

Highly modified bitumen in perpetual pavements

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INTRODUCTION

It is commonly considered that the asphalt pavements are less durable than cement concrete pavement.

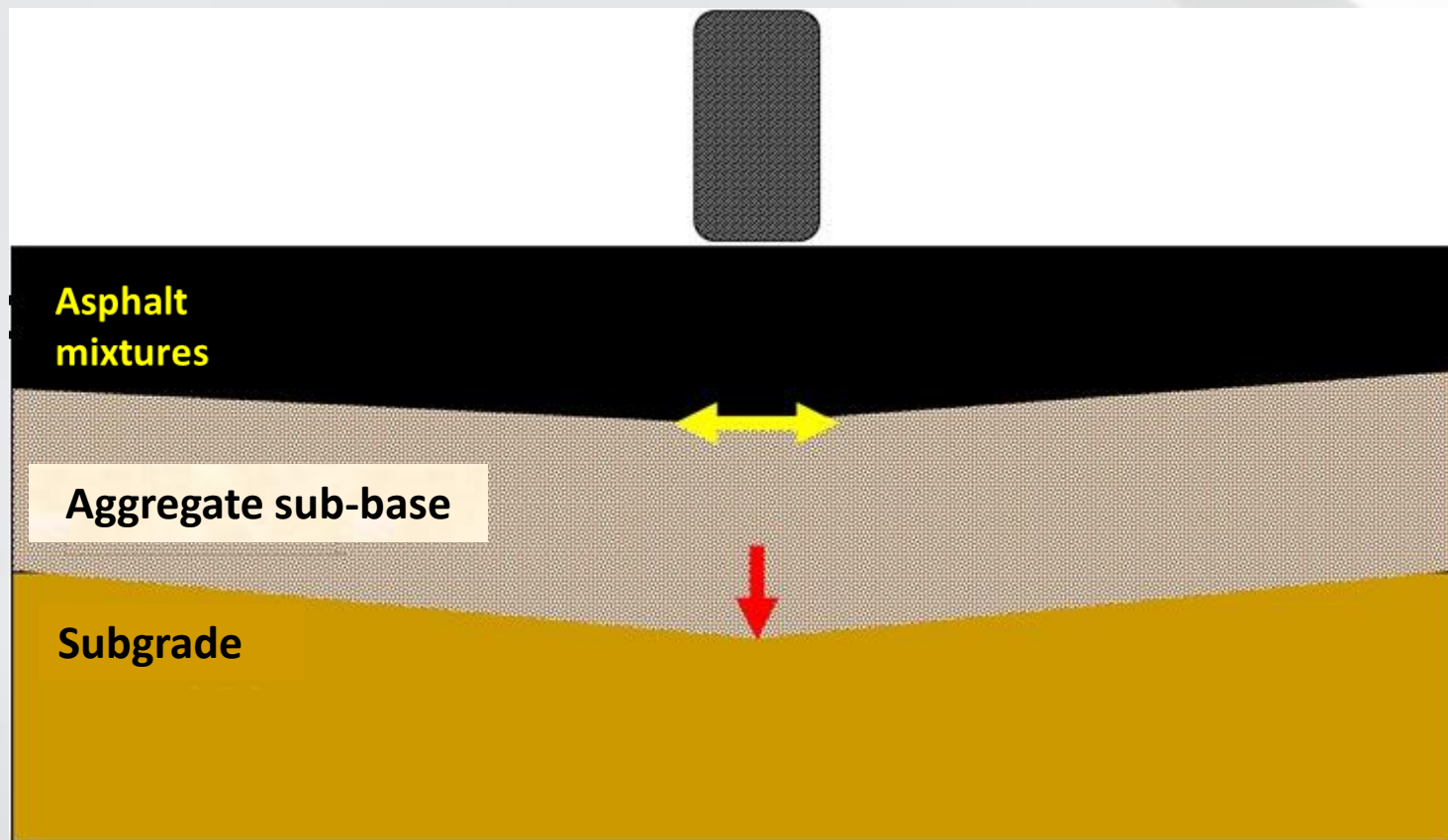
However, they don't have to be!

Several years ago, in Europe and in the USA, there has been developed the concept of durable asphalt pavements known as *perpetual pavements* or *long-lasting pavements*.

