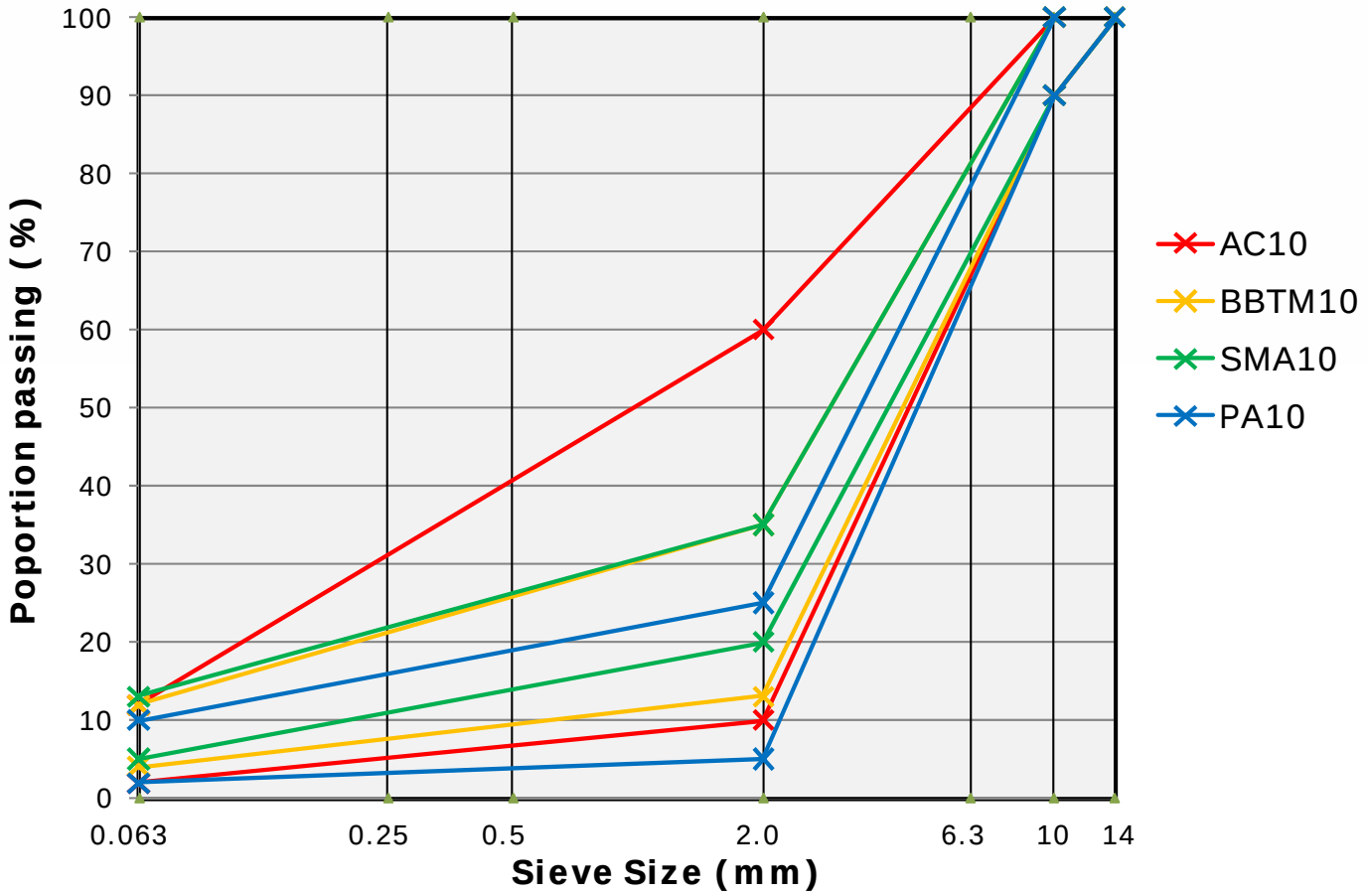
AC 10, BBTM 10 and SMA 10 gradings



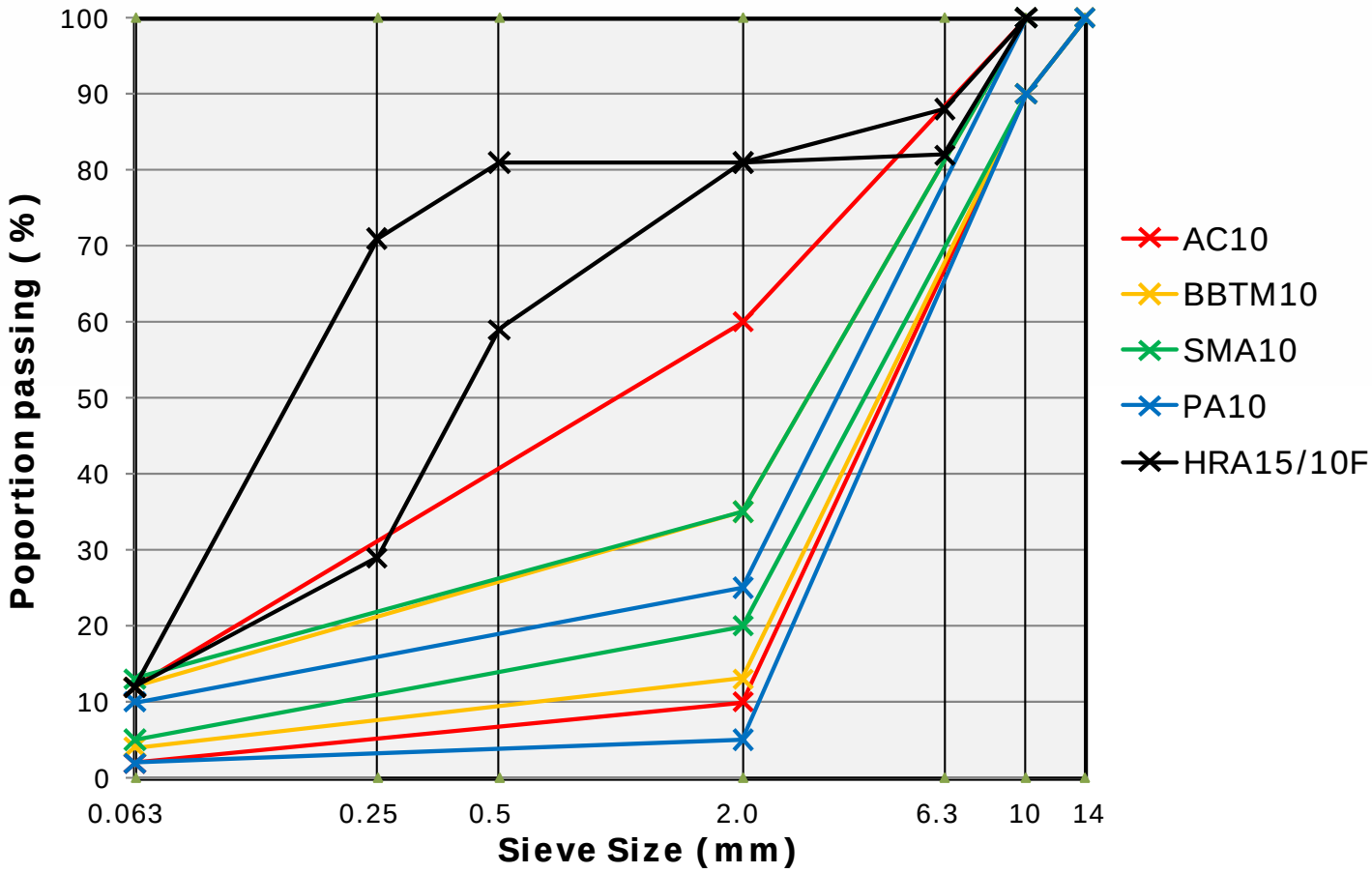
AC 10, BBTM 10, SMA 10 and MA 10 gradings



