Sustainable and economical pavements with a novel class of SBS polymers

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Erik J. Scholten

Contents of the presentation

- Key elements of the concept of superior modified asphalt mixes
- Demonstrating the concept
  - Asphalt mix fatigue
  - Comparing structures using Finite Element Modelling
  - Full scale trial at NCAT
- Design examples
- Concluding remarks

Preparing for tomorrow's requirements

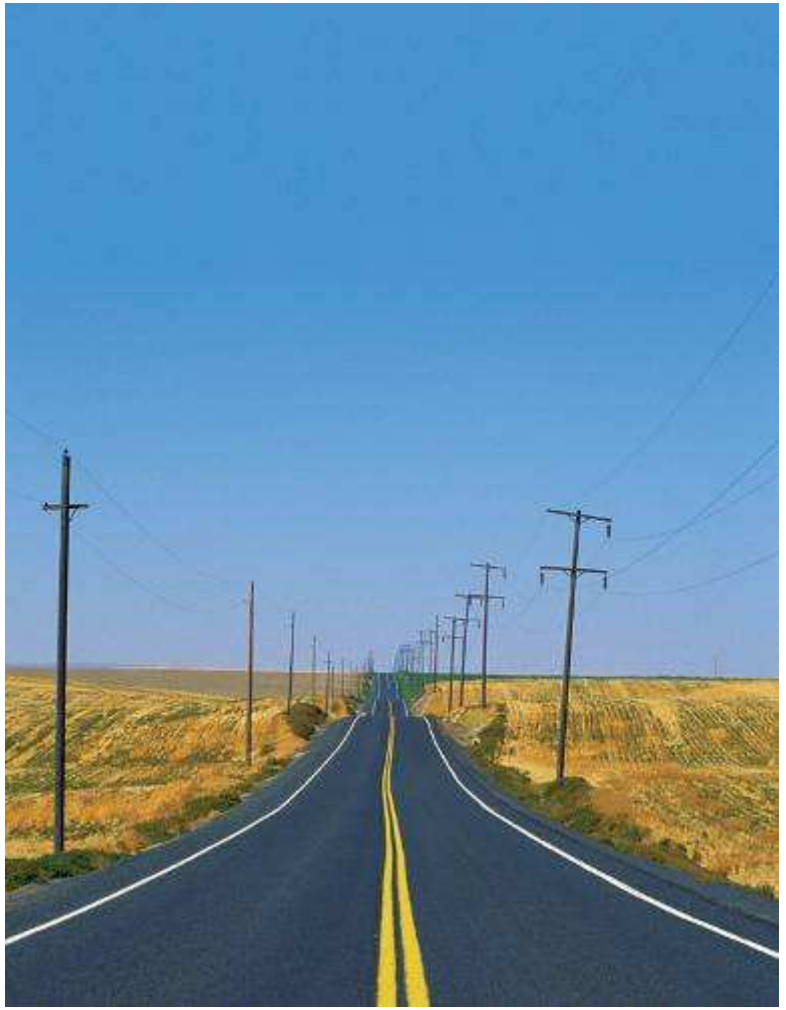
Kraton
Giving Innovators Their Edge

Superior modified asphalt mixes are now possible

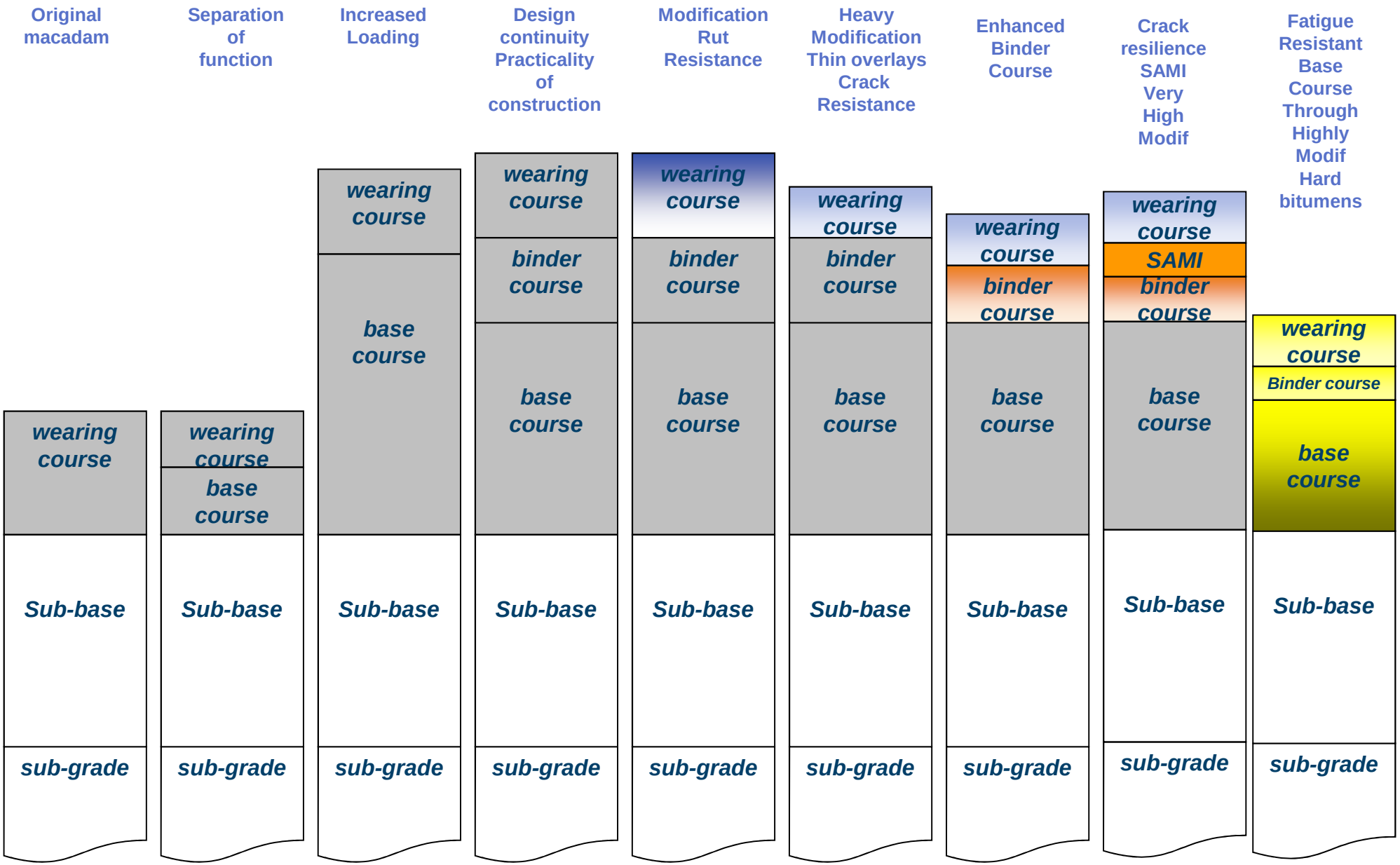
- High modulus, fatigue resistant bitumen bound base courses
- Up front Cost Savings and reduced ecological impact through thickness reduction
- Perpetual pavement at standard thickness