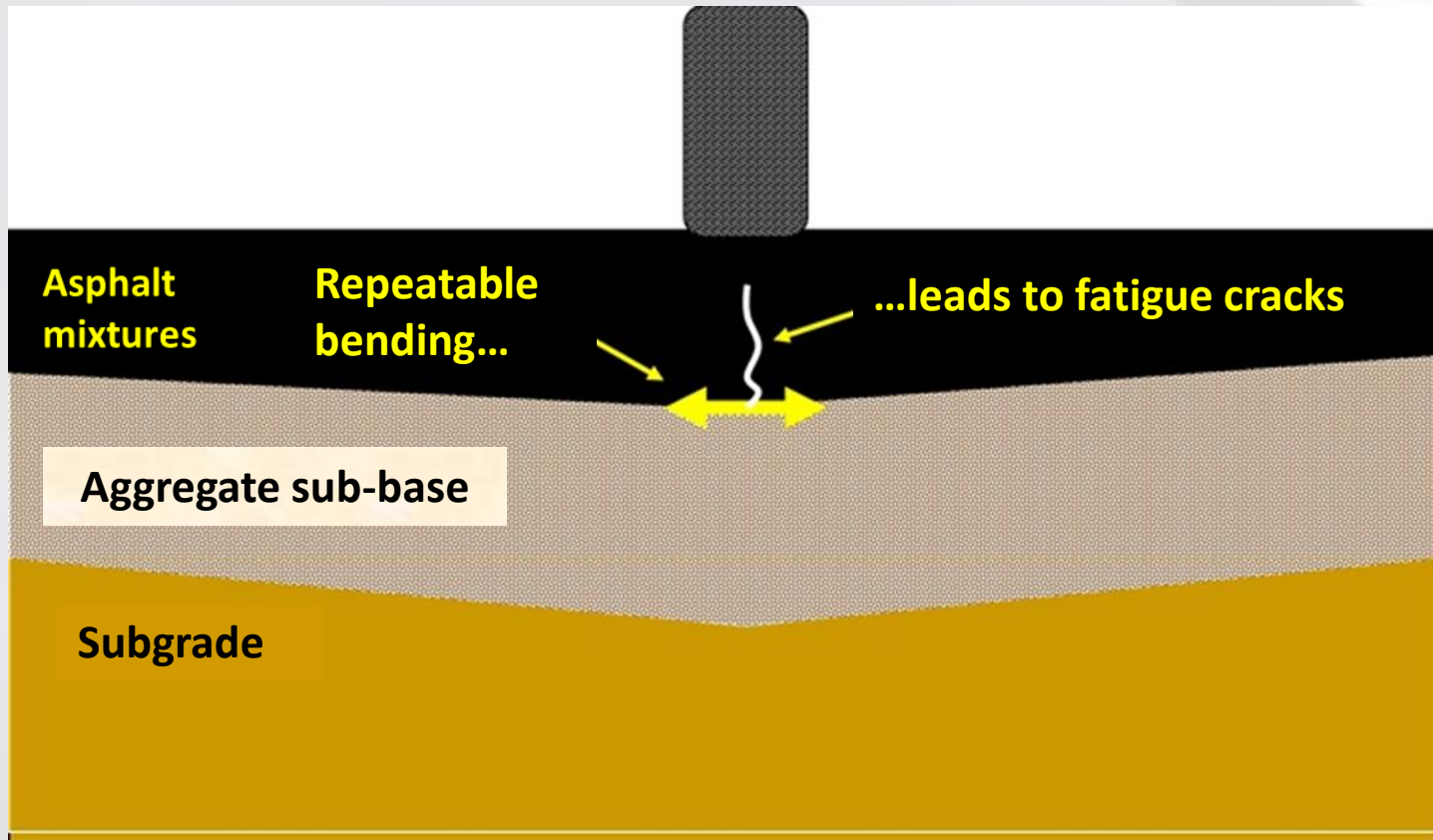
Since that time, there has been made hundreds of sections of asphalt roads, which withstand heavy traffic in an excellent way.

If the concept of *perpetual pavements* is understood completely and if it is applied to the appropriate materials, it will be possible to achieve the above.

