

TII Standards Roadshow 2023

Updates to CC-SPW-00800 Unbound and Hydraulically
Bound Materials

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Research and development group



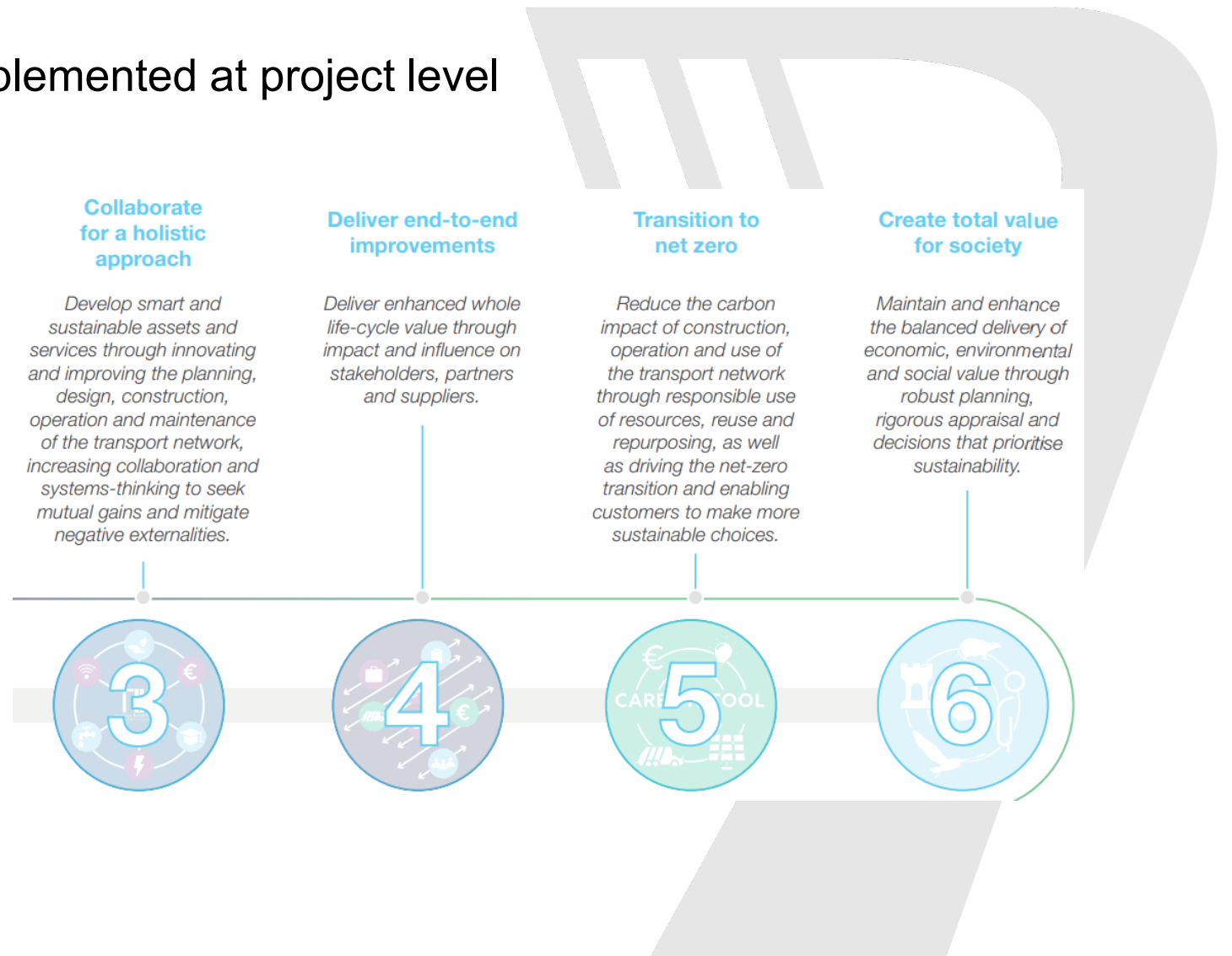
ARUP



Quality
Asphalt

Sustainability and TII Pavements

- How can TII SIP principles be implemented at project level
- Principles 3, 4, 5 and 6
- Lifecycle Approach
 - Design to Asset Disposal



Design

- Optimal material usage
- In-situ material characterisation
- Wider range of materials
- Life Cycle Analysis / Assessment