Kraton Polymers' new SBS grades

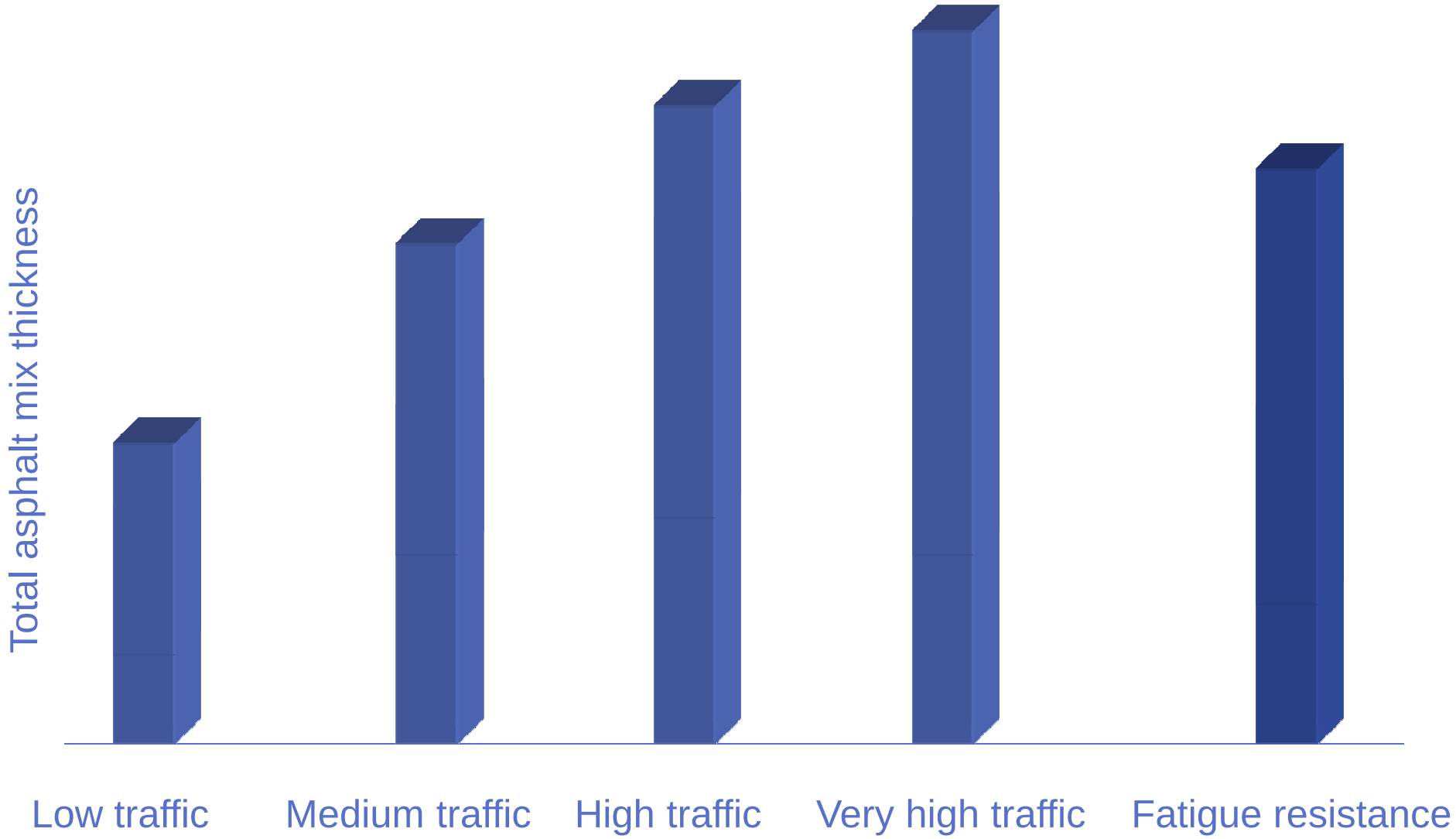
- make it possible with current equipment