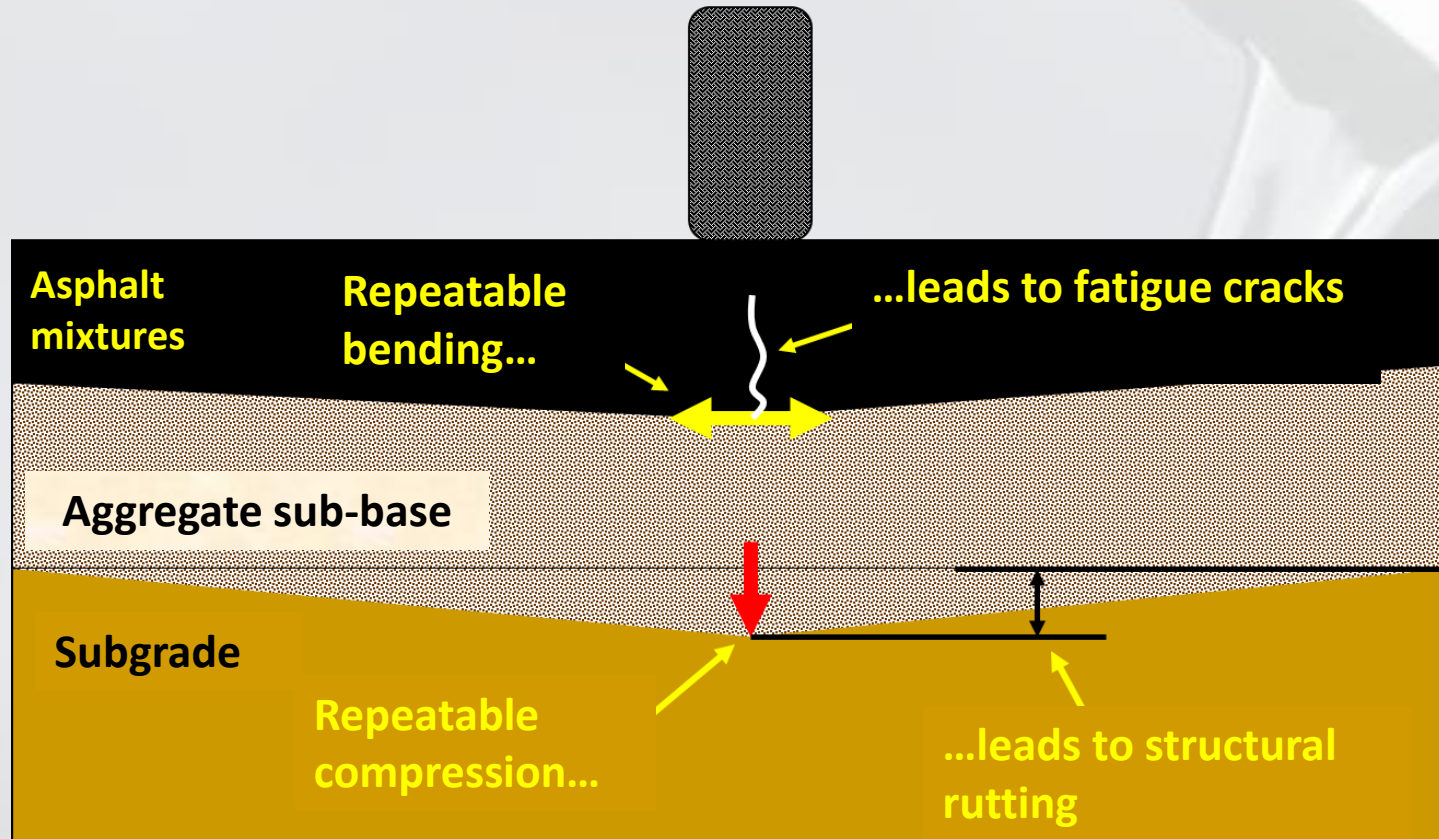
Asphalt pavement – way of work



Asphalt pavement– way of work



Asphalt pavement – way of work



Concept of „*perpetual pavements*”

Perpetual pavements:

Asphalt pavement designed for durability extending 50 years which does not require significant structural repairs (deep), however, it requires only periodic surface treatments which restore driveability.

Concept of „*perpetual pavements*”

The key to achieving such high durability is the suitable fatigue resistance of the asphalt courses.

The most important is the fatigue resistance of the lowest asphalt layer – usually asphalt base-course.

Asphalt pavement - fatigue

The phenomenon of **fatigue in asphalt mixtures**:

- asphalt course in cyclic tensile (during bending)
- the tensile strain values are smaller than the resistance of the material and do not lead to its destruction
- thousands or millions of accumulated cyclic strains causes a crack in the asphalt course.

Asphalt pavement - fatigue

Improving fatigue strength of the asphalt pavement:

