Institut für
Materialprüfung,
Bauberatung
und Analytik.

Indentation test for mastic asphalt

New method and follow-up to standardization

IMP Bautest AG
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1. Why?
2. What?
3. How?

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Why

do we need a new method?

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MA is mainly installed on bridges

Image: epikdrives.com

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Bridges are located at neuralgic points of the road network

Image: Martin Rütschi

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Maintenance work on bridges inevitably leads to major traffic disruptions.

Delays due to quality problems have a greater impact on bridges than on tracks.

Image: Federico Gambarini

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When installing the MA in 2 or more layers…

…the quality of the first layer must be known before the installation of the second layer

→ Test results must be available quickly

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Conclusion 1

When paving asphalt in several layers on bridges, even fewer mistakes should be made than on the track!

→ Reliable, rapid quality controls are required

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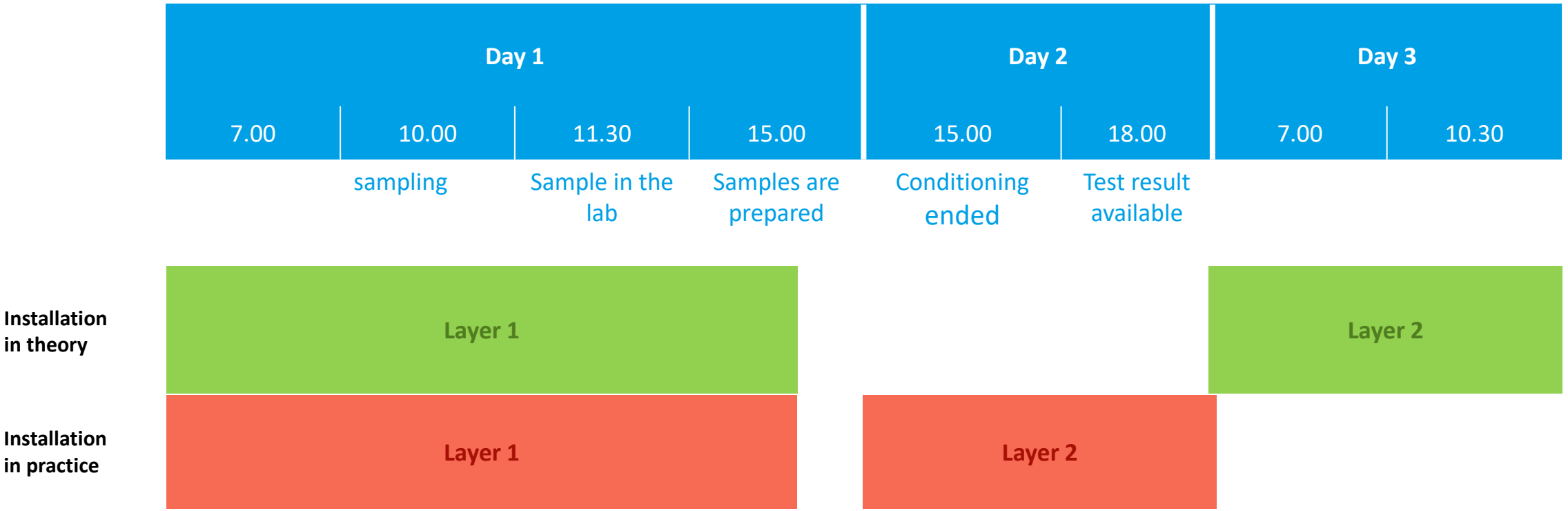
The current test (ET stat EN 12697-20) has two important disadvantages:

- The duration of the test
- The significance of the test

Duration of the test

Example of the time sequence "from sampling to the result”



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significance of the test ET stat

Example from practice
MA paving on a construction site over two years (same asphalt plant/formulation)

Test parameters	Paving 1st year	Paving 2nd year
Binder content [Masse-%]	6.87	7.04
Filler content [Masse-%]	28.8	27.2
SP R&B [°C]	65.0	59.2
ETstat 30' [mm]	**1.6**	**2.3**

- the differences of the individual parameters are partly considerable, moreover their influence on the deformation resistance is cumulative -> significant differences in the deformation resistance are to be expected
- the differences in ET stat are relatively small (increase 44 %)

significance of the test ET stat

Example from the practice

The **ET dyn** clearly shows the differences:

- ET_{dyn} 1st year: 2.1 mm
- ET_{dyn} 2nd year: 5.6 mm → **increase of 167 % !!!**

- **The ET stat is not able to show the existing differences.**

Today's test methods for the mecanical properties of MA

- Static indentation (EN 12697-20): unsuitable for hard MA grades.
- Dynamic indentation (EN 12697-25): very good test method, but takes at least 3 ½ days.

Conclusion 2

Currently, there is no standardised procedure for rapid quality control

→ Reliable, rapid quality controls are needed

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What
is a new method?