Procure

- Alternative designs
- Promote new technologies
- Green scorecard / LCCA / LCA



Construct

- Improved quality control
- Performance based specification



Operate / Maintain

- Optimised rehabilitation design / material usage
- Wider range of materials
- Digital design records to support asset management



End-of-life

- Digital records
- Support material reuse/recycling at EoL

- DN-PAV-03021 / IAPDM
- LCCA + LCA+ EPDs
- CC-SPW's

CC-SPW-00800 (Aug 2022)

- Road Pavements – Unbound and Hydraulically Bound Mixtures
- Defines how materials should be produced and layers constructed
- Ensure constructability
- Achieve expected long-term performance - design



Bonneagar Iompair Éireann
Transport Infrastructure Ireland

TII Publications



Road Pavements – Unbound and Hydraulically Bound Mixtures

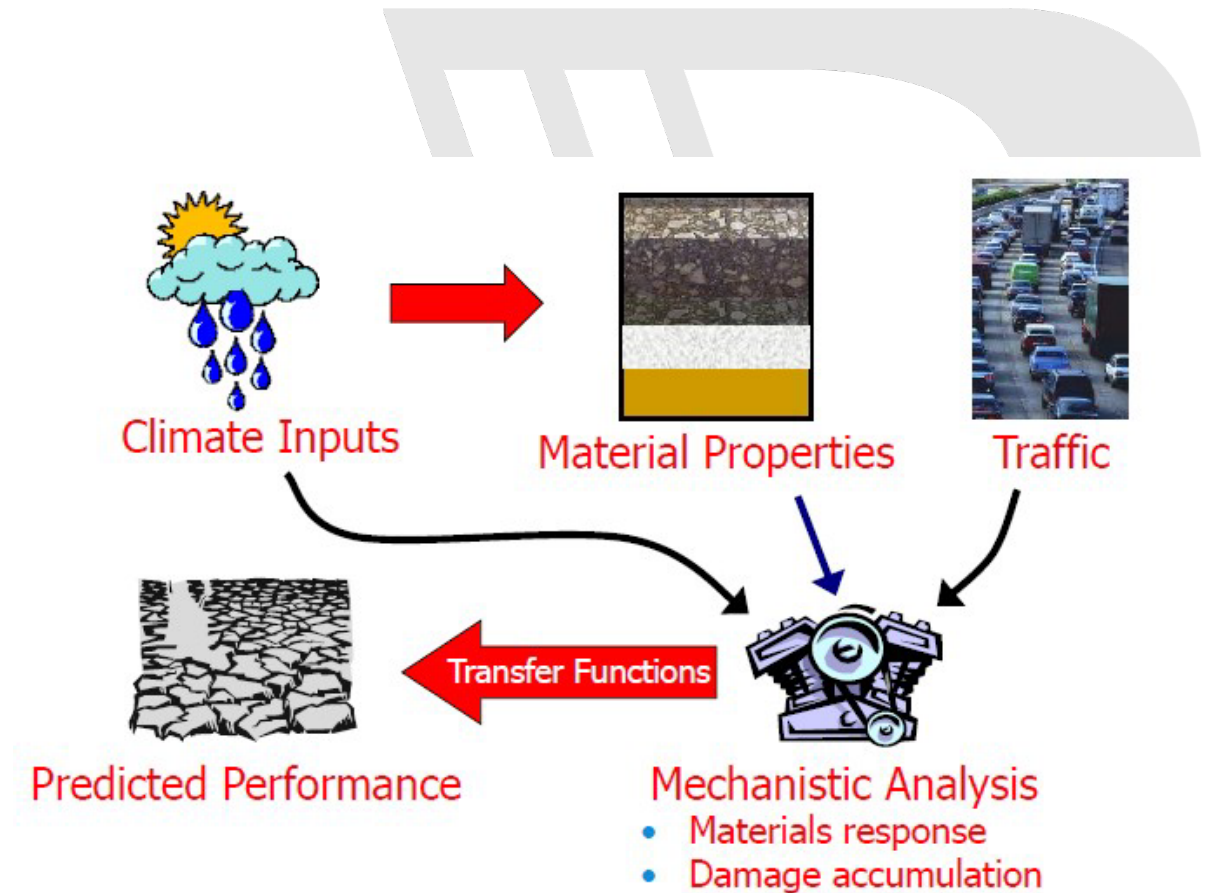
CC-SPW-00800
August 2022



Standards

SIP Principles and CC-SPW-00800

- Facilitate Material Re-use and Recycling
 - Not just backfill
- Optimisation of material use
 - Performance characterisation
 - Linked to design performance
- Provides the designer and specifier the opportunity for the appropriate use of a wider range of materials.