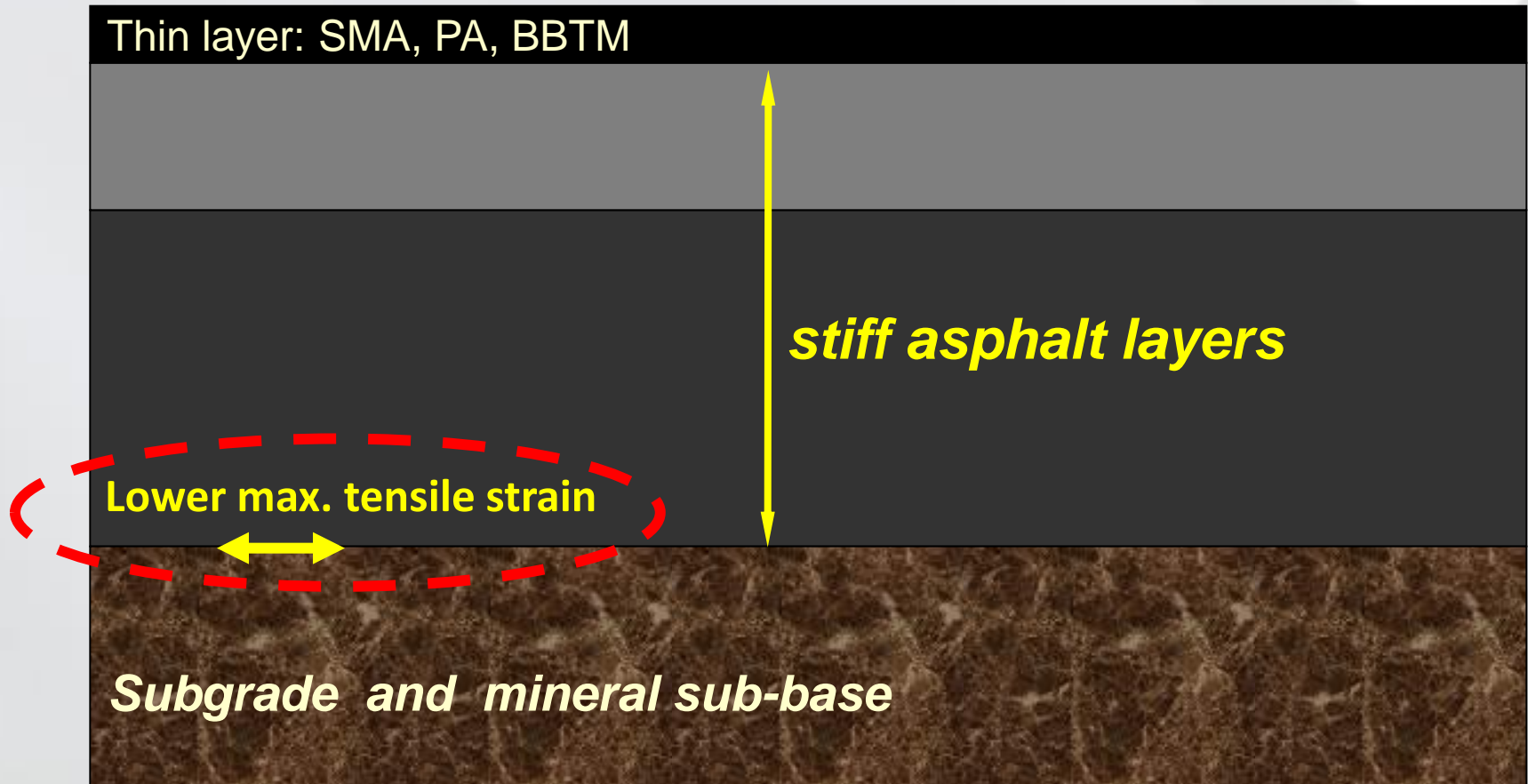
by material way:	by structure change:
<ul style="list-style-type: none">• Higher binder content in asphalt mix• Stiffer binders (10/20, 20/30)• More elastic binders (PMB)• Lower content of air voids in asphalt mix• Other parameters like VFB etc. improvement	<ul style="list-style-type: none">• Stiffer asphalt layers (decreasing of strains)• Elastic layer in the bottom (better resistance to strains)

Implementation of „perpetual pavements”

