igmat d.d.

Building Materials Institute

BITUMEN STABILIZED MATERIAL VERSUS HOT MIX ASPHALT

BSM vs HMA

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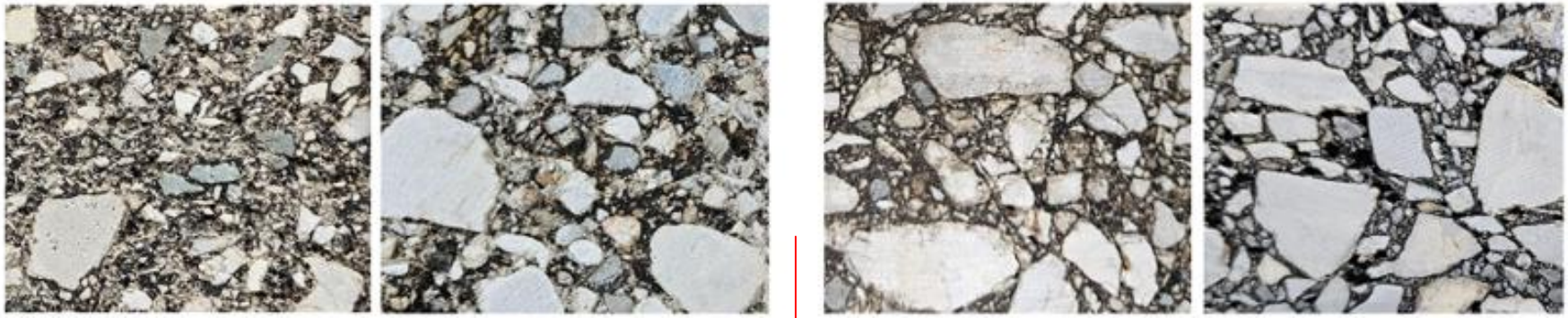
Visual comparison of layer structure.

BSM vs HMA



If we use similar input materials, the appearance is similar, even though the production is completely different.

Differences between BSM and HMA mixtures

1. Mixture temperature

BSM vs HMA

COLD HOT

The input materials for BSM do not need to be heated, as with asphalt mixtures.
This saves a lot of energy.

Differences between BSM and HMA mixtures

2. Moisture content

BSM vs HMA

WET DRY

We have to control the moisture content.

Differences between BSM and HMA mixtures

3. Filler

BSM vs HMA

BSM	HMA
Stone filler + active filler	Stone filler (not active)

Each has a different but important impact on the mixture.

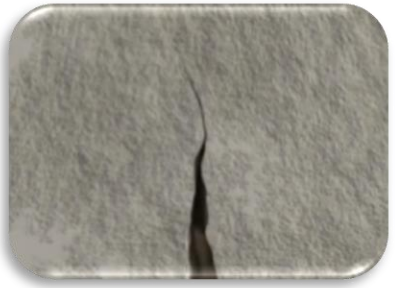
Differences between BSM and HMA mixtures

4. Binding type

BSM vs HMA

non - continuously

continuously



The non-continuously bound material has no fatigue cracks.

Comparison of mixture differences.

BSM vs HMA

	BSM	HMA
1. Mixture temperature	winner	
2. Moisture content		winner
3. Filler		
4. Type of bound	winner	

Can BSM be **equivalent** to HMA (base layer)?

The question is:

1. Can BSM handle heavy traffic loads?

2. Is BSM frost resistance material?

Can BSM handle heavy traffic loads?