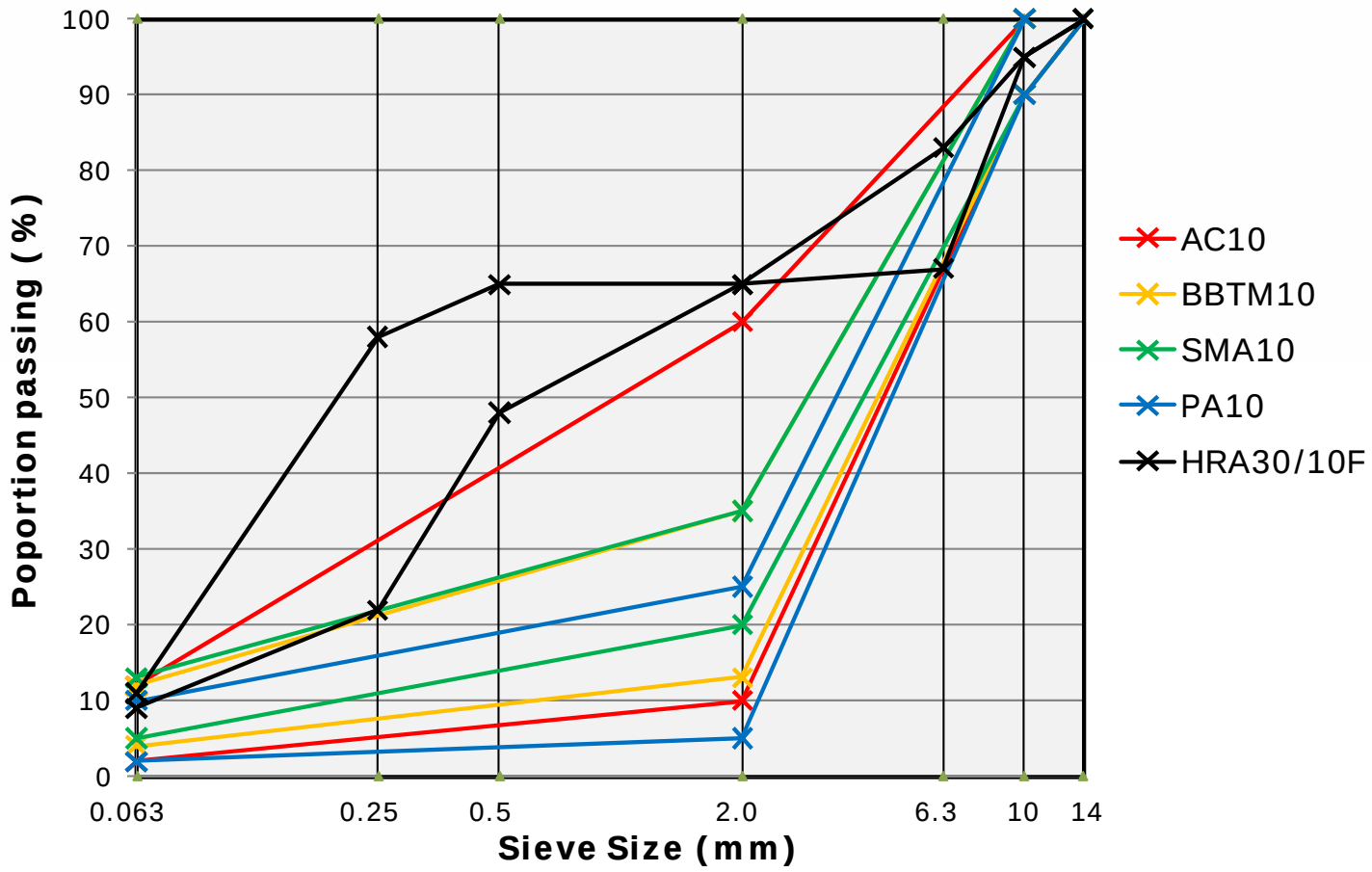
AC 10, BBTM 10, SMA 10 and PA 10 gradings



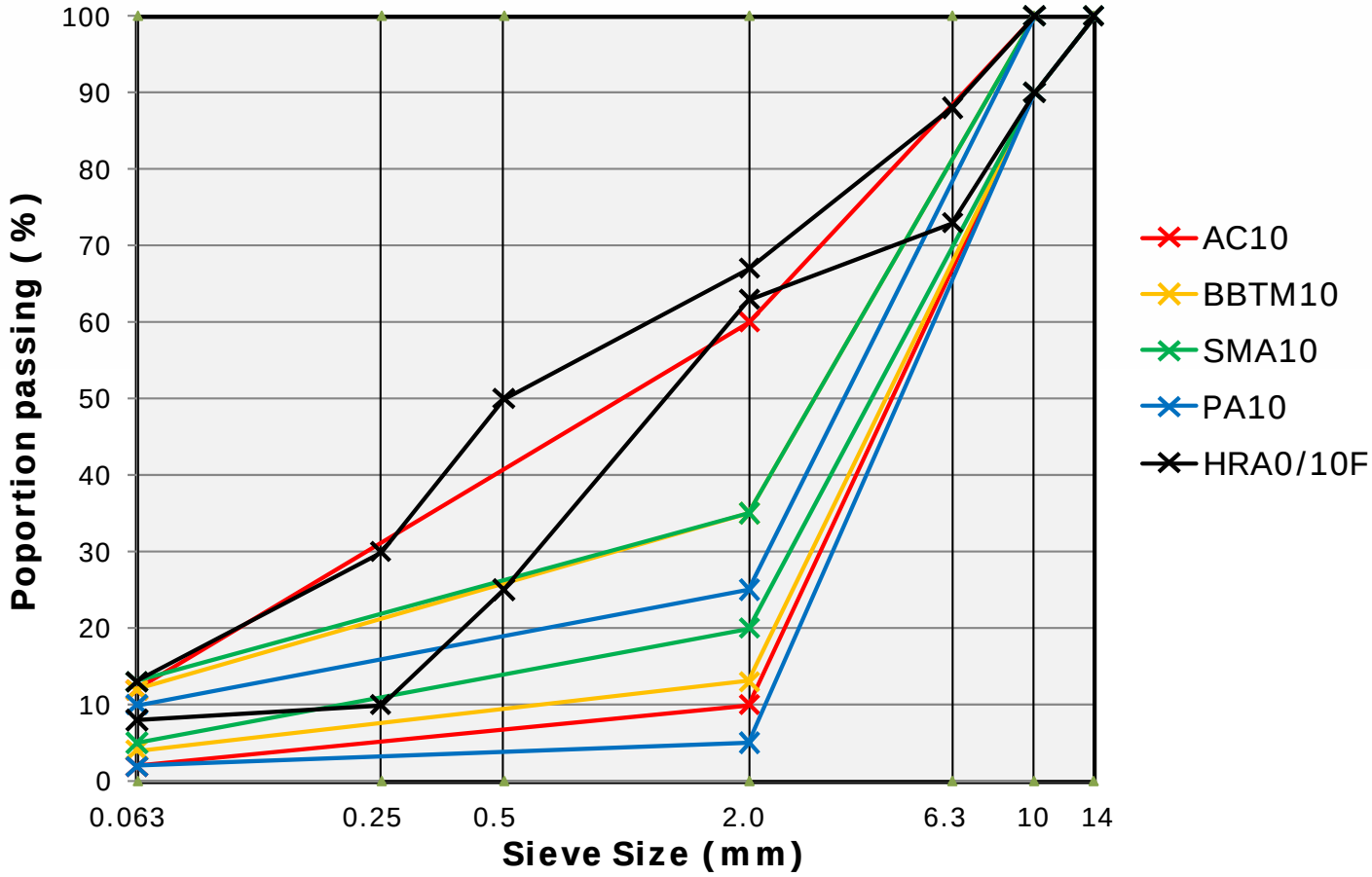
AC 10, BBTM 10, SMA 10, PA 10 and HRA gradings