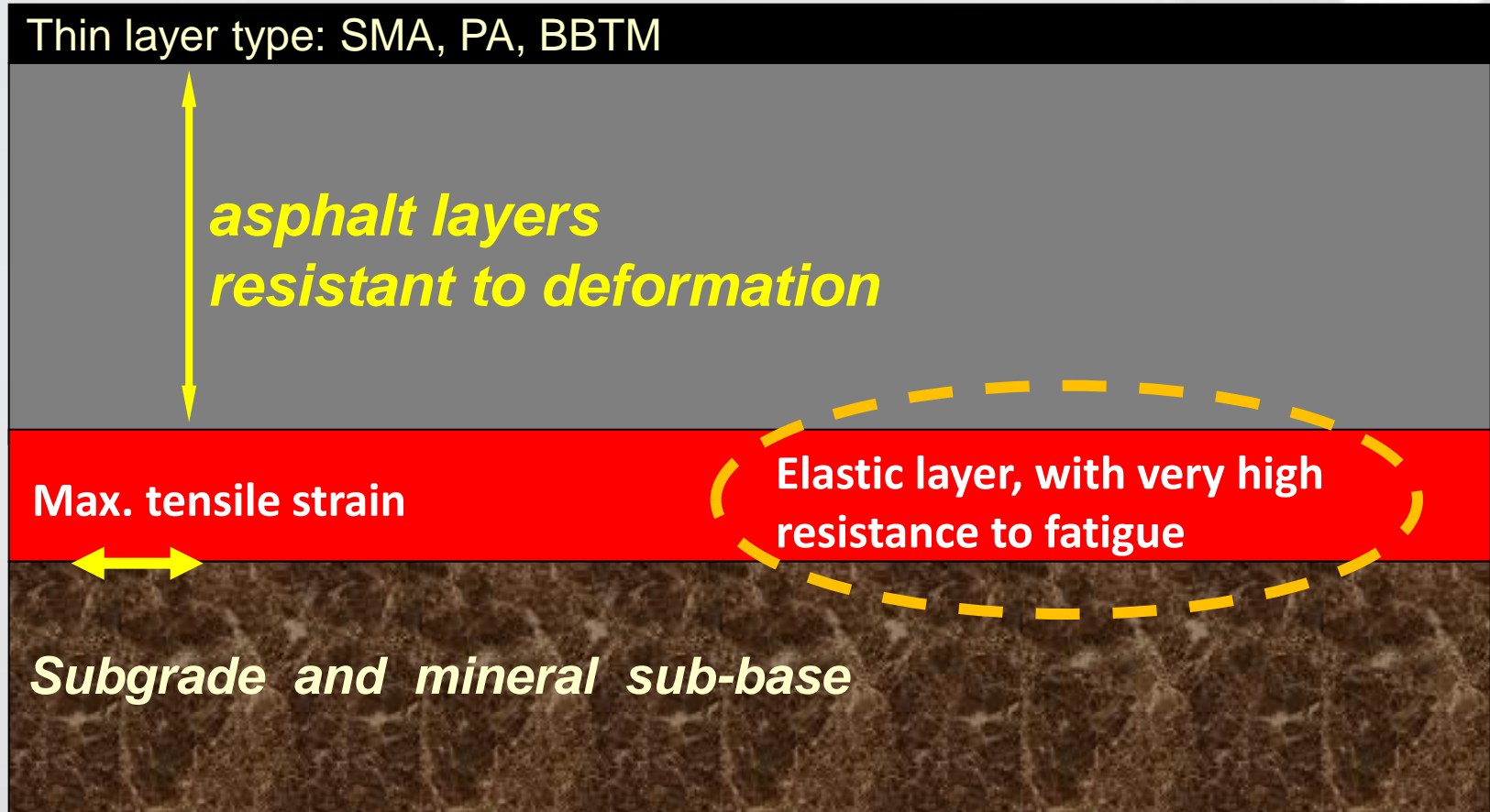
Two concepts of implementation :

- **French/British method – stiff asphalt layers** =>EME mixes (in France), low content of air voids, fine graded, higher content of hard bitumen (pen₂₅<30 dmm)
- **American method – special anti-fatigue (AF) flexible asphalt layer**, low content of air voids, fine graded, high content of modified bitumen or highly modified bitumen

European concept of „perpetual pavements”



American concept of „perpetual pavements”



Application of „perpetual pavements” in Poland

In Poland, we have applied mainly the **French concept of EME** - especially on motorways and express roads **since 2005**.

American concept was tested only in several cases:

- Experimental section SPENS in Pruszków (research project IBDIM) in **2007** using Heavy Vehicle Simulator, AF layer with modified bitumen ORBITON 80C from ORLEN Asphalt
- Road section on the regional road, ZDW* in Katowice, AF layer constructed with SMA 8 and modified bitumen ORBITON 45/80-55, **2009**
- Express Road section on S8, Strabag, with highly modified bitumen, **2014/2015**

*ZDW - Administration of regional roads in Silesia voivodeship



Highly modified bitumens

ORBITON HiMA

in perpetual pavements

ORLEN Asphalt research acc. to Concept of „perpetual pavements”

The Technology, Research and Development Department of ORLEN Asphalt has been working on a new group of bituminous binders – highly modified bitumens, since 2011.

The aim was to introduce into the binder a significantly greater amount of a special SBS (elastomeric) polymer, thereby achieving the special properties of mineral and asphalt mixtures: very high resistance to rutting, and resistance to cracking and fatigue.

In 2013 there was created a new series of bituminous binders **ORBITON HiMA** for further industrial trials and on road test sections.