Research behind updates

- Selected road projects
- Material sampling and laboratory testing of materials
- Works performance testing
 - Deflection surveys
 - Density
 - Lab characterisation



New Material Categories

- Simplification
- Linked to DN-PAV-03021
- Unbound Granular Material (UGM)
 - UGM A
 - UGM B
- Hydraulically Bound Material (HBM)
 - HBM A
 - HBM B
- 'A' higher quality, 'tighter' specification
- 'B' more relaxed specification, wider range of materials
- 'A' > 'B' i.t.o long term performance as defined in DN-PAV-03021



UGM – Constituent Materials

UGM A / Ac / Am:

- i. Crushed rock
- ii. Limited content of reclaimed aggregates

UGM B / Bc / Bm: Crushed rock aggregate

- i. Crushed rock
- ii. Crushed natural gravels
- iii. Reclaimed aggregates



UGM – Constituent Requirements

Table 2.1 Requirements for Aggregates Used in UGMs (amended)

Property		Mixture						Test Method
		2.1.1	2.1.2	2.1.3	2.1.4	2.1.5	2.1.6	
		UGM A	UGM Ac	UGM Am	UGM B	UGM Bc	UGM Bm	
Chemical	Water-soluble sulfate content in mg SO ₄ per litre	NR ¹	≤1500	≤300	NR ¹	≤1500	≤300	I.S. EN 1744-1
	Oxidisable sulfides content as SO ₄	NR ¹	≤0.30%	≤0.06%	NR ¹	≤0.30%	≤0.06%	Refer 2.2.1.1
Geometric	Crushed or broken and totally rounded particles	C _{90/3}			C _{NR}			I.S. EN 933-5
	Shape of coarse aggregate - Flakiness Index	FI ₃₅			FI ₅₀			I.S. EN 933-3
	Fines Quality	Liquid Limit ≤ 20 (Limestone) Liquid Limit ≤ 21 (Non-limestone)						BS 1377-2
Physical	Resistance to fragmentation - Los Angeles test	LA ₃₀			LA ₅₀			I.S. EN 1097-2
Durability	Resistance to freezing and thawing	Water Absorption	WA ₂₄ ²					I.S. EN 1097-6, Annex B
		Magnesium Sulfate Soundness ²	MS ₂₅					I.S. EN 1367-2
All other IS EN 13242 aggregate requirements		NR ¹						

¹ NR = No Requirement

² Magnesium sulphate soundness test is only required where water absorption requirements are not met.

IS EN 13242:2002

UGM – Mixture Requirements

Table 2.4 UGM Requirements (amended)

Property	Mixture Type		Test Method
	UGM A / Ac / Am	UGM B / Bc / Bm	
Mixture Designation	0/31,5	0/31,5	-
Fines Content	UF ₇	UF ₉	IS EN 933-1
Oversize	OC ₈₀	OC ₈₀	IS EN 933-1
General Grading Curve	G _A	G _B	IS EN 933-1
Laboratory dry density and optimum water content	To be recorded		I.S. EN 13286-4 (Vibrating Hammer)
Frost Heave	No frost heave within 350mm of surface, BS 812-124		

IS EN 13285:2018

Reclaimed Aggregates

Table 2.2 Allowable reclaimed aggregate content within a UGM.

UGM A / Ac / Am	UGM B / Bc / Bm
% by mass	% by mass
≤ 30	No Limit

Table 2.3 Allowable constituent contents of reclaimed aggregates portion of a UGM

Constituents	UGM A / Ac / Am	UGM B / Bc / Bm
	% by mass	% by mass
Rc - Concrete, concrete products, mortar Concrete masonry units	No limit	No limit
Ru - Unbound aggregate, natural stone Hydraulically bound aggregate	No limit	No limit
Ra - Bituminous materials	≤ 30	No limit
Rg - Glass	≤ 1	≤ 5
Rb - Clay masonry units (i.e. bricks and tiles) Calcium silicate masonry units Aerated non-floating concrete	≤ 1	≤ 2
X - Cohesive (i.e. clay and soil) Miscellaneous: metals (ferrous and nonferrous), non-floating wood, plastic and rubber Gypsum plaster	≤ 1	≤ 2
FL - Floating material	≤ 1	≤ 1