The logical next step



The importance of fatigue resistance

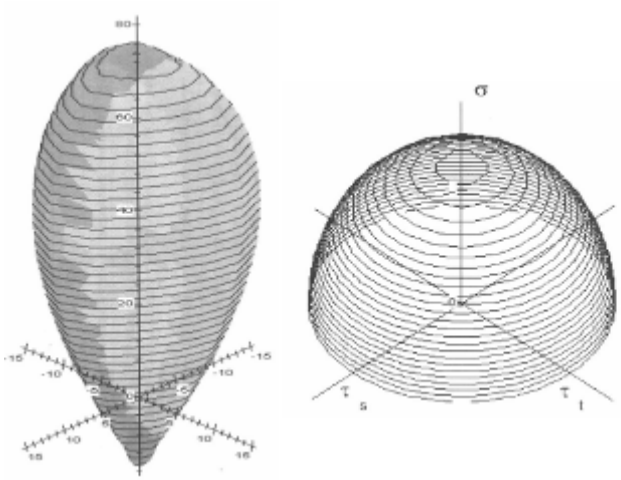


Testing & Modelling

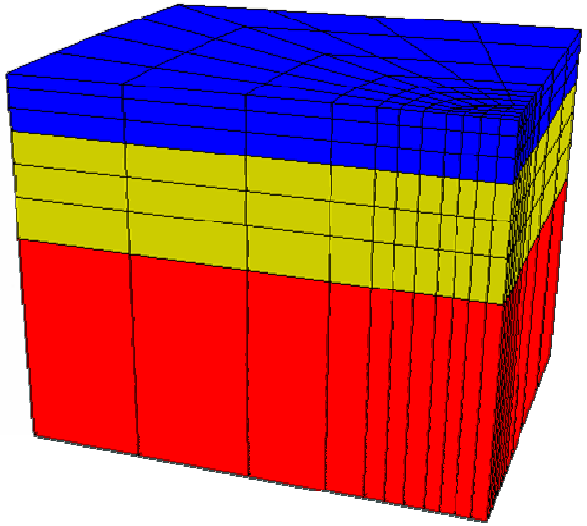
Polymer

Asphalt fatigue tests

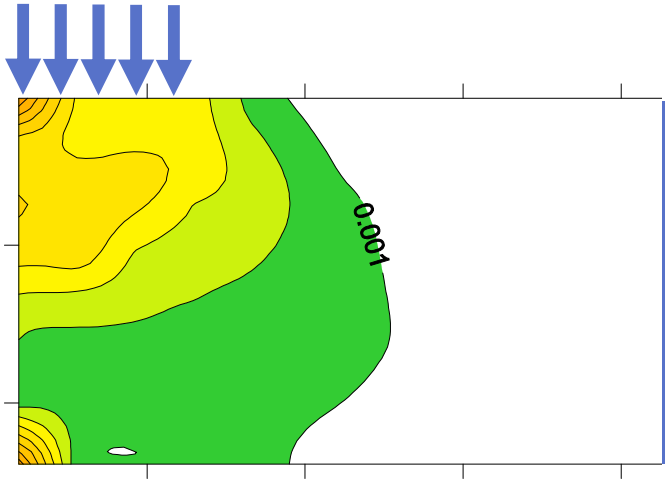
Fundamental asphalt tests



Modelling asphalt for 1 element



Modelling elements into a structure



Calculate ‘damage’ from repeated load

Making it possible with current equipment

Challenges:

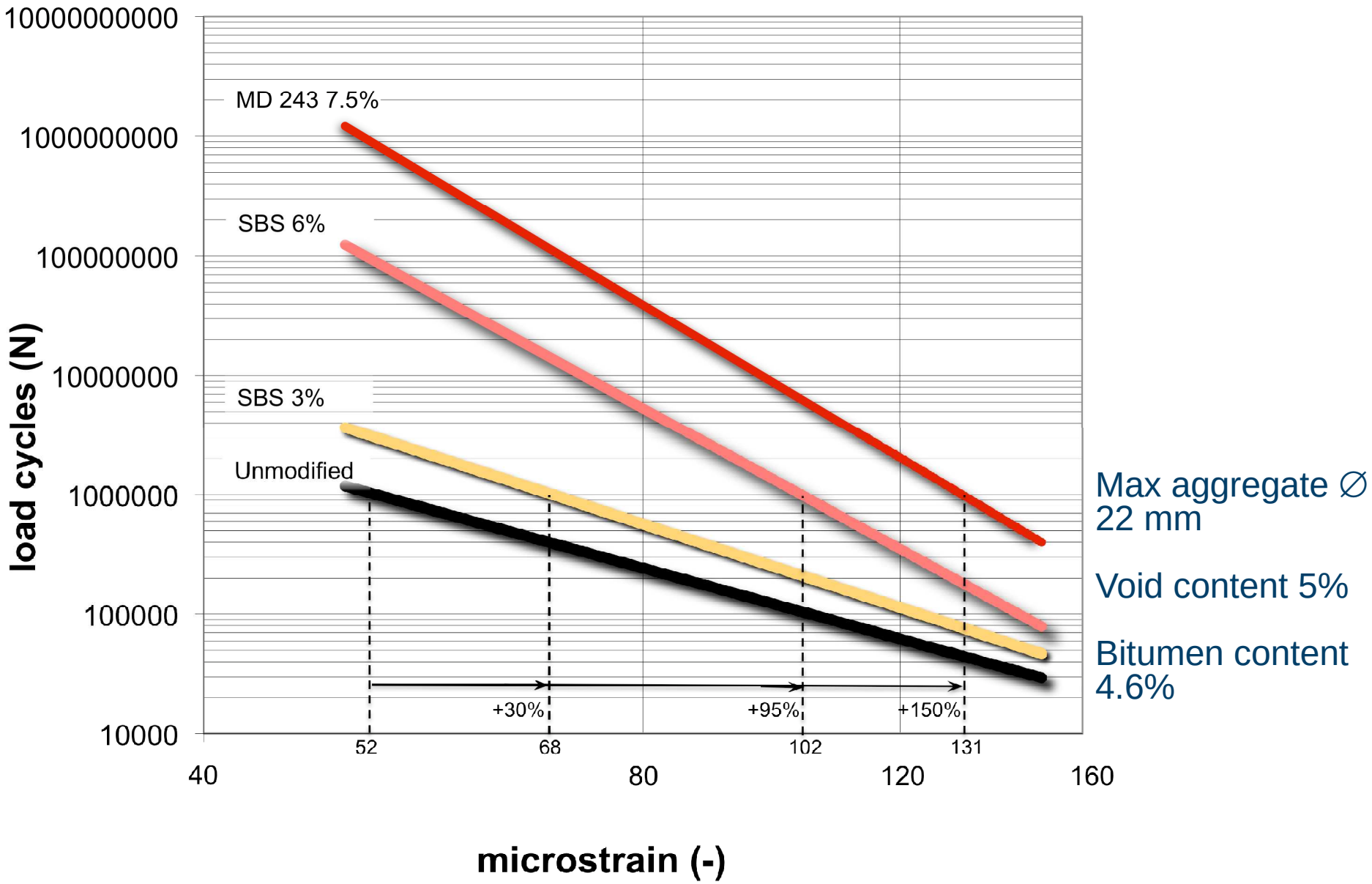
- Hard base bitumens (40-70 pen)
- High SBS content
- Storage stability

Issues solved by adapting design of the polymer

Kraton D 243

- Provides a low viscosity, even in hard bitumens at elevated SBS content
- Provides compatibility
- Provides storage stable PMBs with most base bitumens

Fatigue lines



Max aggregate ∅ 22 mm

Void content 5%

Bitumen content 4.6%

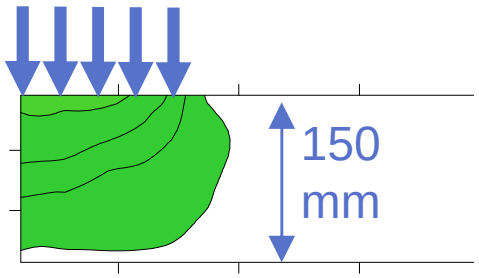
Measured with full sine loading in 4 point bending (20° C, 8 Hz)