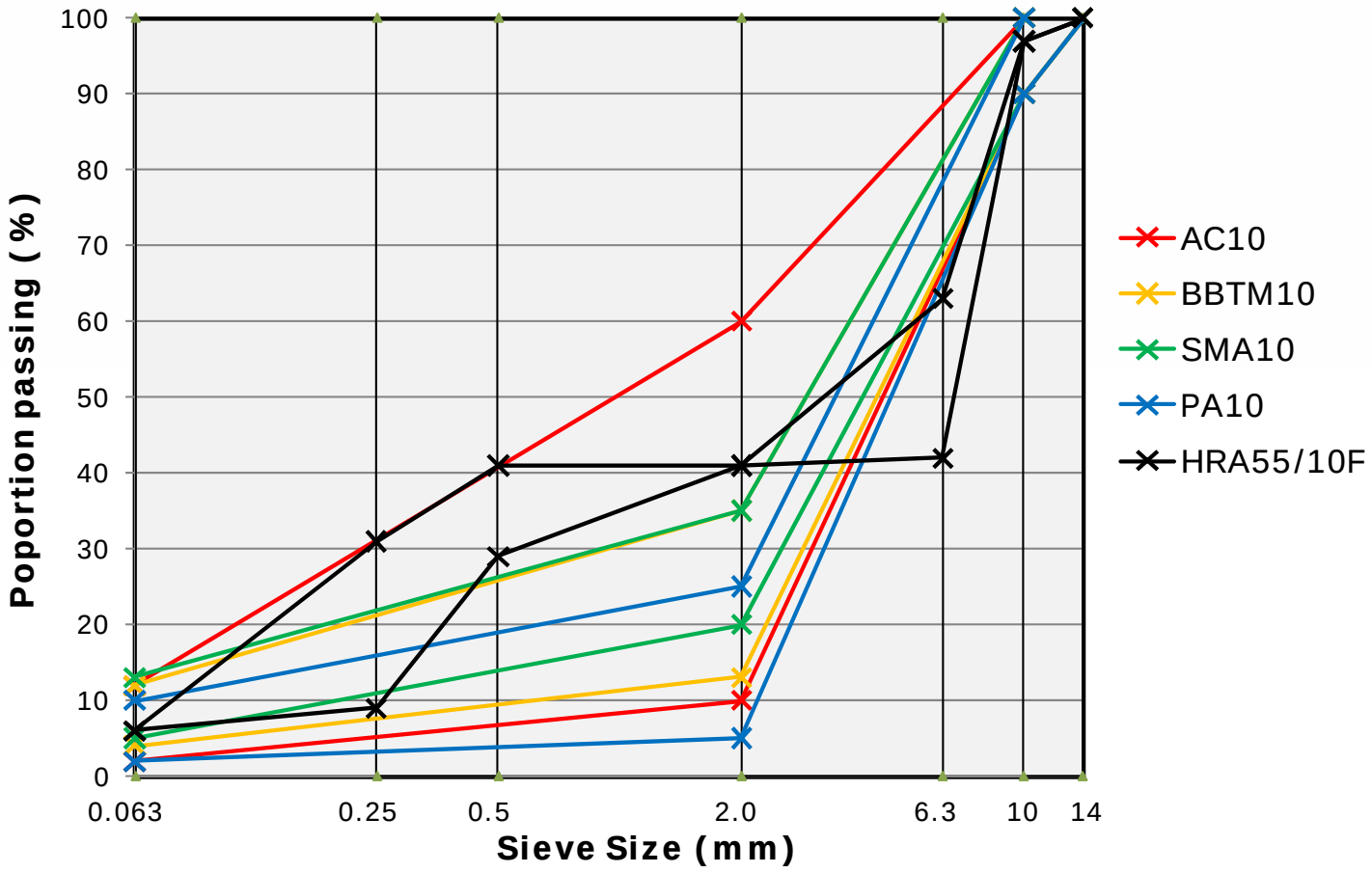
AC 10, BBTM 10, SMA 10, PA 10 and HRA gradings