BSM and Wheel tracking test (SIST EN 12697-22:2020+A1:2024)

Materials used:
- 75% RA; 0/22 mm
- 25% Sand; 0/2 mm

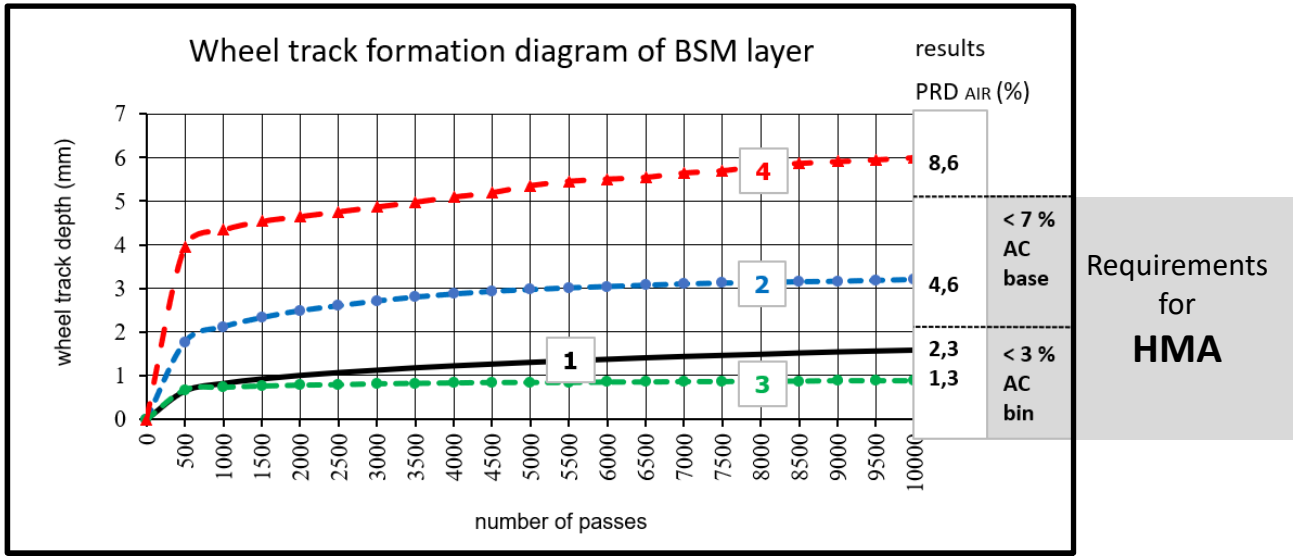
Binders:
- 2,0% Foam bitumen
- **1,0**% Cement
- 5,1% Optimum moisture content

The mixture was compacted with a laboratory roller compactor.
Layer thickness 70 mm.

BSM and Wheel tracking test (SIST EN 12697-22:2020+A1:2024)

Each sample was covered with a damp cloth from compaction until the start of the test to maintain moisture in the layer.

BSM and Wheel tracking test (SIST EN 12697-22:2020+A1:2024)



Test 1 – 24 hours old, moisture content * 1,5%, temperature 60°C

Test 2 – 24 hours old, moisture content * 4,5%, temperature 22°C

Test 3 – 72 hours old, moisture content * 4,6%, temperature 22°C

Test 4 – 3 hours old, moisture content * 5,5%, temperature 22°C

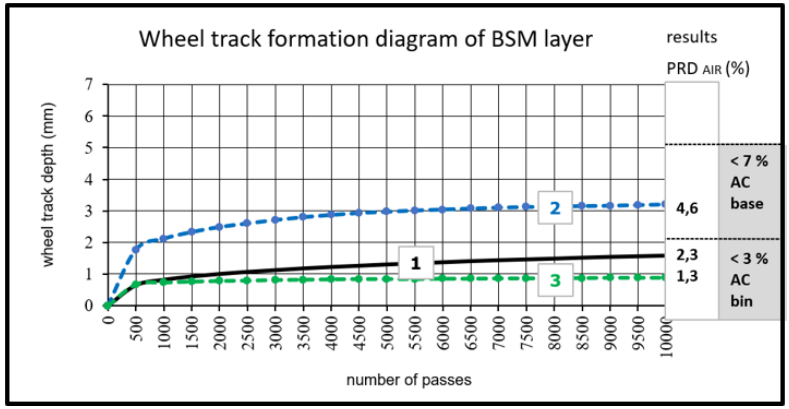
*after test

BSM and Wheel tracking test (SIST EN 12697-22:2020+A1:2024)

- Test 2 wheel track depth 3,2 mm
- Test 4 wheel track depth 6,0 mm

Can BSM handle heavy traffic loads?