Modelling, comparing options

1

7.5% D 243
150mm

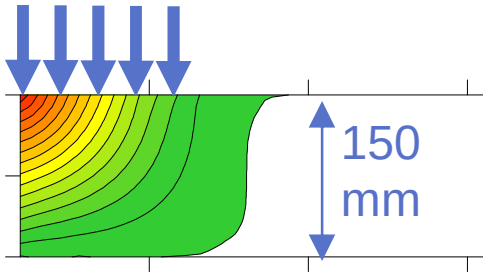
Limited damage



2

6% standard SBS
150mm

More damage
6% not enough

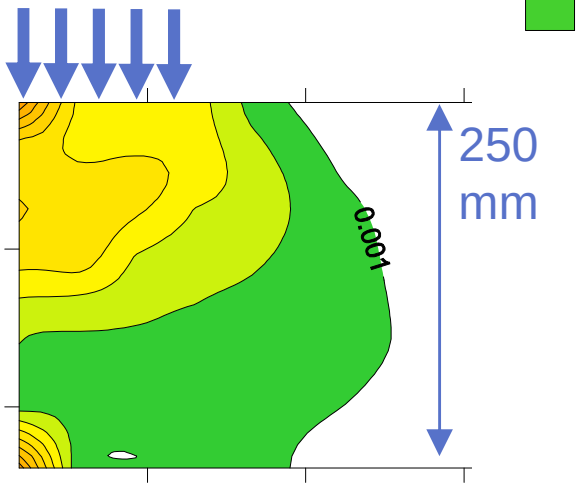


3

Unmodified
250mm

Lots more damage
Despite 66% thicker

Equivalent to 5x higher rutting depth than (1)



NCAT Trial

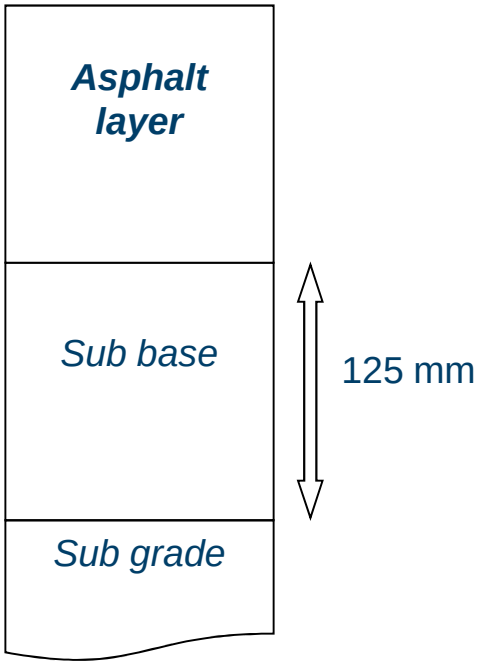
National Center for Asphalt Technology, Auburn, Alabama

- Test track with dedicated trucks
  10 year heavy traffic simulated in 2 years
- Began June 2009
- Interim feedback set for Summer 2010

Kraton Polymers sponsors:

- Reduced base course thickness test section
- Using Kraton HiMA base course binder
- Comparison to be made with standard thickness, unmodified base course section

Design examples



- Design calculations with Shell Pavement Design Manual
- Inland climate
- Taking into account sub grades with CBR = 2-30%
- Gravel sub base: 100-300 MPa

Standard asphalt mix:

Stiffness at 20° C – 8 Hz: 8900 MPa

Fatigue equation:

$$N = 6.10^{11} x^{-3.36}$$

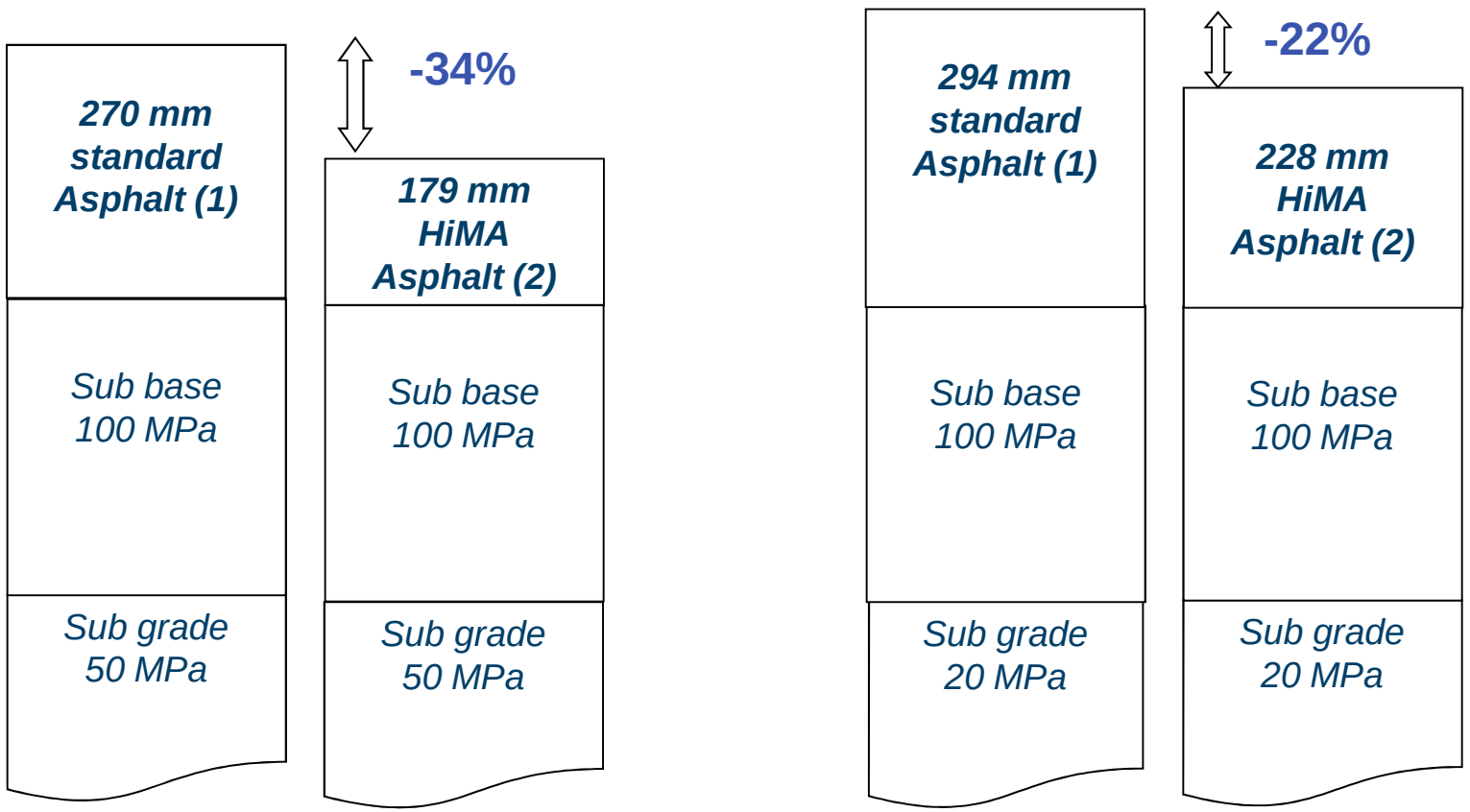
Polymer modified mix:

Stiffness at 20° C – 8 Hz: 9900 MPa

Fatigue equation:

$$N = 3.10^{21} x^{-7.30}$$

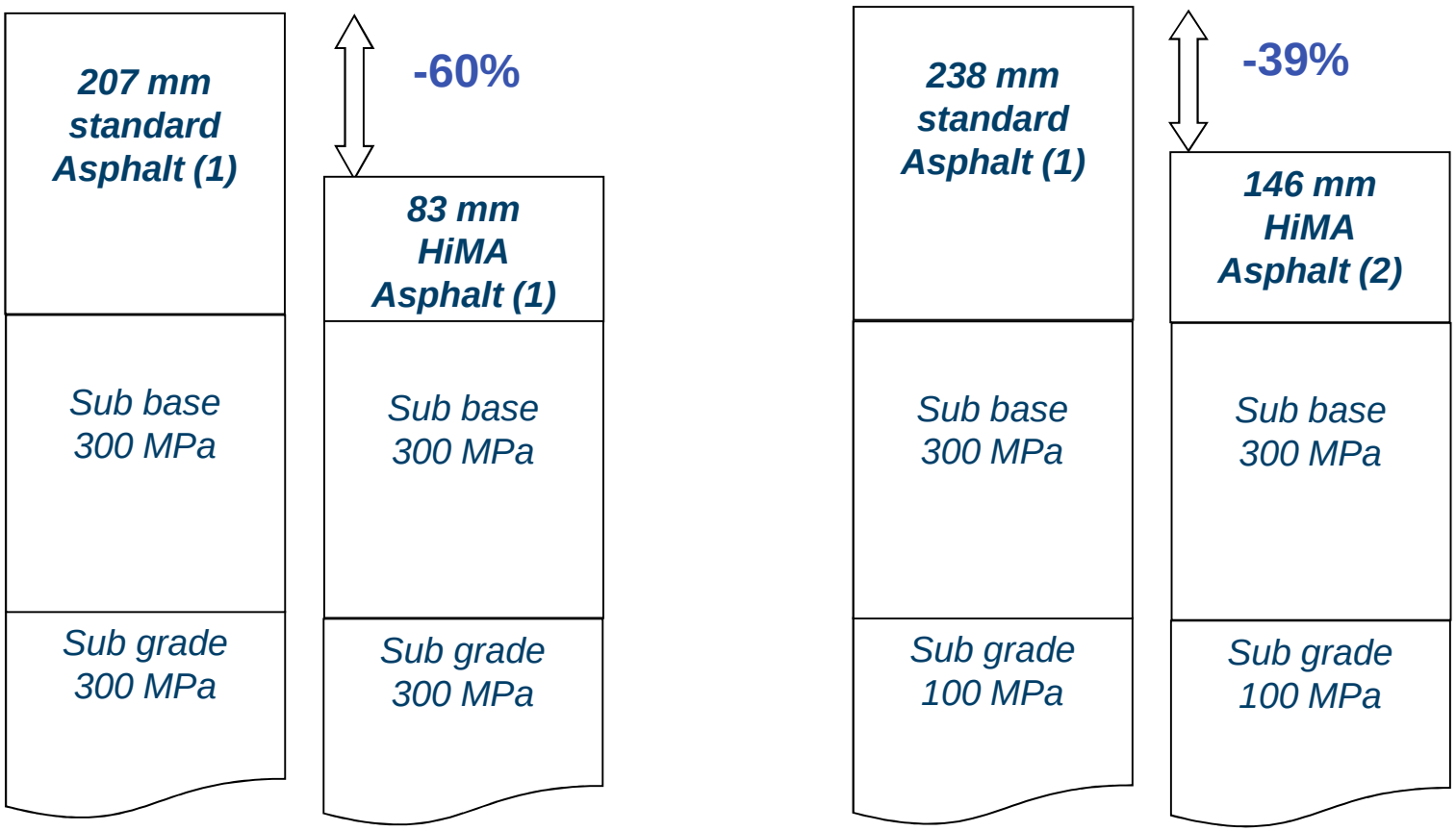
Thickness reduction capability with weak sub grades



(1) Thickness determined by asphalt strain criterion
(2) Thickness determined by sub grade strain criterion

HiMA = Highly Modified Asphalt

Thickness reduction capability with good quality sub base



(1) Thickness determined by asphalt strain criterion
(2) Thickness determined by sub grade strain criterion

HiMA = Highly Modified Asphalt

Concluding remarks

- Thickness reduction of 20-60% depending on base layers
  - Reduce eco impact by reduced resource use
  - Up front cost reduction
- Enhance performance for sustainability
  - Perpetual pavements without excessive base courses
- Enabled by Kraton polymer innovations
  - Efficient interaction between polymer and bitumen
  - Compatibility and workability

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