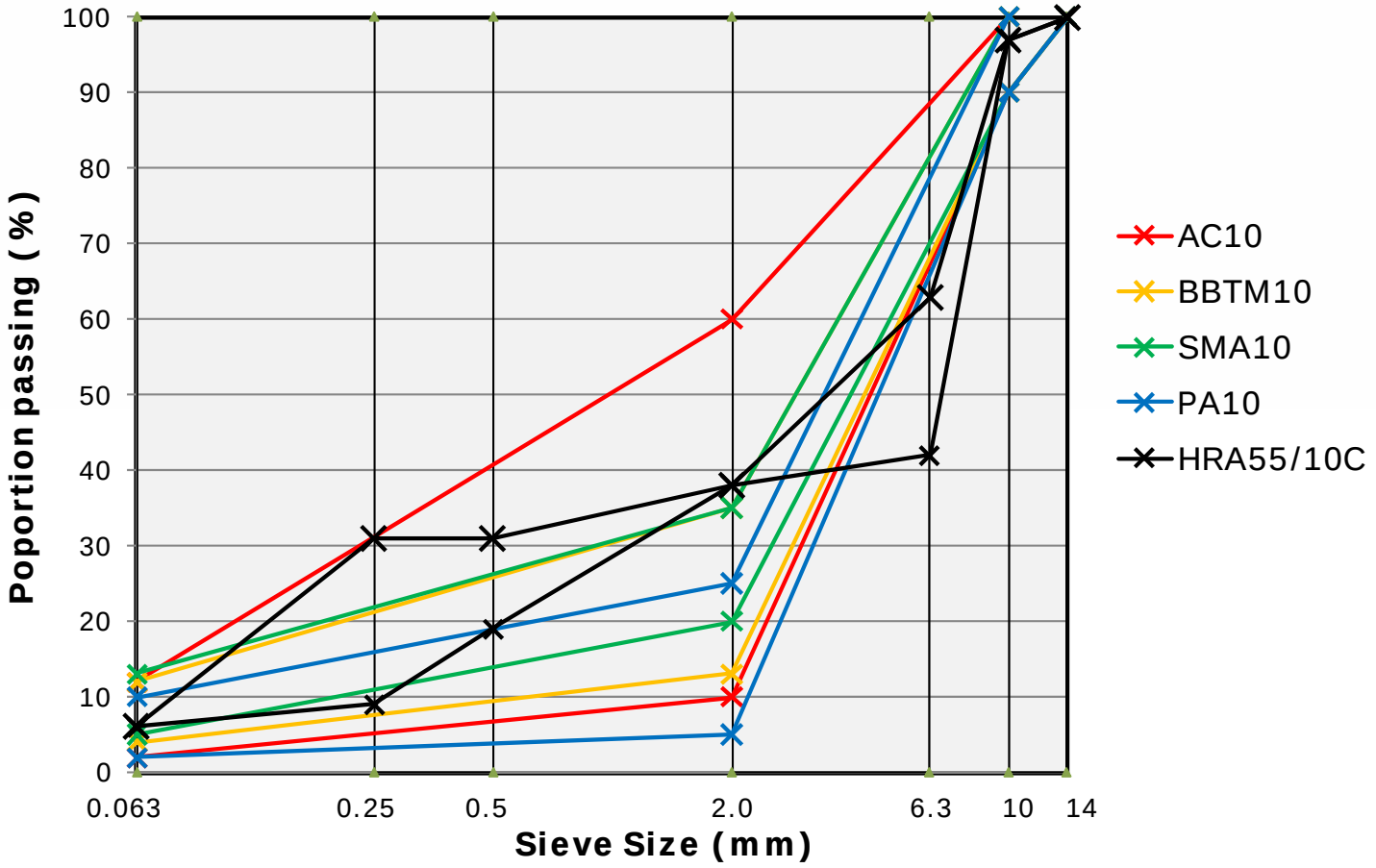
AC 10, BBTM 10, SMA 10, PA 10 and HRA gradings



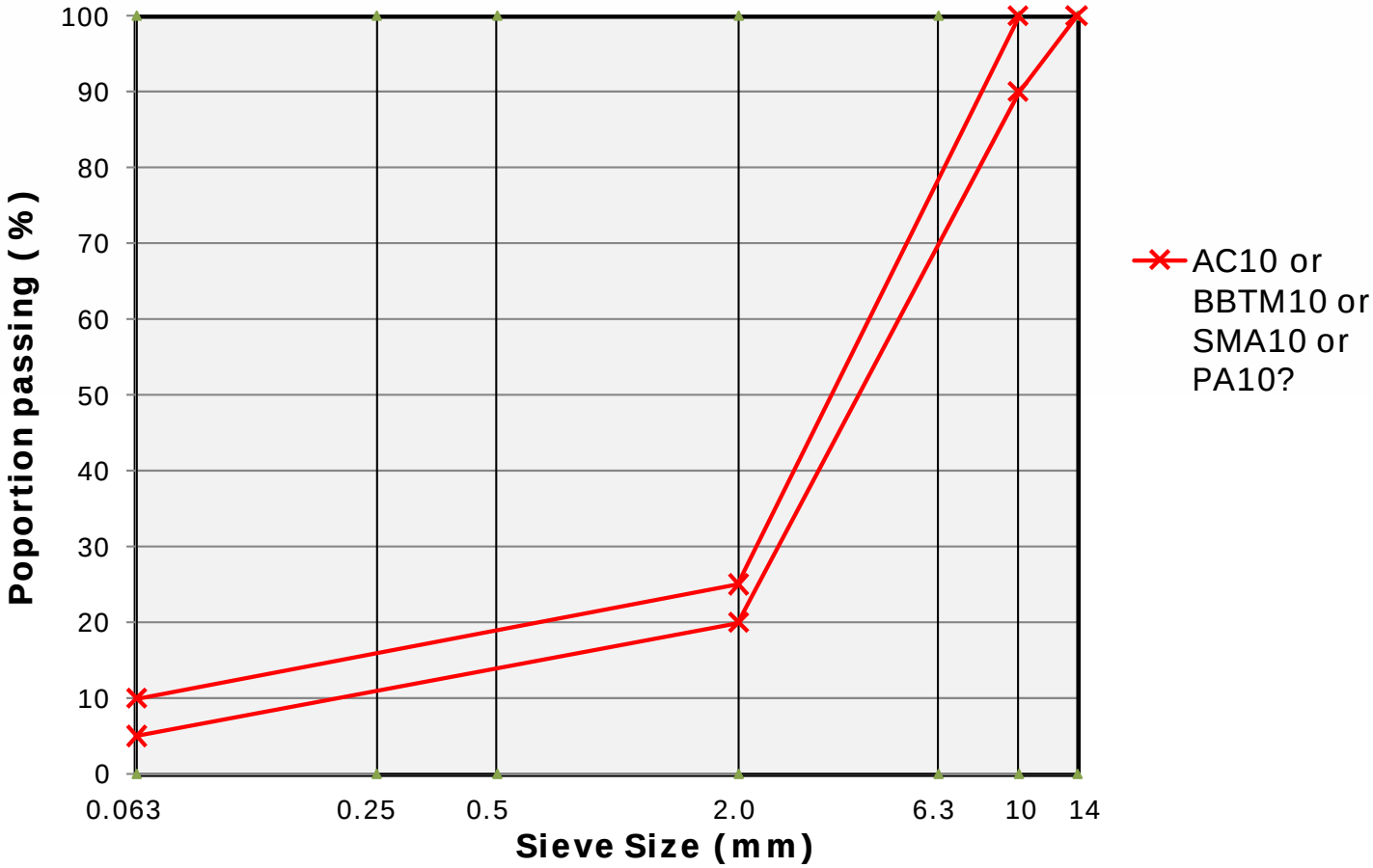
AC 10, BBTM 10, SMA 10, PA 10 and HRA gradings



AC 10, BBTM 10, SMA 10, PA 10 and HRA gradings



AC 10, BBTM 10, SMA 10 or PA 10 grading



Similarities

- Grading envelopes overlap
- What is the “common” mixture like?
- Do not know, but expect:
  - Relatively open macadam, thin surfacing or SMA
  - Relatively impermeable PA
- Mixture types relatively arbitrary classifications

Table of contents

Properties Required of Surfacings

- The envelopes do have differences
- Effect on properties of surfacings?
  (taken from TRL Report TRL250)

- Suitability for re-profiling
- Deformation resistance
- Resistance to cracking
- Spray reduction
- Noise reduction
- Skid resistance
- Texture depth
- Durability
- Quality of ride
- Initial cost
- Speed of construction
- ~~Sustainability~~

Performance of Surfacings (1)

Material	Re-profiling	Deformation	Cracking
Hot rolled asphalt	★★★★	★★★ (★★★★)	★★★★
Porous asphalt	★★★	★★★★★	★★★★★
Macadam	★★★★	★★★★	★★★
Mastic asphalt	★★★	★★	★★★★★
Stone mastic asphalt	★★★★★	★★★★★	★★★★
Thin surf. (26-39 mm)	★★★	★★★★★	★★★
Thin surf. (18-25 mm)	★★	★★★★	★★★
Thin surf. (< 18 mm)	★	★★★	★★