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Requirements for a rapid method

What is expected

- Result available 6 h after laboratory receipt
- Sufficiently reliable
- Can be carried out by simple site laboratories

What is **not** expected:

- No testing within type testing

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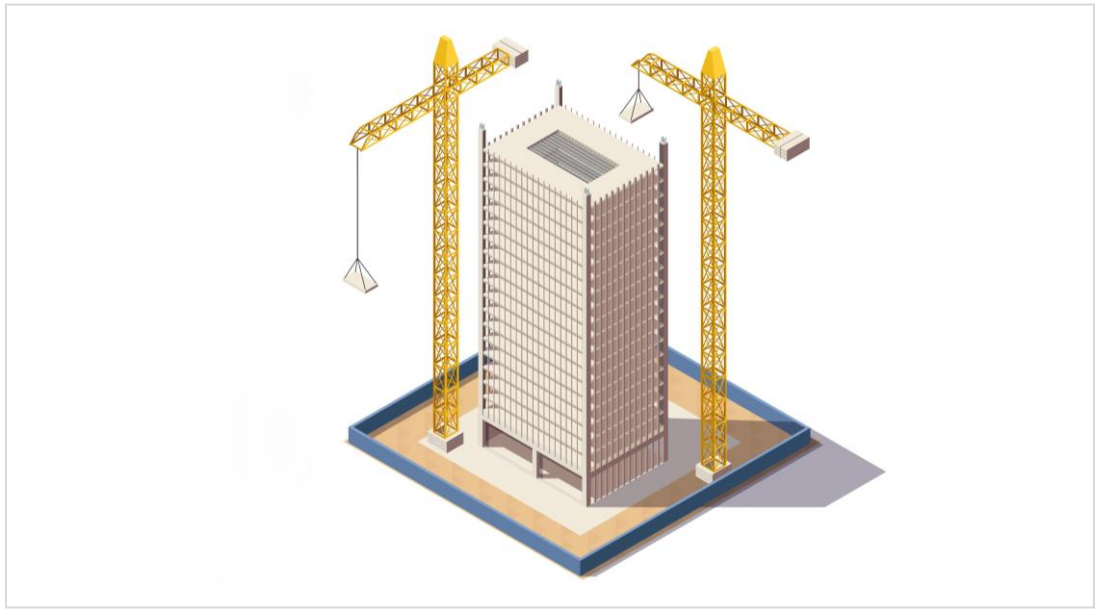
What are other construction sectors doing?

The structural engineer calculates a building with the concrete compressive strength after 28 days



→ The structural engineer cannot wait 28 days for the test results .
→ **Same problem as in the MA !!!**

The solution in concrete construction:

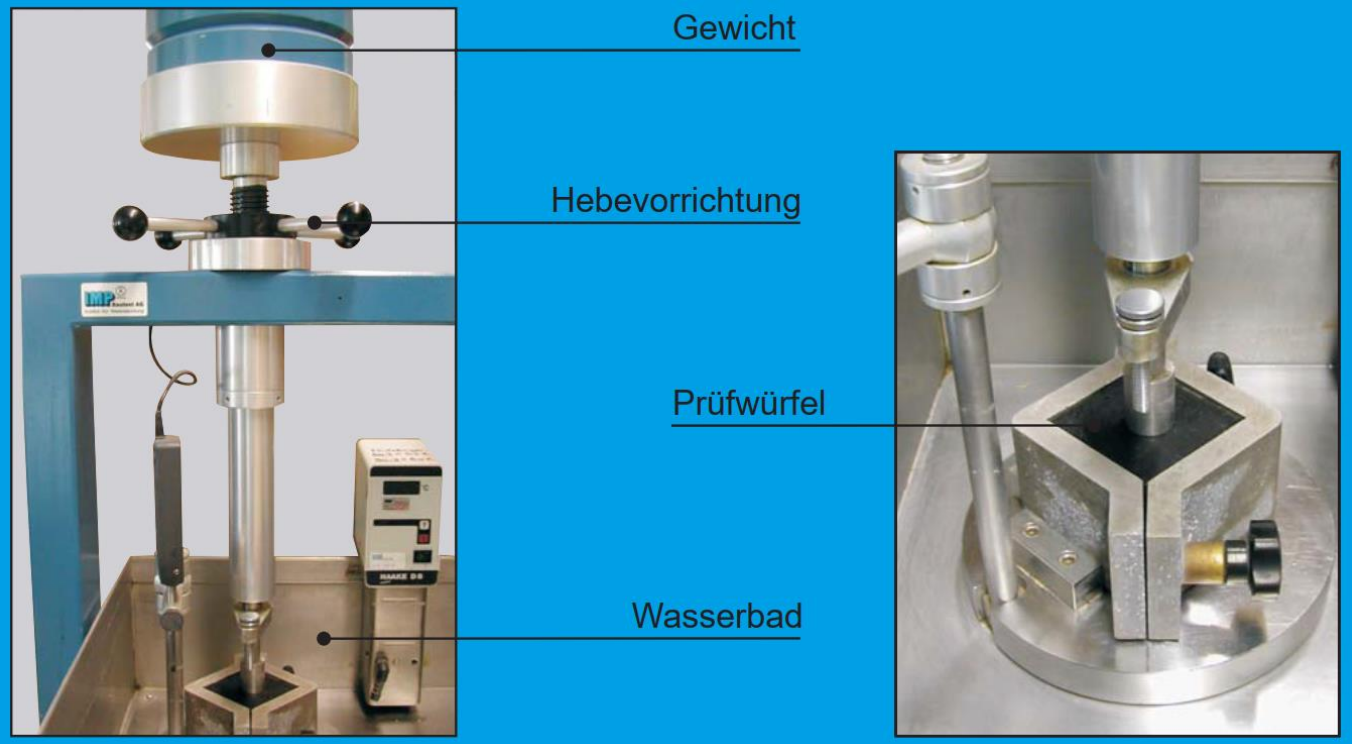
Test on fresh concrete as **control variables**/parameters

