

# Facilitating optimal use of road material resources

Updates to CC-SPW-00800 Road Pavements – Unbound and Hydraulically Bound Mixtures

### Overview of this Presentation

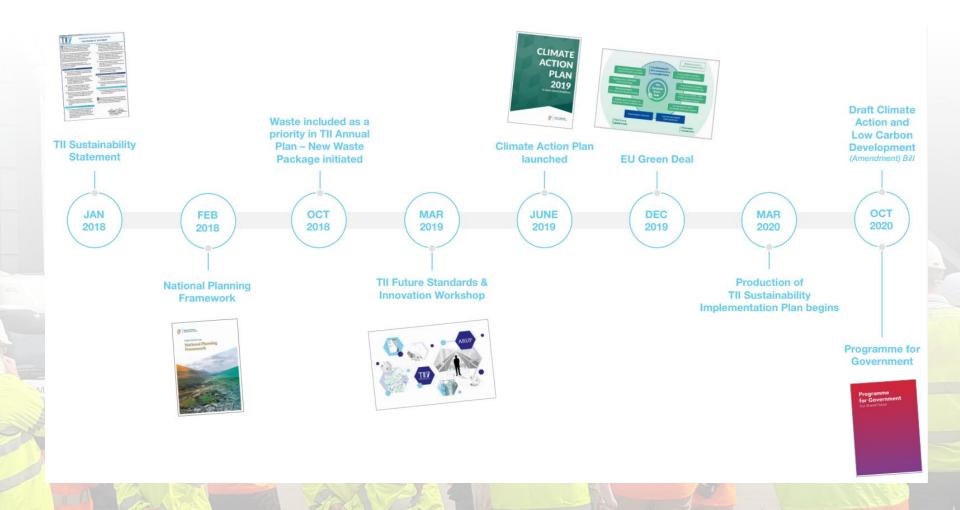
Background to the updates

- Objective of updates
- Updating CC-SPW-00800

# Research and development group



### TII's Sustainability Implementation Plan



### TII's Sustainability Implementation Plan

### • 6 core principles

#### Provide effective, efficient and equitable mobility

Enable compact urban growth and regional accessibility through networks and services that support more efficient journeys, more effective connectivity and increased accessibility.

### Enable safe and resilient networks and services

Enable safe, secure, accessible and inclusive travel through the provision of transport networks, systems and services that are resilient to future change.

### Collaborate for a holistic approach

Develop smart and sustainable assets and services through innovating and improving the planning, design, construction, operation and maintenance of the transport network, increasing collaboration and systems-thinking to seek mutual gains and mitigate negative externalities.

#### Deliver end-to-end improvements

Deliver enhanced whole life-cycle value through impact and influence on stakeholders, partners and suppliers.

### Transition to net zero

Reduce the carbon impact of construction, operation and use of the transport network through responsible use of resources, reuse and repurposing, as well as driving the net-zero transition and enabling customers to make more sustainable choices.

### Create total value for society

Maintain and enhance the balanced delivery of economic, environmental and social value through robust planning, rigorous appraisal and decisions that prioritise sustainability.













Leadership, Collaboration and Partnership

**Working Together and Enabling People** 

### SIP and TII Pavements

 How can SIP principles be implemented at project level

Principles 3, 4, 5 and 6

### Collaborate for a holistic approach

Develop smart and sustainable assets and services through innovating and improving the planning, design, construction, operation and maintenance of the transport network, increasing collaboration and systems-thinking to seek mutual gains and mitigate negative externalities.

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#### Create total value for society

Maintain and enhance the balanced delivery of economic, environmental and social value through robust planning, rigorous appraisal and decisions that prioritise sustainability.









- 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

#### End-of-life

- Digital records
- Support material reuse/recycling at EoL

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

#### 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





# CC-SPW-00800 (Aug 2022)

 Road Pavements – Unbound and Hydraulically Bound Mixtures

• Defines how materials should be produced and layers constructed

Ensure constructability

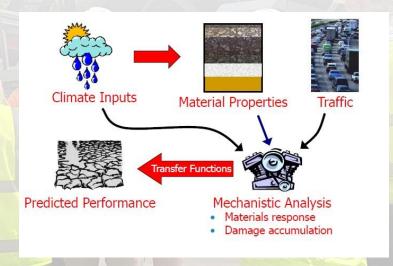
Achieve expected long-term performance - design

**TII Publications** 

# 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



# Updates to CC-SPW-00800

- Re-categorisation of material types
- Changes to constituent and mixture requirements
- Reclaimed aggregate
- Performance based specifications
  - Linked to the IAPDM