Evidence No. 1



Evidence No. 2

Ayrton Senna Highway Test field 600 m (2011)

BSM 30 cm + HMA 5 cm

Both examples have 1% active filler.

This is an upper limit.

BSM **IDEAL BASE LAYER MATERIAL**

HMA **IDEAL SURFACING MATERIAL**

Is BSM frost resistance material?

In 2009 and 2013, we conducted tests at our institute and the Faculty of Civil and Geodetic Engineering (University of Ljubljana).

- Laboratory tests have shown that mixtures have reduced thermal conductivity (increased frost resistance) and do not contain ice lenses.
- The mixture meets frost protection criteria if appropriate materials are used.

BSM also has this advantages:

up to 100 % less material disposal costs

up to 90 % less transport volume

up to 90 % less use of resources

up to 60% less CO_2 emission

up to 50 % less use of binders

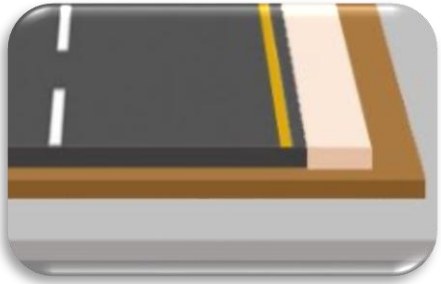
up to 50 % shorter construction time

up to 50 % lower overall cost

If we have all this.
Why didn't BSM defeated HMA?
Why don't we have an immediate and complete victory?

Where is the catch?

The story usually goes like this.



layers
design

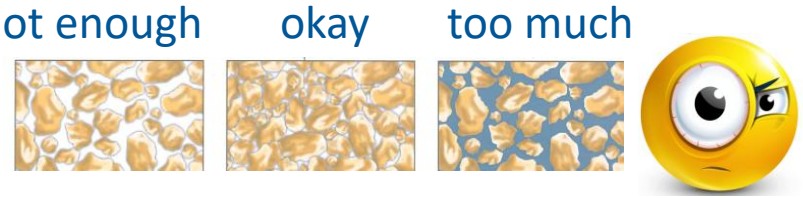
recipe
preparation

test
field

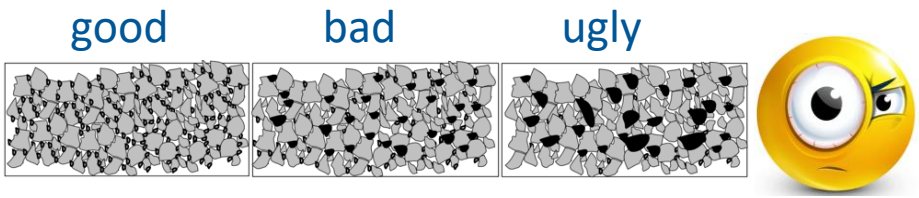
mass
production

During the production of BSM must be **constantly checked**:

- moisture content



- foaming quality



- quality of materials
- sieve analysis

HMA doesn't need most of this.

These are some of the reasons why we have more mistakes in BSM.

A construction supervisor must **understand** how to properly **set up** systems and **recognize** when things are not working or are not appropriate.
It must be connected to all participants in the work process so that it can **change** settings **immediately,** (which is not necessary with HMA).

We need:

knowledge
experiences
qualified person

immediately
respond
correction

military
discipline

HMA production technology is significantly more expensive, but also more sophisticated.
The quality characteristics of the mixture have the smallest deviations compared to other productions.

BSM technology is cheaper and less sophisticated. The material's path through the production plant to the mixer is shorter and the possibility of mistakes is greater.