Performance of Surfacings (2)

Material	Spray	Noise	Skid
Hot rolled asphalt	★★★	★★	★★★★
Porous asphalt	★★★★★	★★★★★	★★★★
Macadam	★★	★★★	★★★
Mastic asphalt	★	★★★	★
Stone mastic asphalt	★★★★	★★★★	★★★★★
Thin surf. (26-39 mm)	★★★★	★★★★	★★★★
Thin surf. (18-25 mm)	★★★	★★★	★★★★
Thin surf. (< 18 mm)	★★	★★★	★★★★

Performance of Surfacings (3)

Material	Texture	Durability	Ride
Hot rolled asphalt	★★★★	★★★★★	★★★★
Porous asphalt	★★★★★	★★★	★★★★★
Macadam	★★	★★★	★★★★
Mastic asphalt	★	★★★★★	★★★
Stone mastic asphalt	★★★★	★★★★★	★★★★
Thin surf. (26-39 mm)	★★★★	★★★★	★★★★
Thin surf. (18-25 mm)	★★★	★★★	★★★★
Thin surf. (< 18 mm)	★★★	★★	★★★★

Performance of Surfacings (4)

Material	Cost	Speed
Hot rolled asphalt	★★★	★★
Porous asphalt	★★	★★★
Macadam	★★★★	★★★
Mastic asphalt	★	★★
Stone mastic asphalt	★★★	★★★
Thin surf. (26-39 mm)	★★★★	★★★
Thin surf. (18-25 mm)	★★★	★★★★
Thin surf. (< 18 mm)	★★★	★★★★

Differences

- Some properties also dependant on aggregate size
- No mixture is best for all properties
- No mixture is worst for all properties
- Engineering judgement for each situation

"Horses for courses"

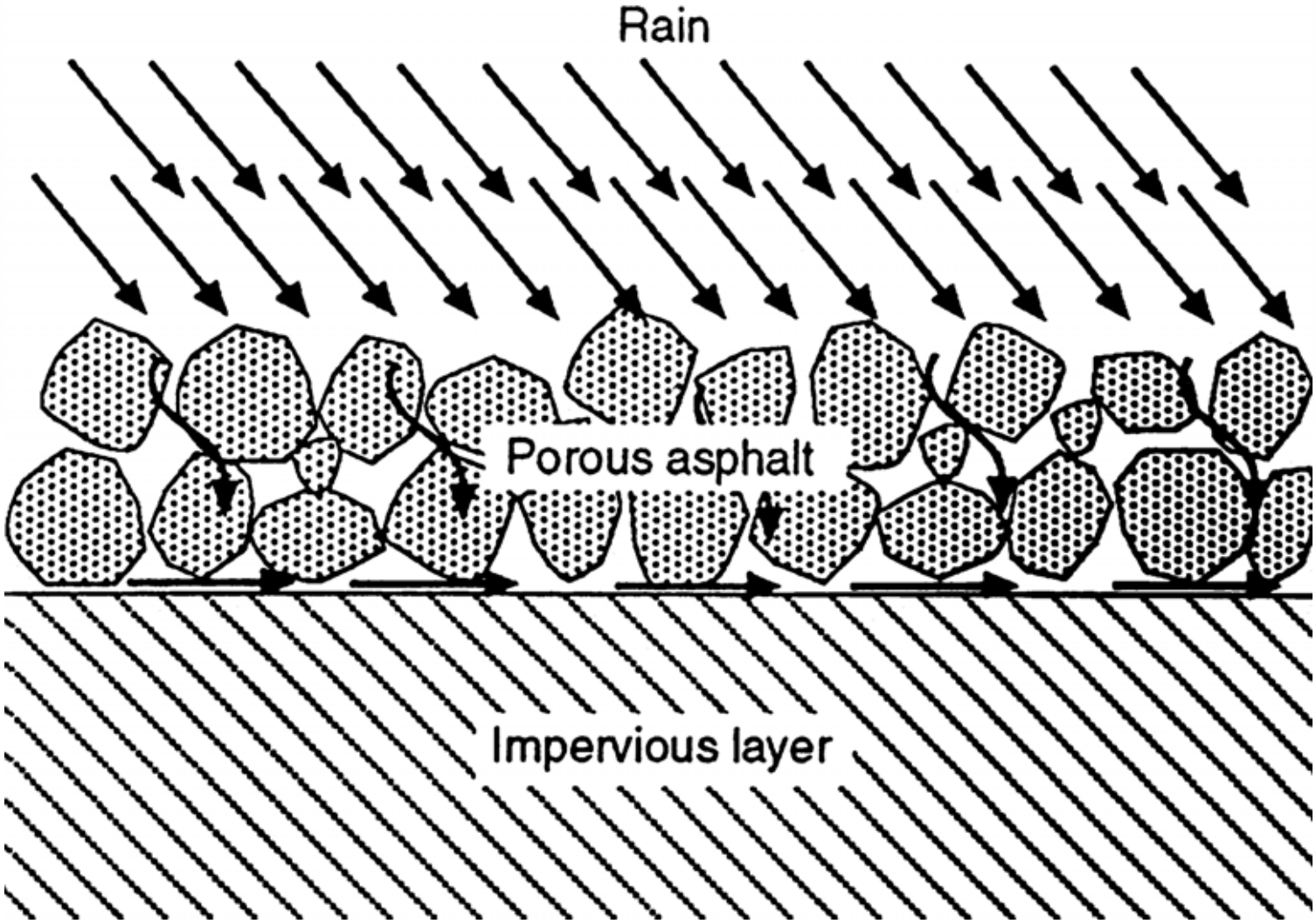
- Overall durability
  - Wild variations with workmanship
  - Workmanship in design, manufacture and laying
  - To UK specifications

Expected Service Life of Different Surfacings

Type	Category	Expected Life
Thin surfacing	BBTM	11 to 15 years
	SMA	10 to 16 years
	Ultra-thin	8 to 11 years
	Multiple surface dressing	4 to 8 years
	Micro-surfacing	2 to 6 years
Hot rolled asphalt	High & medium stability	14 to 24 years
	Low stability	8 to 13 years
Asphalt concrete	DBM	10 to 16 years
	Open graded macadam	6 to 10 years
	Marshall asphalt	15 to 25 years
Porous asphalt		7 to 10 years