## 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 aggregate
- ii. Limited content of reclaimed aggregates



### UGM B / Bc / Bm: Crushed rock aggregate

- i. Crushed natural gravels
- ii. Reclaimed aggregates



# UGM – Constituent Requirements

			Mixture						
Property			2.1.1	2.1.2	2.1.3	2.1.4	2.1.5	2.1.6	Test Method
			UGM A	UGM Ac	UGM Am	UGM B	UGM Bc	UGM Bm	
Chemical	Water-soluble sulfate content in mg SO <sub>4</sub> per litre		NR¹	≤1500	≤300	NR¹	≤1500	≤300	I.S. EN 1744-1
Chemical	Oxidisable sulfides content as SO <sub>4</sub>		NR <sup>1</sup>	≤0.30%	≤0.06%	NR¹	≤0.30%	≤0.06%	Refer 2.2.1.1
Crushed or broken and totally rounded particles			C <sub>90/3</sub>			C <sub>NR</sub>	C <sub>NR</sub>		
Geometric	Shape of coarse aggregate - Flakiness Index		Fl <sub>35</sub>			FI <sub>50</sub>			I.S. EN 933-3
	Fines Quality		Liquid Limit ≤ 20 (Limestone)  Liquid Limit ≤ 21 (Non-limestone)					BS 1377-2	
Physical	Resistar fragmentati Angeles	on - Los	LA <sub>30</sub>				LA <sub>50</sub>		I.S. EN 1097-2
	Water Absorptio n				W	A <sub>24</sub> 2			I.S. EN 1097-6, Annex B
Durability freezing and thawing Magnesiu m Sulfate Soundnes s <sup>2</sup>		MS <sub>25</sub>						I.S. EN 1367-2	
All other IS EN 13242 aggregate requirements			NR <sup>1</sup>				111		
$^{1}NR = No R$	equirement			3 7 1/2					

<sup>&</sup>lt;sup>2</sup> Magnesium sulphate soundness test is only required where water absorption requirements are not met.

# UGM – Mixture Requirements

Dyamayty	Mixtur	е Туре	Test Method	
Property	UGM A / Ac / Am	UGM B / Bc / Bm		
Mixture Designation	0/31,5	0/31,5		
Fines Content	UF <sub>7</sub>	UF <sub>9</sub>	IS EN 933-1	
Oversize	OC <sub>80</sub>	OC <sub>80</sub>	IS EN 933-1	
<b>General Grading Curve</b>	$G_A$	$G_{B}$	IS EN 933-1	
Laboratory dry density and optimum water	To be recorded		I.S. EN 13286-4	
content			(Vibrating Hammer)	
Frost Heave	No frost heave within 350mm of surface, BS 812-124			

IS EN 13285:2018

# Reclaimed Aggregates

#### **UGM RA Content limits**

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

### **RA Composition**

Constituents	UGM A / Ac / Am	UGM B / Bc / Bm % by mass	
Constituents	% 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**

#### **Compaction Requirements (DL1 + DL2)**

Parameter	Test Method	Test Frequency	Require	ements
	Nuclear	Minimum of 5 locations	Average	≥ 97% MDD
Relative Compaction	Nuclear Density Gauge	within each 1000 m2 or part thereof laid each day	Single location	≥ 92% MDD

### **Works Performance Requirements (DL2 only)**

3/1/2		FWD Test Consists	Requirements			
Characteristic	Test		IAPDM	Surface Modulus (MPa)		
Characteristic	Method	FWD Test Spacing	Performance Category	Rolling Average*	Minimum	
		Seating drop + 3 drops at	S1	≥ 100	≥ 70	
Lover Ctiffness	FWD	25m station spacing in the	S2	≥ 200	≥ 120	
Layer Stiffness	LVVD	left wheel path of each lane	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

	Mixt	ure	Test	
	HBM A	HBM B	Method	
			3.1.2	Method
	Crushed or broken and totally rounded particles	C <sub>90/3</sub>	C <sub>NR</sub>	I.S. EN 933-5
Geometrical	Shape of course aggregate - Flakiness Index	FI <sub>50</sub>	FI <sub>NR</sub>	I.S. EN 933-3
Physical	Resistance to fragmentation - Los Angeles test	LA <sub>50</sub>	LA <sub>NR</sub>	I.S. EN 1097-2
	Acid-soluble sulfate content	AS <sub>0.2</sub>		I.S. EN
Chemical	Water-soluble sulfate (WS) content in mg SO <sub>4</sub> per litre	≤ 1500		1744-1
MA CE	Oxidisable sulfides (OS) content as SO <sub>4</sub>	≤ 0.	3%	Refer to 2.2.1.1

IS EN 13242:2002

# HBM – Mixture Requirements

Droporty	Mixtur	Took Mathed		
Property	HBM A	HBM B	Test Method	
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		Refer to 3.3.5.1		

IS EN 14227-1:2013

# Reclaimed Aggregates

#### **HBM RA Content limits**

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

#### **RA Composition**

Constituents	HBM A	нвм в
Constituents	% 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

#### **Works Performance Requirements (DL1)**

		Requirements		
Characteristic	Test Method	IAPDM Performance Category	Minimum	
		C8/10	10 MPa	
Compressive Strength (R <sub>c</sub> )	IS EN 13286-41	C12/15	15 MPa	
Strength (IX <sub>c</sub> )		C16/20	20 MPa	

### **Works Performance Requirements (DL2)**

		Requirements		
Characteristic	Test Method	IAPDM Performance Category	Minimum	
Modulus of		S1	20 GPa	
Elasticity in	IS EN 13286-43	S2	28 GPa	
Compression (E <sub>c</sub> )		S3	33 GPa	
		F1	1.2 MPa	
Indirect Tensile Strength (R <sub>it</sub> )	IS EN 13286-42	F2	1.8 MPa	
Strength (N <sub>it</sub> )		F3	2.4 MPa	

# Research behind updates

- Selected road projects
- Material sampling and laboratory testing of materials



- Works performance testing
  - Deflection surveys
  - Density
  - Lab characterisation



## Future Development

- Identify and correct errors
  - Reclaimed aggregates
- Industry feedback
  - Practicality
- EPA alignment RA composition
- Works Performance feedback
  - Pavement Asset Management
  - Long-Term Pavement Performance monitoring sites