The quality characteristics of the mixture are significantly influenced by the **HUMAN FACTOR**.

Probability of deviation of quality characteristics of the mixture

quality characteristics	GOOD team		BAD team	
	HMA	BSM	HMA	BSM
material quality	1	1	1	2
sieve analysis	1	1 or 2	2	3
binder content	1	1	1	2
moisture content	0	1	0	2
confidence factor Σ	3	4 or 5	4	9

(estimated values)

0 - never
1 - low probability
2 - medium probability
3 - high probability

If we have a bad team on HMA, the mixture will be worse.

If we have a bad team on BSM, the mixture will be a **disaster.**

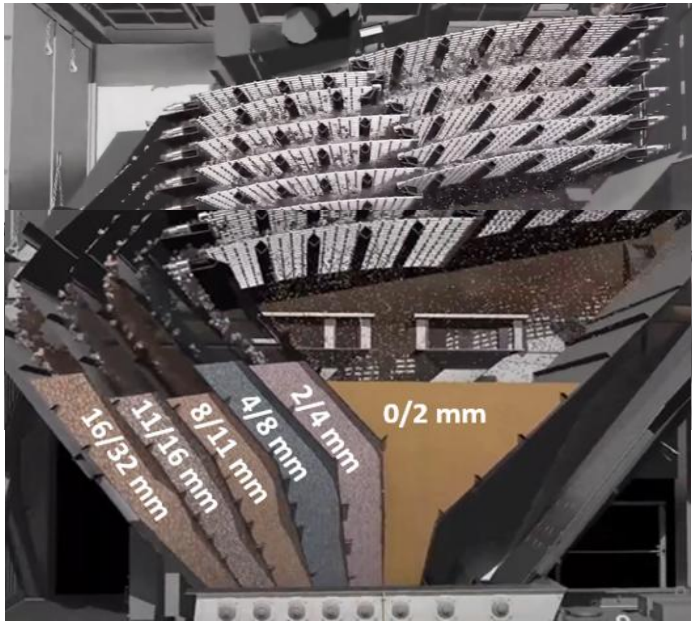
Asphalt plant

The material is dry, sieved and sorted by grain size.

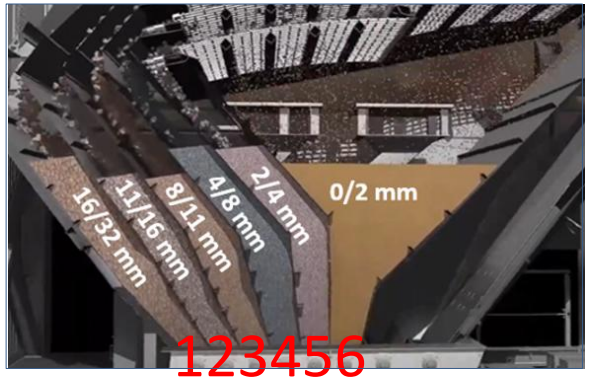
TECHNICAL FACTOR Production in plant

Only completely dry or completely wet materials can be sieved.

The material for the production of BSM contains moisture, so it cannot be sieved because the stones stick to each other and to the sieve.