Table of contents

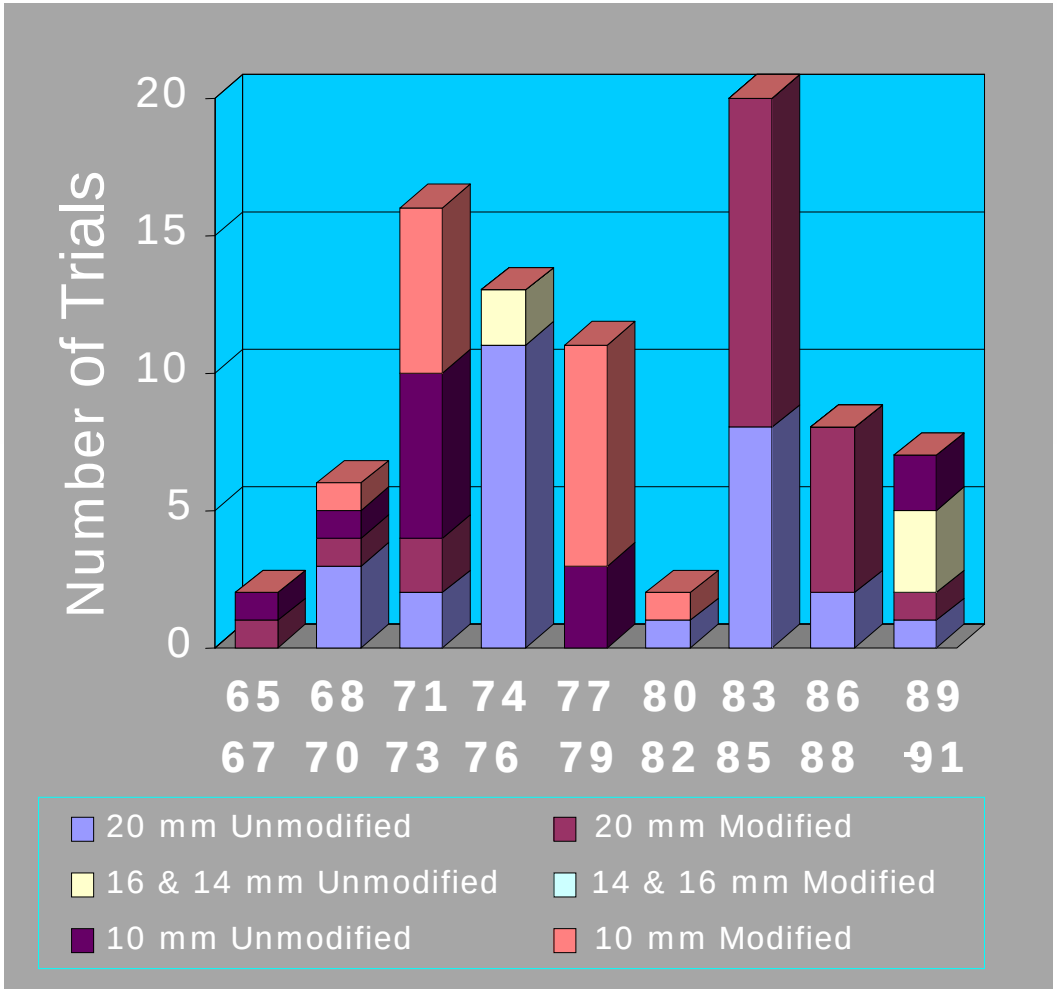
Porous asphalt - Concept

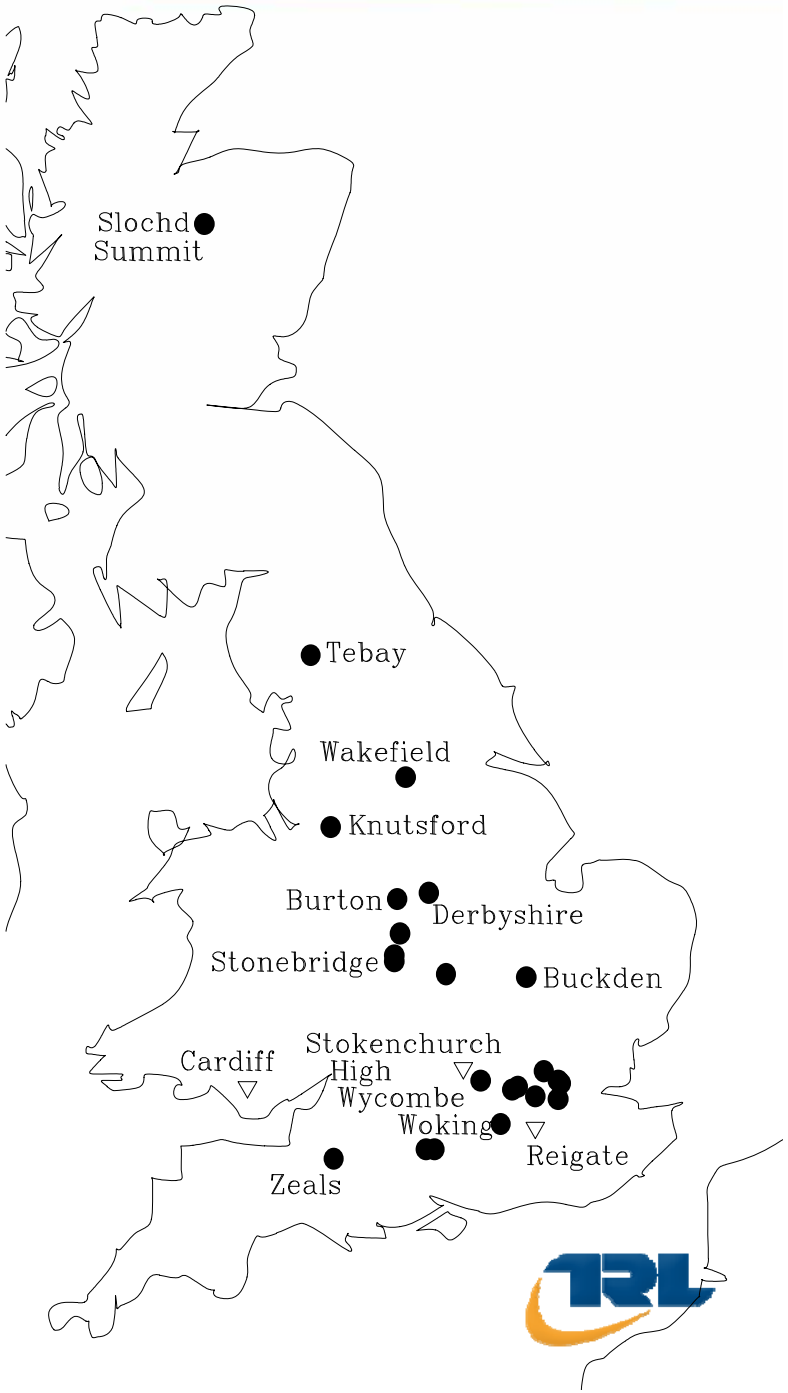


Porous asphalt - History

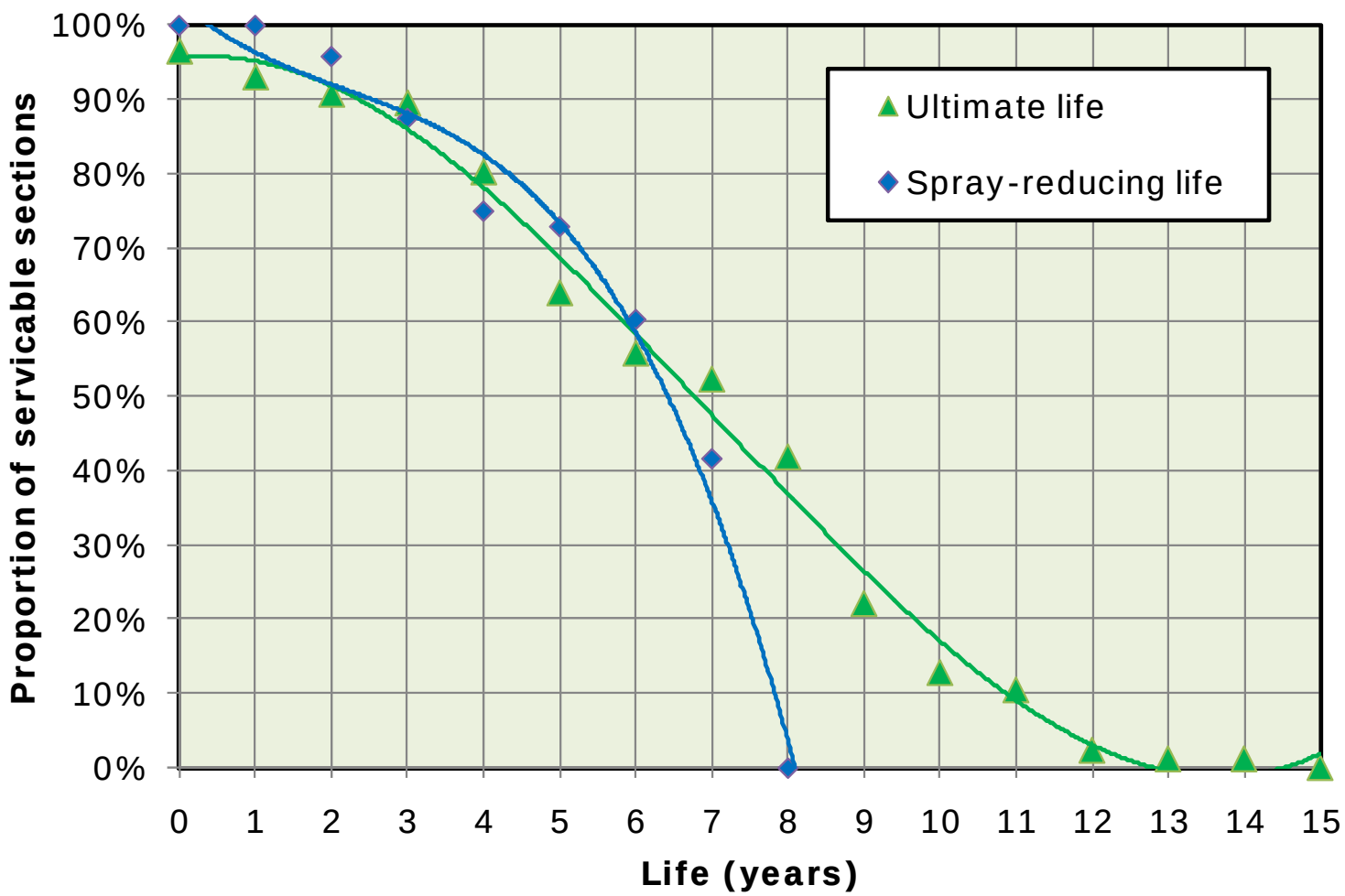
▪ PSA developed friction course for airfields	1950s
▪ First TRL road trial	1967
▪ Pervious macadam incorporated into BS 4987	1988
▪ HA 50/93 issued	1993
▪ Porous asphalt incorporated into *SHW*	1994
▪ Still in *SHW* but not preferred material	

UK trials of porous asphalt



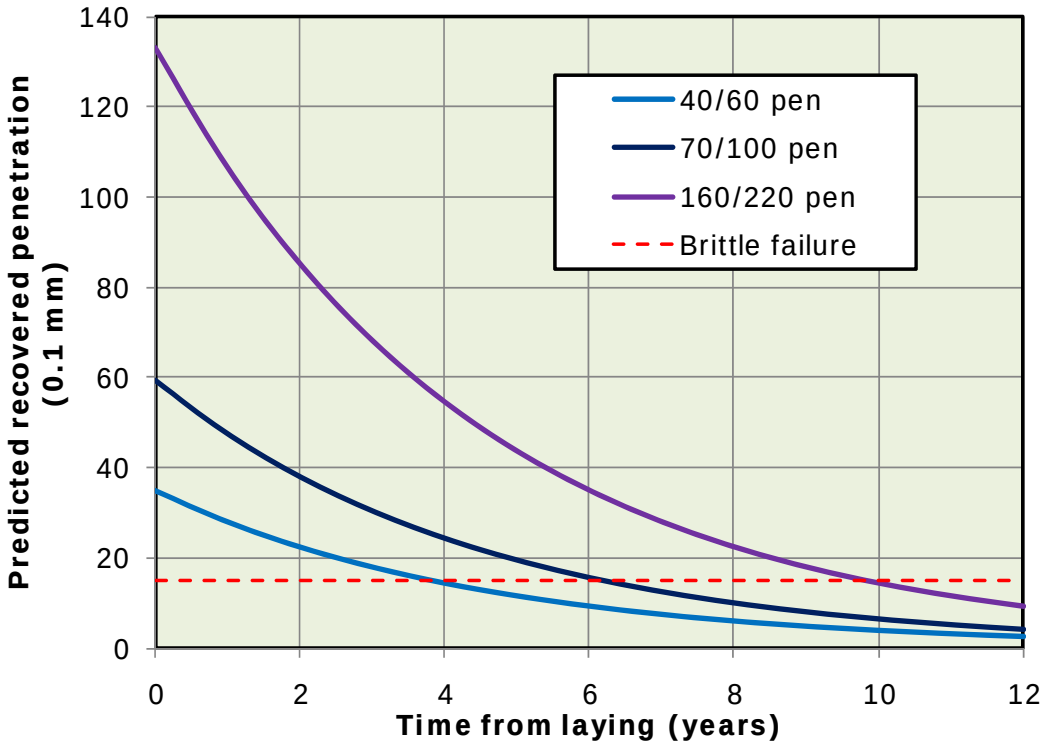


Service life of porous asphalt



Identification of failure

- Failure can be sudden
- Literally “There one day, gone the next”
- Identify potential
- Estimate for paving grade binders
- Polymer-modified binders different slope



Advantages of porous asphalt

- Less traffic noise in both dry and wet conditions
- Less splash and spray in wet conditions
- Reduced possibility of aquaplaning
- Reduced surface glare
- Reduced rolling resistance

Disadvantages of porous asphalt

- Reduced structural strength
- Requires positive edge drainage details
- Requires extra lighting
- Requires tighter tolerances
- Care needed to ensure no barriers within mat
- Tendency for the pores to clog
- Maintenance operations limited to avoid creating dams
- Winter maintenance regimes need adjustment
- Concerns over durability
- High cost

Uses for porous asphalt

- High prestige sites
- Sites not needing long durability
- Sites with spray problems
- Sites where excessive surface water with heavy rainfall
- Not necessary for sites with noise problems
- Therefore uses will be limited …
- … but there are still some uses

Table of contents

Mastic asphalt

- Basic components:
  - Stiff binder
  - Aggregate in powdered or finely crushed form
  - High binder content
- Heated and mixed together to form a pudding or porridge-like product
- Capable of being poured and trowelled or screeded out to level
- “Poured asphalt”
- Two sub-categories