Highly modified polymer asphalts

The new family of highly modified bitumens **ORBITON HiMA** contains:

ORBITON 25/55-80 HiMA

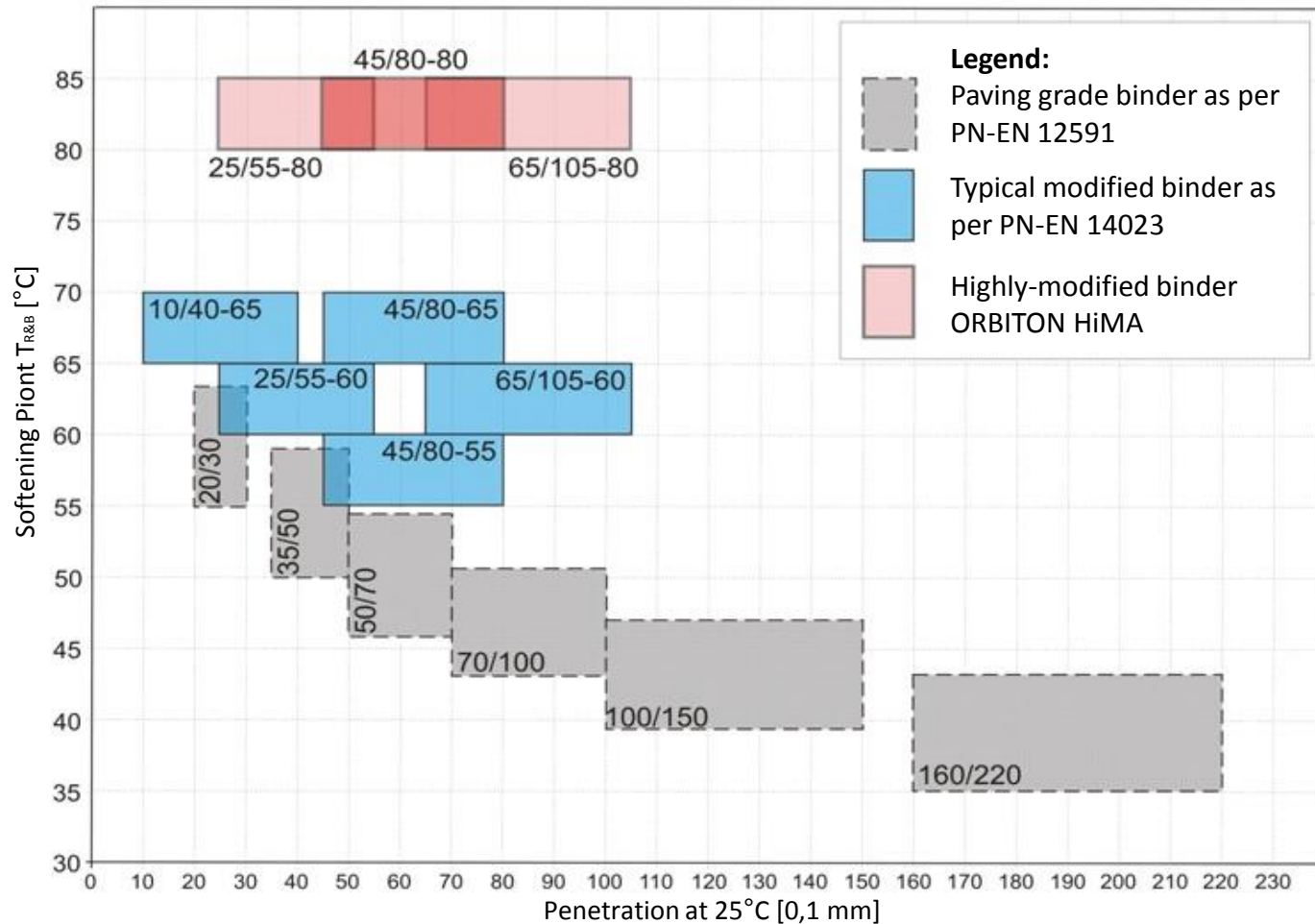
ORBITON 45/80-80 HiMA

ORBITON 65/105-80 HiMA

Applied acronym **HiMA**, according to the US terminology, means:

Highly **M**odified **A**sphalt.