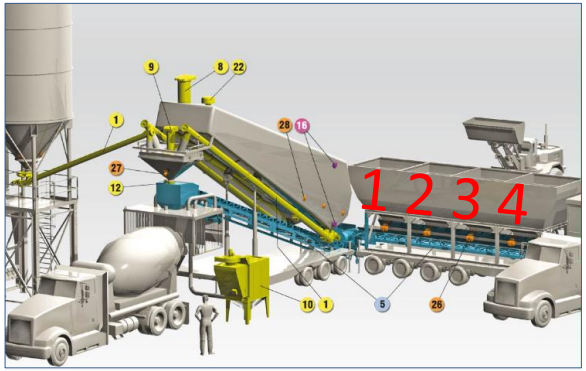


Asphalt plant



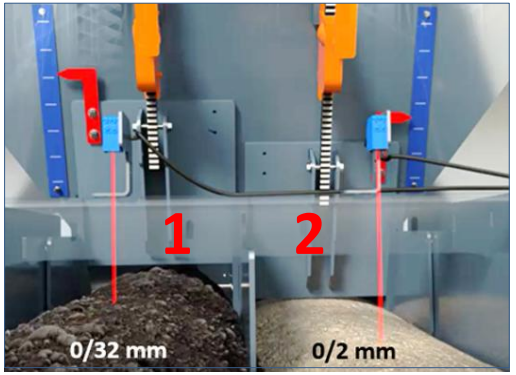
six feeders

Concrete plant



four feeders

KMA (BSM)



two feeders

The **more feeders** we have (the deviation of the gradation curve will be smaller), the **better the quality** of the mixture will be.

Deviation of the gradation curves.

Production in plant.

BSM	good (if the incoming materials are OK)
CONCRETE	better
HMA	the best

When preparing BSM recipe, the mixture is divided into three different grain sizes.
This reduces differences between samples.

Sample Preperation for Specimen Manufacture

BLEND PROPORTIONING WORKSHEET

Sample Information

	DN:000-A-25	Location / Source	0
Job Card	0	Section	0
Sample Number	0	Date Received	

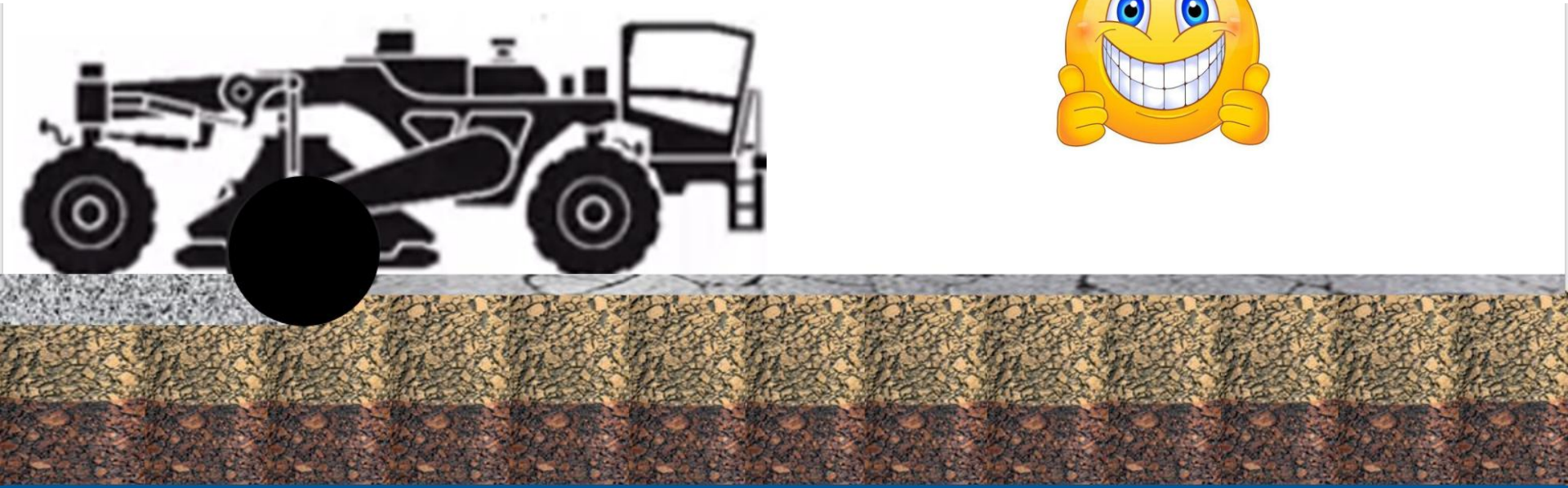
000-GEO-25

za Proctor (g)	7000	Blend from Layer 1 (%)	#DIV/0!
za ITS (g)	20000	Blend from Layer 2 (%)	#DIV/0!
Triaxial specimens (g)	0	Blend from Layer 3 (%)	#DIV/0!