Mastic asphalt

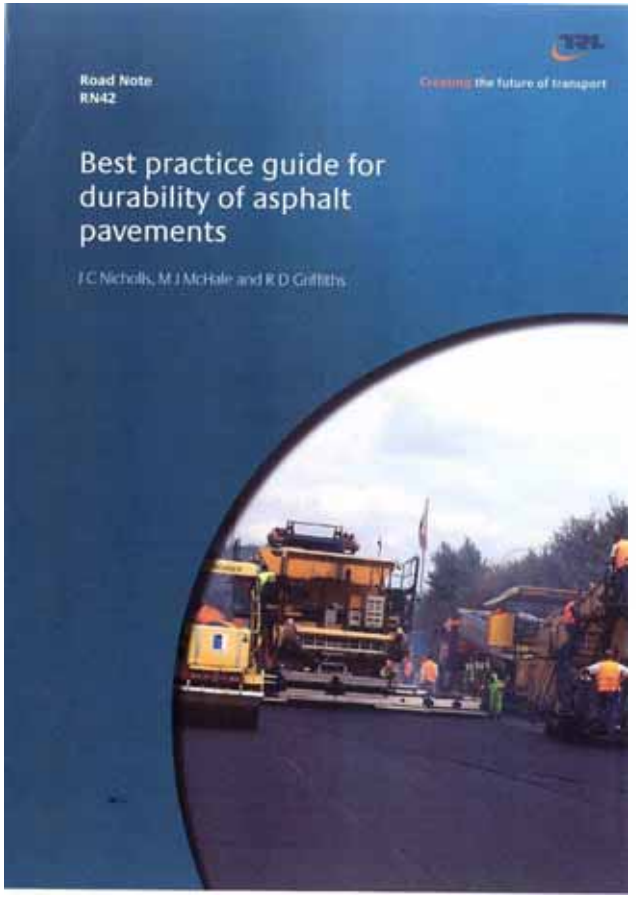
- Mastic asphalt
  - Voidless with the consistency of a pudding
  - Screeded by hand
  - Used in UK, France and Mediterranean
- Gussasphalt
  - Relies on a graded aggregate structure
  - Flows into place, albeit assisted by compaction
  - Laid by machine
  - Germany, Northern Europe and Scandinavian countries

Mastic asphalt

- Good waterproofing
- Primary uses:
  - Tunnels
  - Concrete bridge decks
  - Steel bridge decks
  - Footpaths
  - Flat roofs

Table of contents

Conclusions

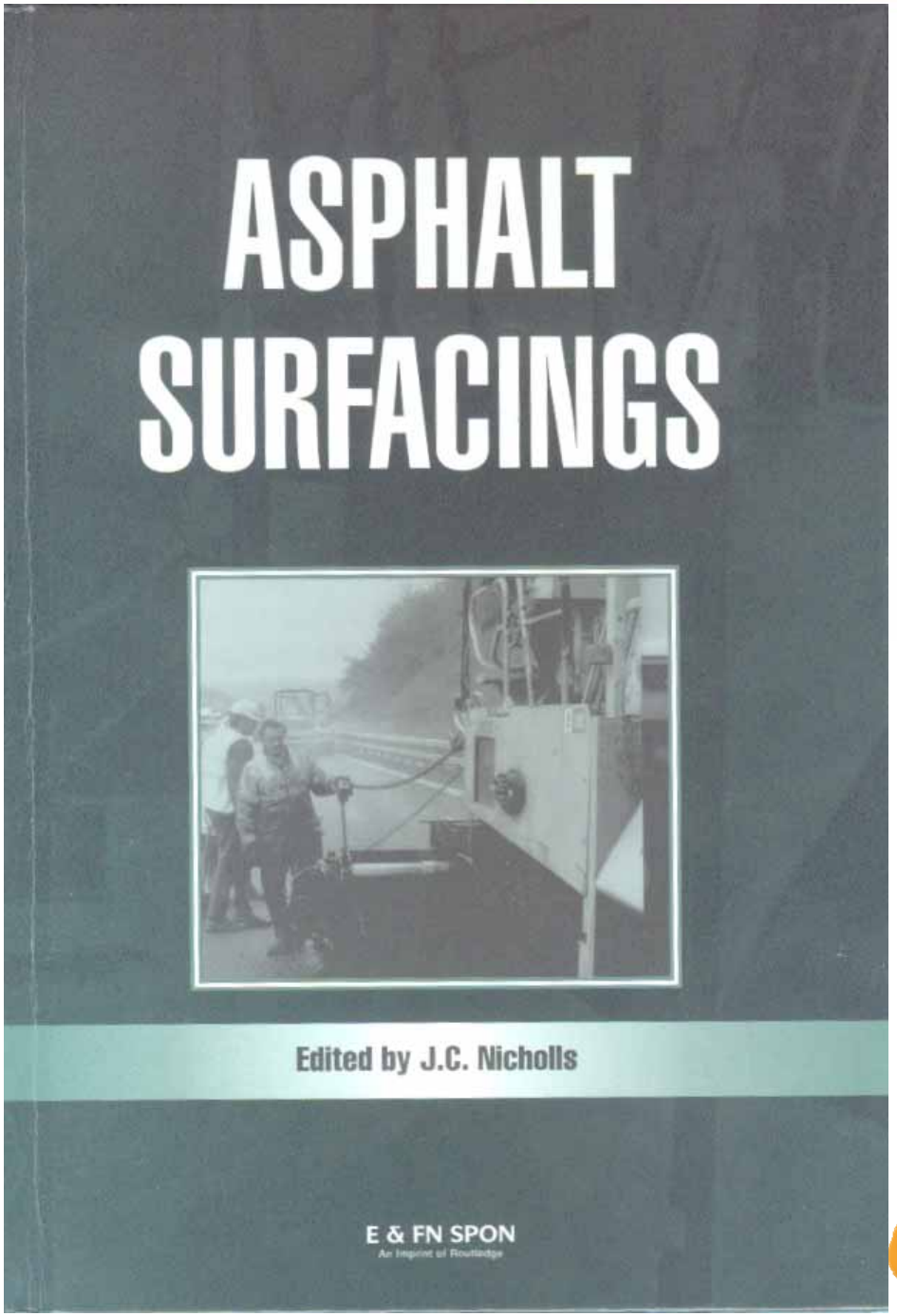


- Mixture types are relatively arbitrary
- But are still useful
- No mixture is best for all properties
- No mixture is worst for all properties
- Engineering judgement for each situation
- Appropriate choice is important
- But ...
- ... care and attention (workmanship) can be as important

Asphalt Surfacings

All that there is to know ...

... about the details of all asphalt types



Conclusions

- Porous asphalt
  - Widely used on airfields
  - Not widely used on highways
  - Good for sites with spray problems or where excessive surface water with heavy rainfall
  - Limited durability
- Mastic asphalt
  - Highly impermeable
  - Several specialist uses
  - One of the few options for long steel bridge decks
  - High costs

Do You Have Any Questions?

Thank you
SCI / IAT / IHT Seminar
"Overview, including less common options"

Presented by Dr Cliff Nicholls
Senior Academy Fellow – 15 October 2009
Tel: 01344 770276
Email: cnicholls@trl.co.uk