Works Performance

Table 2.8 UGM Compaction Requirements

Parameter	Test Method	Test Frequency	Requirements	
Relative Compaction	Nuclear Density Gauge	Minimum of 5 locations within each 1000 m ² or part thereof laid each day	Average	≥ 97% MDD
			Single location	≥ 92% MDD

Table 2.9 UGM Works Performance Requirements - Design Level 2

Characteristic	Test Method	FWD Test Spacing	Requirements		
			IAPDM Performance Category	Surface Modulus (MPa)	
				Rolling Average*	Minimum
Layer Stiffness	FWD	Seating drop + 3 drops at 25m station spacing in the left wheel path of each lane	S1	≥ 100	≥ 70
			S2	≥ 200	≥ 120
			S3	≥ 300	≥ 175

HBM – Constituent Materials

HBM A shall comprise of one or a combination of the following materials:

- i. Crushed rock aggregate
- ii. Limited content of reclaimed aggregates

HBM B shall comprise of one or a combination of the following materials:

- i. Crushed rock aggregate
- ii. Crushed natural gravels
- iii. Reclaimed aggregates

HBM – Constituent Requirements

Table 3.1 Requirements for Aggregates Used in HBMs (amended)

Property		Mixture		Test Method
		HBM A	HBM B	
		3.1.1	3.1.2	
Geometrical	Crushed or broken and totally rounded particles	$C_{90/3}$	C_{NR}	I.S. EN 933-5
	Shape of coarse aggregate - Flakiness Index	Fl_{50}	Fl_{NR}	I.S. EN 933-3
Physical	Resistance to fragmentation - Los Angeles test	LA_{50}	LA_{NR}	I.S. EN 1097-2
Chemical	Acid-soluble sulfate content	$AS_{0.2}$		I.S. EN 1744-1
	Water-soluble sulfate (WS) content in mg SO_4 per litre	≤ 1500		
	Oxidisable sulfides (OS) content as SO_4	$\leq 0.3\%$		Refer to 2.2.1.1

IS EN 13242:2002

HBM – Mixture Requirements

Table 3.4 HBM Requirements (amended)

Property	Mixture Type		Test Method
	HBM A	HBM B	
Aggregate Size	0/20	0/20	I.S. EN 933-1
Grading Envelope	G1	G2	I.S. EN 933-1
Water Content	Mix design to meet performance with minimum binder limits		
Binder Content			
Strength after Immersion	I ₈₀		Refer to 3.3.5.1

IS EN 14227-1:2013

Reclaimed Aggregates

Table 3.2 Allowable reclaimed aggregate content within a HBM

HBM A	HBM B
% by mass	% by mass
≤ 50	No Limit

Table 3.3 Allowable contents of constituents of reclaimed aggregates for HBMs

Constituents	HBM A	HBM B
	% by mass	% by mass
Rc - Concrete, concrete products, mortar Concrete masonry units	No limit	No limit
Ru - Unbound aggregate, natural stone Hydraulically bound aggregate	No limit	No limit
Ra - Bituminous materials	≤ 50	No limit
Rg - Glass	≤ 1	≤ 5
Rb - Clay masonry units (i.e. bricks and tiles) Calcium silicate masonry units Aerated non- floating concrete	≤ 1	≤ 2
X - Cohesive (i.e. clay and soil) Miscellaneous: metals (ferrous and nonferrous), non-floating wood, plastic and rubber Gypsum plaster	≤ 1	≤ 2
FL - Floating material	≤ 1	≤ 1

Works Performance

Table 3.7 HBM Laboratory Performance Requirements - Design Level 1

Characteristic	Test Method	Requirements	
		IAPDM Performance Category	Minimum
Compressive Strength (R_c)	IS EN 13286-41	C8/10	10 MPa
		C12/15	15 MPa
		C16/20	20 MPa

Table 3.8 HBM Laboratory Performance Requirements - Design Level 2

Characteristic	Test Method	Requirements	
		IAPDM Performance Category	Minimum
Modulus of Elasticity in Compression (E_c)	IS EN 13286-43	S1	20 GPa
		S2	28 GPa
		S3	33 GPa
Indirect Tensile Strength (R_{it})	IS EN 13286-42	F1	1.2 MPa
		F2	1.8 MPa
		F3	2.4 MPa

Future Development

- Update test requirements
 - Reclaimed aggregates
- Industry feedback
 - Practicality
- EPA alignment
 - RA composition
- Works Performance feedback
 - Pavement Asset Management
 - Long-Term Pavement Performance monitoring sites