ORBITON HiMA



ORBITON HiMA

Volumetric content
of SBS polymer
and bitumen:



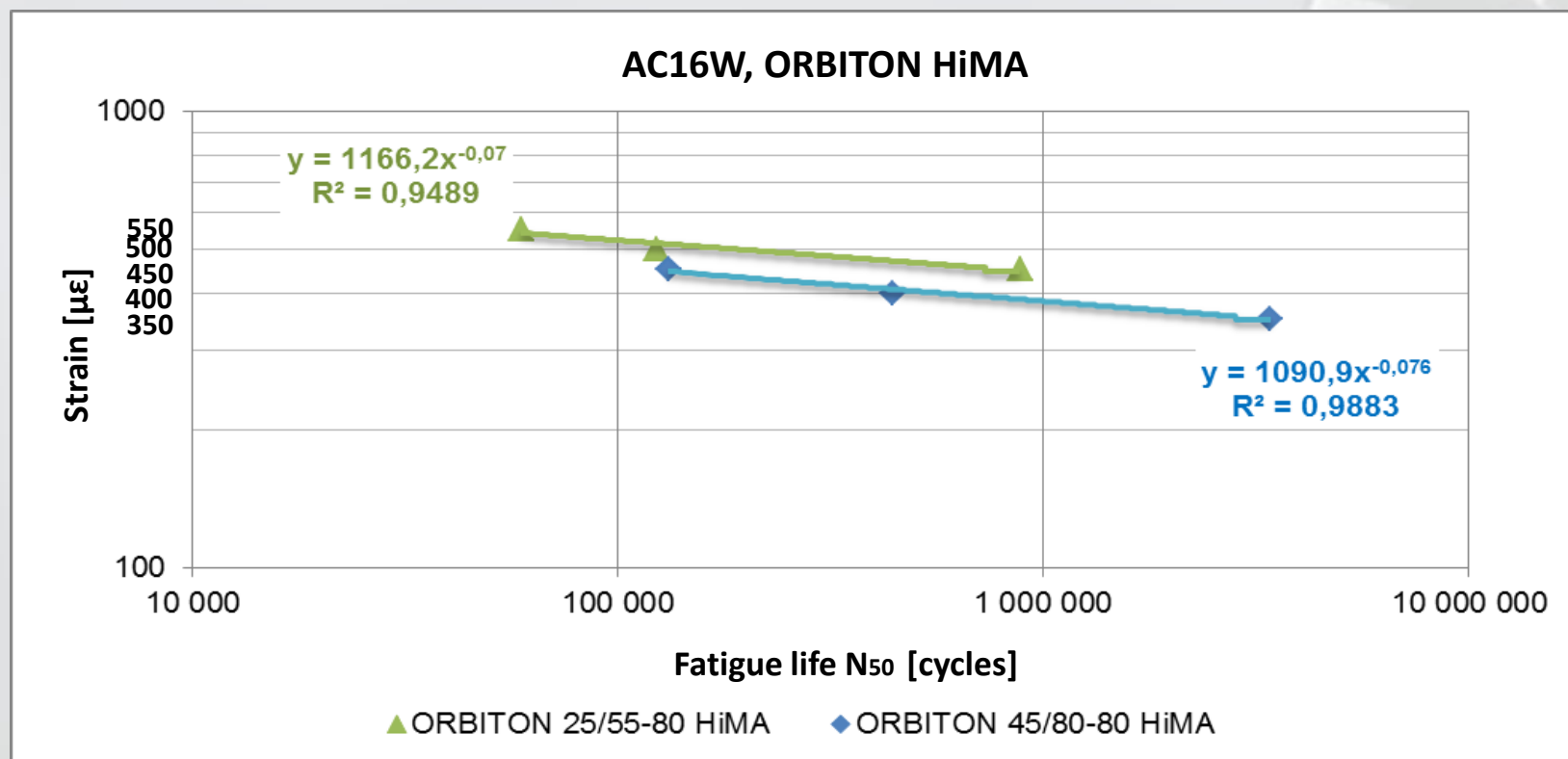
ORBITON HiMA
(Continuous
polymer matrix)