If the fresh concrete test results are good, the hardened cement properties will also (most likely) be good

Rapid method for indentation

Basic ideas for the choice of test parameters

Use of existing unit



Most common PmB for MA

Softening point R & B

PmB 25/50 - **55**
PmB 25/55 - **65**
PmB 10/40 - **60**
PmB 10/40 - **70**

→ **Test temperature 55 °C**

Rapid method for indentation

Basic ideas for the choice of test parameters

Use of existing unit

Test temperature <
Softening point R & B

Increase load

Previously
525 N; applied by:
25 N (rod) +
4 x 125 N (weight rings)

New
650 N; applied by:
25 N (rod) +
5 x 125 N (weight rings)

Rapid method for indentation

Basic ideas for the choice of test parameters

Use of existing unit

Test temperature <
Softening point R & B

Increase load

Shorten load time

32 MA samples evaluated after 15' and after 30':

	ET stat mod [mm]	
	15 Min	**30 Min**
Mean value	1.90	2.14
Standard deviation	0.44	0.52
Coefficient of variance	**0.23**	**0.24**
Number of value pairs	32	32

→ **15' instead of 30' possible with same precision (variance coefficient)**

Use of existing unit

Test temperature <
Softening point R & B

Increase load

Shorten load time

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Rapid method for indentation

- Use of existing unit
- Test temperature 55°C
- Load 650 N
- Load time 15 minute
- Number of samples 2

Advantages of the method (rapidity)

	Cube according to standard	Cube accelerated	Cylinder (new)
Operation	**[h]**	**[h]**	**[h]**
Reception of sample	0.5	0.5	0.5
Sample division	0.5	0.5	
heating in a stove	2	2	
Cutting cylinder			0.5
Preparation of cubes	0.5	0.5	
Cooling (wather bath)		2	
Waiting according to standard	24		
Conditioning to test temperature (water bath)	1	1	1
Tetsting	1.1	1.1	0.5
Evaluation	0.5	0.5	0.5
Total time required	**30.1**	**8.1**	**3**

→ **27 h faster**

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Advantages of the method (significance)

- 24 MA-samples were examined
- Method according to the standard and rapid method
- selectivity was assessed by the ratio ET max / ET min of all 24 samples

standardised method **ET max/ ET min = 7.0**
rapid method **ET max/ ET min = 11.4**

→ **New method spreads 50 % better**

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Rapid method for indentation

Advantages:

Time gain (27h)

Significance improved (selectivity 50 % better)

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Rapid method for indentation

Präzision

- The precision of the method strongly depends on the sample preparation on the construction site
- For companies with trained and experienced personnel, the precision of the rapid method is comparable to that of the standardised method

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Rapid method for indentation

Requirements

Investigation of IMAA on 40 MA samples (2 test specimens tested each) as a basis for provisional requirements:

MA type	Requirement	Number of samples tested	remark
MA 8 and MA 11 Typ (S und H)	< 2.5 mm *	35	*target value
MA 5	< 3.0 mm **	5	**guideline value

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How

do we implement it in the EN-standardization?

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EN-Standardization

Existing EN 12697-20…

…contains already two test methods

- test of MA on cubes
- test on cylindrical specimens for asphalt other than MA

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EN-Standardization

Examples of standards with several test methods

EN 12697-25 «Cyclic compression test»

method A – Uniaxial cyclic compression test with confinement
method A1- block pulse loading
method A2 – haversine pulse loading

method B – Triaxial cyclic compression test

EN 12697-24 «Resistance to fatigue»

2-Point bending test on trapezoidal specimens (2PB-TZ)
2-Point bending test on prismatic shaped specimens (2PB-PR)
3-Point bending test on prismatic shaped specimens (3PB-PR)
4-Point bending test on prismatic shaped specimens (4PB-PR)
Indirect tensile test on cylindrical shaped specimens (IT-CY)
Cyclic indirect tensile test on cylindrical shaped specimens (CIT-CY)

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EN-Standardization of the rapid method

The simplest way -> supplement the existing standard EN12697-20 with a third method.

Thanks to IMAA, which funded parts of the study:

→ **Development of the method:**
ASTRA (Swiss federal road authority)
(IMP)

→ **Validation of the method:**
→ **IMAA (International Mastic Asphalt Association)**
(IMP/ Berner Fachhochschule)

→ **Definition of requirements**
IMAA (International Mastic Asphalt Association)
(IMP/ Berner Fachhochschule)

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Thank you.

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