Cost-Benefit analysis for prioritizing noise reducing pavements in road maintenance

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Agenda

• Aim

• Method
  • Associate dwellings to certain road sections
  • Setting minimum criteria: Protection level
  • Road sections
  • Pavements – lifetime and noise reduction
  • Pavements – yearly change in annoyance
  • Socioeconomic calculations
  • Choosing pavement

• Outcome
Aim

• To establish clear and precise criteria for prioritizing noise reducing pavements on state roads
Method

- Associate dwellings to certain road sections
- Setting minimum criteria: Protection level
- Road sections
- Pavements – lifetime and noise reduction
- Pavements – yearly change in annoyance
- Socioeconomic calculations
- Choosing pavement
Method

**Associate dwellings to certain road sections**

1. National strategic noise mapping results (from 2012)
2. Associate dwellings to certain road section. Dwellings are projected perpendicular onto the most dominating (noise) road.
3. Road network is split into 100 m sections. For each road section are the following know:
   1. Number of annoyed dwellings in each 1-dB class (58-59 dB, 59-60 dB,…)
   2. Noise Annoyance Number (In danish Støjbelastningstal, SBT).
Method

Setting minimum criteria: Protection level

- $SBT/\text{km} \geq 5$
- $SBT/\text{km} \geq 20$
- $SBT/\text{km} \geq 40$
- $SBT/\text{km} \geq 60$
- $SBT/\text{km} \geq 10$
- $SBT/\text{km} \geq 30$
- $SBT/\text{km} \geq 50$
- $SBT/\text{km} \geq 70$
Method

Road sections

- Minimum speed: 80 km/h
- Minimum sections: 500 m (+200 m in each end) due to maintenance
- Sections:
  - Most sections are given
  - Sections nearby Copenhagen are split from maintenance point of view

SBT/km ≥ 10
## Pavements – lifetime and noise reduction

<table>
<thead>
<tr>
<th>Pavement type</th>
<th>Lifetime</th>
<th>Noise reduction in lifetime</th>
<th>Price</th>
<th>Cost</th>
<th>Additional costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>SMA 11</td>
<td>17</td>
<td>0</td>
<td>100</td>
<td>5,9</td>
<td>0</td>
</tr>
</tbody>
</table>
| SMA 8 Standard                    | 14       | -1,8                        | 90    | 6,4  | 0,5             | 8%
| SMA 8 SRS                         | 12       | -2,4                        | 90    | 7,5  | 1,6             | 27%
| SMA 8 SRS incl. new binder course | 12       | -2,4                        | 190   | 15,8 | 9,9             | 168%
Method

Pavements – yearly change in annoyance

\[ \Delta \text{SBT} \% \]

\[ y = 2.0139x - 42.06 \]
\[ y = 2.0739x - 37.35 \]
\[ y = 6.1055x - 60.12 \]
\[ y = 2.8012x - 23.81 \]

Age [year]
Method

Socioeconomic calculations

Included costs:

- Costs for renewing pavement and possibly binder course, and expected lifetimes.
- Traffic annoyance during paving: Lower speeds.
- Expected effect on noise.
- Other consequences – e.g. influence on taxes and labor supply distortion
Method

Choosing pavement

• Sections:
  • ~200 km state road network
  • Covering 84,000 dwellings (2/3 of the annoyed dwellings at the state road network)

- SBT/km ≥ 10
  - Yes
    - SBT/km ≥ 70
      - Yes
        - Best socioeconomy?
          - Yes
            - SMA 8 STD
          - No
            - SMA 8 STD
    - No
      - SMA 11

- No
  - SMA 8 STD
  - SMA 8 Low Noise
Choosing pavement

Method

SBT/km ≥70 → Yes → Best socioeconomy?

- SMA 8 STD
- SMA 8 Low Noise

SBT/km ≥70

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Outcome

- Possible to reduce the noise level with ~2 dB for ~75 % of the annoyed dwellings at the state road network
- Dynamic strategy for noise reducing pavements
- Updated after the Strategic Noise Mapping in 2017

SBT/km ≥10

- Covering 84,000 dwellings (2/3 of the annoyed dwellings at the state road network)

SMA 8 Low noise

- Covering 43,000 dwellings (1/3 of the annoyed dwellings at the state road network)