**Conventional
modified bitumen**
(Continuous
bitumen matrix)

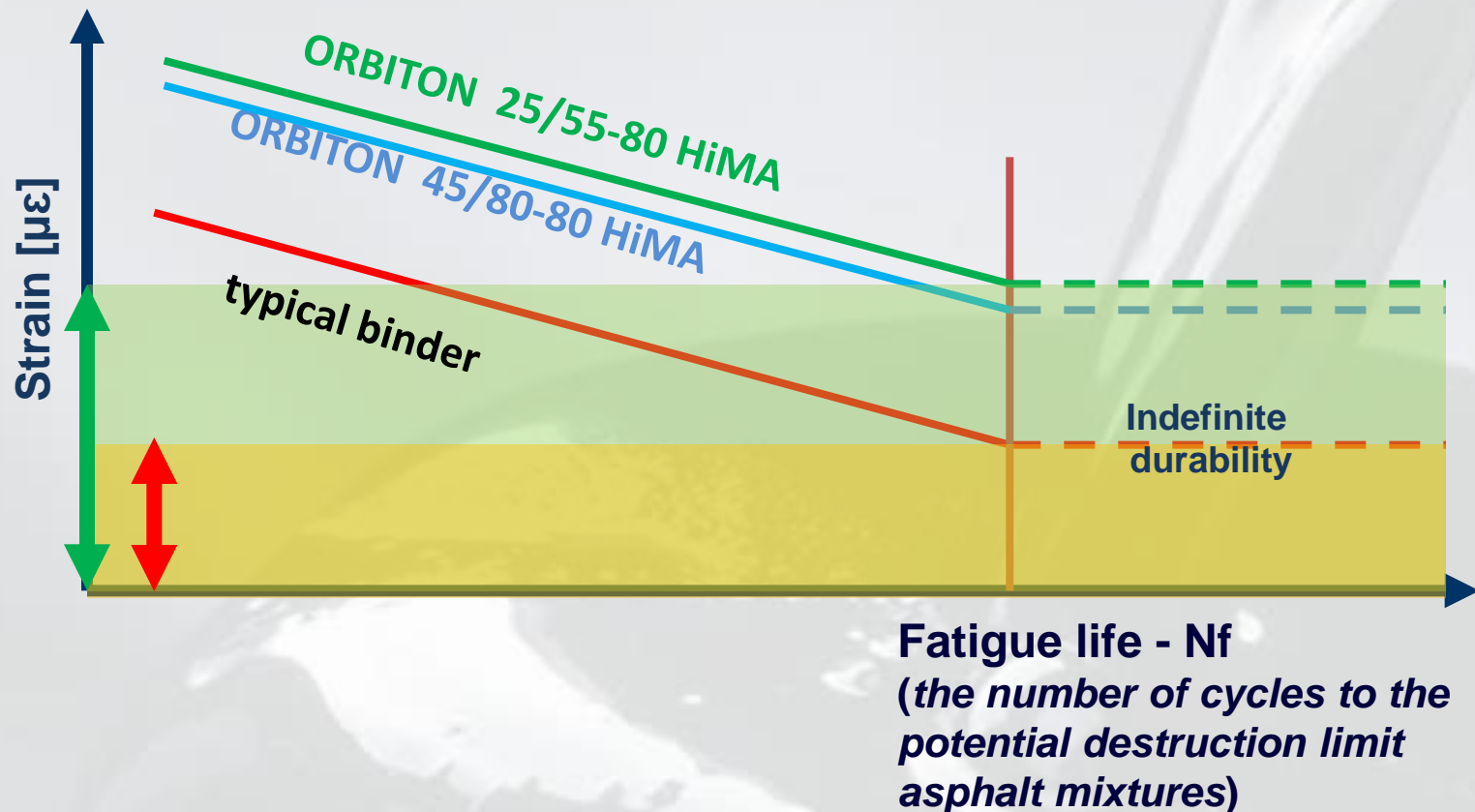
Fatigue life: ORBITON 25/55-80 HiMA and ORBITON 45/80-80 HiMA 4PB-PR (EN 12697-24), 10°C, 10 Hz

Results with peak to peak amplitude (full amplitude)



ORBITON HiMA

Asphalt mixtures with ORBITON HiMA has achieved remarkable results of fatigue strength, locating them in the range of "Indefinite durability, immeasurable" (out of range) – they create bigger reserve of fatigue life than other binders



ORBITON HiMA

The results of fatigue tests performed on Gdansk University of Technology and on Road and Bridge Research Institute, using mixtures AC16W (for binder course), showed that:

- both of mixtures with bitumens ORBITON 25/55-80 HiMA and ORBITON 45/80-80 HiMA have achieved very good fatigue durability,
- **typical values of tensile strain below 100 $\mu\epsilon$ do not cause any remarkable fatigue damage in the mixtures**
- approximation fatigue of durability mixtures with ORBITON HiMA, using the obtained fatigue equations, allows to get theoretical result durability more than 50 million axles, which means indestructibility of fatigue layer or durability more than 50 years of exploitation.

Conclusion

ORBITON HiMA

Conclusion

ORBITON HiMA is a binder dedicated to applications requiring very high performance, using the appropriate type/ hardness.

- asphalt pavements subjected to high stresses and strains, eg.: on bridges
- layer with high resistance to low temperatures,
- thin and ultra-thin wearing course,
- **Asphalt base layers with very high fatigue strength, eg.: for long-lived pavement types as „perpetual pavements“.**

Highly modified bitumens ORBITON HiMA provide more than the standard value added to the quality of asphalt pavements.

Thank you for attention!



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