New Tools from EN Standards for high performances mixes

- Evolution of EN standards
- Towards Performances
- What about Binders
- Performances and cold Climate
  - Ex Denmark
  - Ex Canada
- Ideas for Poland
Evolution of EN Standards

Revision of EN 13108 PRODUCTS & TYPE TESTING & FPC

2008-2016

EC mandate: Avoid barriers to trade
Moving to performances
Additional test: durability & ageing

& Cold mixes appears
Evolution of EN Standards

New tests =

- Investment
- Training / Practice
- Lab results
- Sites survey!
- Mid term relevant characteristics for contracts

44 Cracking
46 Low temp.
45 Saturation Ageing
Tensile Stiffness
49 Skid resistance
50 Scuffing (TS)
52 Ageing (TS)
What about binders

- Evolution of standards on binders
  - More characteristics than before
  - Pen and R&B not sufficient
  - Some rheology to better qualify binders
    - Temperature susceptibility
    - And rutting behaviour (MSCR) for PmB
What about binders

- Good correlation $G^*$, $E^*$

ISTTAR 1977
What about Binders

<table>
<thead>
<tr>
<th>Binder grade</th>
<th>Range of modulus</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/20</td>
<td>34-144</td>
</tr>
<tr>
<td>15/25</td>
<td>39-78</td>
</tr>
<tr>
<td>20/30</td>
<td>27/ 80 (106 !)</td>
</tr>
<tr>
<td>35/50</td>
<td>20/49</td>
</tr>
<tr>
<td>50/70</td>
<td>12-32</td>
</tr>
</tbody>
</table>

Variation between suppliers for the same grade

G* binder
What about Binders

- Usual characteristics not sufficient
- Need of better tools
  - To anticipate AC Mixes characteristics
  - Easy to do & relevant

Rheology
- Equipment available
- Easy to practise
- Quite good reproducibility
- Helpful to guarantee AC performances
## What about Binders

**EN 12591 DRAFT - Annex C**

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST METHOD</th>
<th>UNIT</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low temperature behaviour after long term ageing</td>
<td>EN 12607-1 + EN 14769 + EN 14771 (BBR)</td>
<td>°C</td>
<td>RV</td>
</tr>
<tr>
<td>Addressing temperature sensitivity:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G* and δ @ 1,59 Hz (10 rad ·s⁻¹) after short term ageing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 mm plate Temperature T₁ for G* = 5 MPa</td>
<td>EN 12607-1 + EN 14770 (DSR)</td>
<td>°C</td>
<td>RV</td>
</tr>
<tr>
<td>Value of δ at T₁</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 mm plate Temperature T₂ for G* = 50 kPa</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of δ at T₂</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Note**

- The applicable properties shall be provided for bitumen grades appearing in Table 1A; long term ageing includes RTFOT + PAV conditioning.
- The temperatures T₁ and T₂ have to be determined by interpolation from two temperatures, one below and one above the targeted temperature.
What about Binders

Predict AC mix thermomechanical behavior 2S2P1D Model

MSCR for rutting: Don’t forget Aggregates!

Low temperature behaviour
DSR 4 mm. Possible prediction / research still needed..
Performances and Cold Climate

DENMARK

ADAPT MIX DESIGN TO AVAILABLE MATERIALS

SELECT THE RIGH BINDER

MECHANICAL CHARACTERIZATION

FIRST TRIAL SECTION 2004

DEVELOPMENT

Capping layer 360 mm of sand
Roadbase course 200 mm untreated aggregates
Capping layer 360 mm of sand
## Performances and Cold Climate

### CANADA MECHANICAL PERFORMANCES

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rutting</td>
<td>LC 26-410 ≤ 5</td>
</tr>
<tr>
<td>Water resistance</td>
<td>AASHTO T283 ≥ 75</td>
</tr>
<tr>
<td>Bitumen content (%)</td>
<td>LC 26_006 3,75</td>
</tr>
<tr>
<td>TSRST</td>
<td>AASHTO TP 10-93 ≤ -28°C</td>
</tr>
<tr>
<td>Binder grade</td>
<td>PG 88-28</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fatigue resistance</th>
<th>TC-CY 10°C 10Hz 106 cycles</th>
<th>&gt; 130</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex modulus</td>
<td>TC CY 10°C 10Hz</td>
<td>&gt; 14000</td>
</tr>
<tr>
<td></td>
<td>TC CY 15°C 10Hz</td>
<td>&gt; 11000</td>
</tr>
</tbody>
</table>
# Performances and Cold Climate

## CANADA MECHANICAL PERFORMANCES

Table 1. Adaptation of High Modulus mix performance to climatic conditions.

<table>
<thead>
<tr>
<th>Description</th>
<th>Regions</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vancouver USA</td>
<td>Toronto USA</td>
</tr>
<tr>
<td>Modulus $</td>
<td>E^*$, MPa</td>
<td>&gt; 14,000</td>
</tr>
<tr>
<td>$15^\circ C, 10$ Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$10^\circ C, 10$ Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$5^\circ C, 10$ Hz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatigue, $10^6$ cycles, $\mu$def</td>
<td>$&gt; 130$</td>
<td>$&gt; 130$</td>
</tr>
<tr>
<td>$10^\circ C, 10$ Hz, TCD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$10^\circ C, 25$ Hz, 2 points</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rutting resistance, 30,000 cycles, %</td>
<td>$&lt; 5.0$</td>
<td>$&lt; 5.0$</td>
</tr>
<tr>
<td>$100$ mm, $60^\circ C$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermal shrinkage resistance, °C</td>
<td>$&lt; -22$</td>
<td>$&lt; -28$</td>
</tr>
</tbody>
</table>

Yves Brosseau - Laboratoire Central des Ponts et Chaussées (France)
Bogdan Bogdanski - Roads Laboratory of Poznan (Poland)
Didier Carré - Product Manager - Nynas Bitumen (France)

SELECT RIGHT BINDER  20/30
ADAPT COMPOSITION  : AC 16 / TL 5% /
ENOUGHT MECHANICAL IMPROVEMENT TO BE RELEVANT IN PAVEMENT DESIGN
Back to Poland

Improvement of Mechanical characteristics

Higher stiffness higher fatigue

Reduce thickness

French Experience

No limits with Cold climate
Back to Poland

AC WMS ~ BC with 20/30

Too stiff?
Back to Poland

Possible Issues with recent jobsite

Important survey of the Network

Better knowledge of climatic conditions

Fig. 11. Climatic zones for selecting PGs of bitumens for motorways and expressways, base course ($P = 98\%$)

Rys. 9. Stery klimatyczne doboru rodzaju funkcjonalnego PG asfaltów dla autostrad i dróg ekspresowych, warstwa podbudowy ($P = 98\%$)

Fig. 9. Climatic zones for selecting PG of bitumens for motorways and expressways, wearing course ($P = 98\%$)

Dawid Rys*, Jozef Judycki, Marek Pszczola, Mariusz Jacewski, Lukasz Mejnun

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Back to Poland

Still prevent Rutting

Low temperature behaviour
No cracking

Mecanichal Performances For Pavement design

Requirements

« Design » adapted PmB binder
To conclude

We are going towards Performances

Project will define the right ones: With relevant requirements

New tools available
  To better anticipate AC mix characteristics
  To improve behaviour
  To take into account all needs

To guide AC producer to the good solution (Technical economical)

And now to include durability