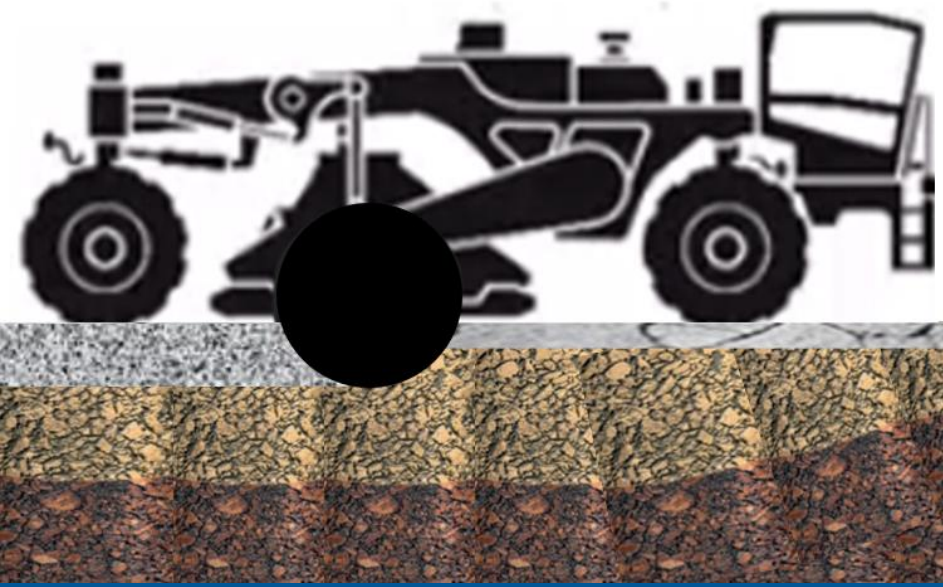
Sample ID	Blend Quantity (%)	Sieve Size (mm)	Quantity (%)	za Proctor (g)	za ITS (g)	Triaxial (g)
0	#DIV/0!	22,4mm - 11,2mm	0			
		11,2mm - 4,0mm	0			
		< 4,0mm	0			

Production in situ

If we have the same thickness, type of materials and moisture content **all the time**, there is no problem.
BSM can be equivalent to HMA.



If the changes are too big, problems will follow.



The advantage of BSM technology is the recycling of materials, which is usually very cheap or even free.

These materials also have a disadvantage. The level of confidence is often much lower than when using new materials.

It would be easier for us, if we only used new materials.

To make **BSM equivalent to HMA** (base layer) we need:

in general

- the knowledge of builders and supervisors needs to be improved (human factor)
- the production of the mixture needs to be improved (technical factor)

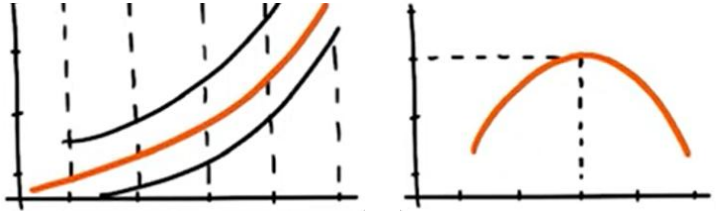
To make **BSM equivalent to HMA** (base layer) we need:

shown in a different way

- the material for BSM must have similar properties to the material used for HMA (or RAP)
- the mixture must bi designed well
- the quality characteristics of the **entire** (all the time) produced mixture must be within the requirements

So we need:

good materials



qualified construction team

good supervisor

Three kings of BSM

Dave Collings Prof. Kim Jenkins André Greyling

BSM Recycling specialists