Presentation of the new CEDR report on noise reducing pavements

Hans Bendtsen
Senior Scientist
Danish Road Directorate
Member of the CEDR noise group
About the report

• Main purpose to make knowledge on noise-reducing pavements available to all the CEDR member states

• Knowledge to be implemented in road planning and road maintenance

• Based on collection of results from research and development

• A handbook presenting European state of the art in the mid-2010s

• Target group:
  • road engineers
  • planners
  • decision makers
The CEDR noise history

First task group road noise - 2010
- Consider use of noise-reducing pavements
- Noise as an active component in pavement management systems
- Development of noise labelling system can enhance the market
- Research in improved long-time durability and noise reduction

Second task group road noise - 2013
- Most cost-effective tool for noise abatement is reduction of the noise emissions from new vehicles and tyres – a task for EU
- Followed by the use of noise-reducing pavements – a task for Road Administrations
Vibration generated noise

- The texture of the surface makes tyre vibrate
- Low frequency under 1500 Hz
Air pumping noise

- Air is pressed out and in between the rubber blocks of the tyre
- High frequency
  - over 1000 Hz
Optimization of noise reduction:

- The highest points of the surface same height. Reduce X
- Cubic aggregate and good compaction
- Distance between high points short. Reduce H
- Small aggregate size
- Holes in the surface as big as possible. Increase MPD
- Large built in air void
Porous asphalt
Open in the whole layer thickness

Thin layers
Only open in the top surface
Measurement of tyre road noise
CPX - Close ProXimity method
Measurement of tyre road noise
SPB - Statistical Pass By method

84.4 dB at 110 km/h at 20° C
Tyres and noise

![Graph showing tyre and noise data at 80 km/t](image)

- AB6å, AB8å, AB11t, SMA6+8, SMA6+11, SMA8
- D7, D3, D6, D5, D4, SRTT-VD, D2

![Image of road and tyres](image)
The aging of pavements and their noise emission

Measured - Kongelundsvej SPB Passenger Cars 60 km/h

Age [years]

$L_{veh}$ [dB]

- AC 11d
- UTLAC 6
- SMA 6+
- AC 8d
- AC 6o
Aging of typical Danish pavements

![Graph showing aging of typical Danish pavements](image)

**Speed 80 km/h**
Noise emission Danish version
Nord2000 prediction Method

![Graph showing noise emission over age and CPX LAmx dB for different materials (SMA11, SMA8, AC11, SRS, Nord2000 SMA11, Nord2000 AC11, Nord2000 SMA8, Nord2000 SRS). The graph indicates a linear relationship between age and noise emission at a speed of 80 km/h.]
**Constructed example**

Development of noise over time for SMA 11 pavement and noise-reducing thin layer SMA 6 over a period of 50 years.
Relevant functionalities and factors:

1. noise reduction, and lifetime of noise reduction
2. rolling resistance (influence on energy consumption and CO₂ emissions)
3. friction (important for traffic safety)
4. drivers comfort (splash and spray), more silent inside vehicle
5. traffic safety (aqua planning, wet grip, splash and spray and visibility of road markings)
6. cost of pavement
7. lifetime of pavement
8. maintenance operations if needed
9. winter maintenance
10. restrictions on practical application on roads
# Noise-reducing thin layer pavements

<table>
<thead>
<tr>
<th>Functionalities and factors</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Estimated lifetime average noise reduction for passenger cars    | 1 – 3 dB relative to AC 11  
                    | 2.5 – 4.5 dB relative to SMA 16                                          |
| Friction                                                         | Using smaller aggregates improves friction                                |
| Cost of pavement                                                 | Basic cost same as a standard pavement. If the sub layer in poor condition – new sub layer |
| Lifetime of pavement                                             | A few years shorter than standard pavements                               |
| Restrictions on practical application on roads                   | Not suitable for road sections and intersections with turning forces caused by tyres |
# Porous asphalt

<table>
<thead>
<tr>
<th>Functionalities and factors</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Estimated lifetime average noise reduction for passenger cars | One layer porous asphalt:  
2 – 4 dB relative to AC 11  
3.5 – 5.5 dB relative to SMA 16  
Two layer 1 to 2 dB extra |
| Traffic safety                                    | Slight improvement caused friction and reduced splash and spray.  
Slight reduction caused by worsened conditions in winter time |
| Cost of pavement                                  | Higher than standard pavements                                           |
| Lifetime of pavement                              | A few years shorter than standard pavements                              |
| Winter maintenance                                | Complicated and challenging                                              |
### Optimized cement concrete pavement

<table>
<thead>
<tr>
<th>Functionalities and factors</th>
<th>Comments</th>
</tr>
</thead>
</table>
| Estimated lifetime average noise reduction for passenger cars    | 0 – 1.5 dB relative to AC 11  
1.5 – 3.0 dB relative to SMA 16                                       |
| Cost of pavement                                                 | Construction costs higher than with asphalt construction, through the long lifetime lower lifecycle costs |
# Poroelastic pavements

<table>
<thead>
<tr>
<th>Functionalities and factors</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated lifetime average noise reduction for passenger cars</td>
<td>In the first year: 8 – 10 dB relative to AC 11 10 - 12 dB relative to SMA 16 no long-time measurement series</td>
</tr>
<tr>
<td>Friction</td>
<td>Friction over guidelines</td>
</tr>
<tr>
<td>Cost of pavement</td>
<td>Significantly higher than cost for porous pavements</td>
</tr>
<tr>
<td>Lifetime of pavement</td>
<td>Shorter than ordinary porous pavements</td>
</tr>
</tbody>
</table>
ON-AIR Guidance Book from CEDR

Tools and guidelines which can facilitate the integration of noise abatement in:

- Planning of new roads and motorways
- Planning of reconstruction and enlargement of existing roads and motorways
- Maintenance and management of existing roads and motorways

Includes noise reducing pavements at all stages
Noise integration in the tendering process

1. Specify a pavement type such as a thin layer or a porous pavement, without control measurement of noise after application

2. National system of noise labelling of pavements produced by different contractors, without control measurement of noise after application

3. Noise reduction criteria in tendering for the initial noise, but no requirements for specific pavement types, with control measurement of noise after application

4. Noise reduction criteria in tendering for the initial noise, as well as the development of noise over time but no requirements for specific pavement types, with control measurement of noise every year