Establishing a large scale noise reducing pavement network by evaluating the effectiveness for inhabitants

Senior Project Manager
City of Helsinki
Noise reducing pavements
- General knowledge

• Reduces traffic noise by affecting directly to the noise source
  – In Finland -3 dB(A) measured by CPX after one winter from paving.
  – Because of studded tyres, the typical age of these pavements is 6-8 years.
    • Reducing effect only on summer time.
    • However, noise effect lasts through the service life.

• In Finland a large scale research project (HILJA, 2001-2004)
  – Asphalt contractors developed their own brand pavements

CPX-device from Aalto-University
Reason to establish the network?

- Tyre noise dominates in speed 40-80 km/h
- Over 90% of people suffering from noise live near communal street
- In Helsinki over 240,000 citizens (over 30% of all) live inside of the area over 55 dB surrounding noise.
  - Aim is to decrease this number by 20% before year 2020.

- The city is already built intensively and noise walls could not be used everywhere → what are choices?

Who has seen graffiti on a pavement?
Academic study 1/2

- The aim was to identify and prioritize street sections, which could be suitable for noise reducing pavements.
  - Due to the effect of studded tyres, main streets were not first in importance.

- For each section determined matters were:
  - Number of inhabitants
  - Number people in sensitive places (kindergarten, school, hospital, etc.), [effect was a double than inhabitants]
  - Actual speed, amount of traffic, decelarator humps, etc.
  - Street geometry, etc.
A simple model was built up: 

\[ Benefit\_index = a_x \times v_x \times \frac{ADT_x}{15000} \]

After preliminary treatment of analysis the limits were determined:

- Significant benefit when index > 1500
- Good benefit when 800-1500
- Satisfactory benefit when 300-799
- Slight benefit when < 300 (…Always some kind of benefit is achieved)
Example from the target table

<table>
<thead>
<tr>
<th>Street</th>
<th>ADT</th>
<th>Speed limit</th>
<th>Significant benefit</th>
<th>Good benefit</th>
<th>Satisfactory benefit</th>
<th>Slight benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abraham Wetterin tie</td>
<td>4750</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td>3/6</td>
</tr>
<tr>
<td>Eskolantie</td>
<td>10500</td>
<td>40-50</td>
<td>5/10</td>
<td>1/10</td>
<td></td>
<td>4/10</td>
</tr>
<tr>
<td>Hämmeentie</td>
<td>9700</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td>1/17</td>
</tr>
<tr>
<td>Hämmeentie</td>
<td>4000</td>
<td>40-50</td>
<td>4/31</td>
<td>3/31</td>
<td></td>
<td>24/31</td>
</tr>
<tr>
<td>Itäväylä</td>
<td>10550</td>
<td>60</td>
<td></td>
<td></td>
<td></td>
<td>2/18</td>
</tr>
<tr>
<td>Itäväylä</td>
<td>9700</td>
<td>60</td>
<td>2/2</td>
<td></td>
<td></td>
<td>16/18</td>
</tr>
<tr>
<td>Itäväylä</td>
<td>9250</td>
<td>60</td>
<td>3/18</td>
<td>4/18</td>
<td></td>
<td>11/18</td>
</tr>
<tr>
<td>Kaivonkatsojantie</td>
<td>4900</td>
<td>40-50</td>
<td>2/8</td>
<td>4/8</td>
<td></td>
<td>2/8</td>
</tr>
<tr>
<td>Kallvikintie</td>
<td>8700</td>
<td>40-50</td>
<td>2/8</td>
<td></td>
<td></td>
<td>6/8</td>
</tr>
<tr>
<td>Kallvikintie</td>
<td>7000</td>
<td>50</td>
<td>5/30</td>
<td>3/30</td>
<td></td>
<td>21/30</td>
</tr>
<tr>
<td>Karhulantie</td>
<td>2600</td>
<td>50</td>
<td>1/12</td>
<td>2/12</td>
<td></td>
<td>9/12</td>
</tr>
<tr>
<td>Katajaharjuntie</td>
<td>7300</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
<td>3/4</td>
</tr>
</tbody>
</table>
Example from one potential street

- There are totally 630 inhabitants and 4 sensitive places and numerous amount of playfields inside the street noise area.

- Even though the red section is most significant, it is reasonable to pave from crossing to crossing.

→ After academic study, a lot of "practical work" needed before network for noise reducing pavements was established.
  - Amount of heavy traffic
  - Noise level from surroundings (trams, etc.)
  - Humps, traffic lights,
  - Planned other noise reductions
Only in 10 % of the examined sections good or better benefits are achieved.
  – Quite surprising result?

<table>
<thead>
<tr>
<th>Amount of sections</th>
<th>Significant benefit</th>
<th>Good benefit</th>
<th>Satisfactory benefit</th>
<th>Slight benefit</th>
<th>Sections totally</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed 40 km/h, ADT &lt; 12 000</td>
<td>131 (3 %)</td>
<td>213 (5 %)</td>
<td>392 (9 %)</td>
<td>3781 (84 %)</td>
<td>4517 (62 %)</td>
</tr>
<tr>
<td>Speed 50-80 km/h, ADT &lt; 12 000</td>
<td>117 (7 %)</td>
<td>112 (6 %)</td>
<td>116 (6 %)</td>
<td>1442 (81 %)</td>
<td>1787 (25 %)</td>
</tr>
<tr>
<td>Speed &lt; 70 km/h, ADT 12 000 - 15 000</td>
<td>122 (13 %)</td>
<td>47 (5 %)</td>
<td>35 (4 %)</td>
<td>737 (78 %)</td>
<td>941 (13 %)</td>
</tr>
<tr>
<td>Total</td>
<td>370 (5 %)</td>
<td>372 (5 %)</td>
<td>543 (7 %)</td>
<td>5960 (82 %)</td>
<td>7245 (100 %)</td>
</tr>
</tbody>
</table>
Final network

- Final network consist of 39 different sections and 33 kilometers.
  - Total length of streets is 1200 km → 2.75% will be covered with noise reducing pavements.

- Additional expenses will be ~2%/160 000 € from the paving budget.
  - Yearly will be repaved 12% of this network.

- Noise reducing pavements are ~70% more expensive than normal pavements.
  - Yearly cost 5.5 €/meter.

- How much can noise reducing cost?
In the 2009 paved streets

Downtown
Other on going development…

- **Procurement guide for noise reducing pavements**
  - For cities and communes
  - Together with contractors
- **Tyre change to CPX-method**
  - Now slick is being used. Change to SRTT (from CPX-standard)
    - Changes noise levels
    - At the moment under 89 dB(A) is considered to be "low noise". Normal SMA 92-93 dB(A).
- **Temperature correction determination**
  - In the summer time the temperature of air and specially pavement varies a lot (+10…+50 Celsius)
  - This affects to noise levels.
  - Done with SRTT and Slick-tyre
- **Noise levels from network before new pavements.**
  - How much does the actual environmental noise decrease?
  - Do we achieve the limit: under 55 dB(A)?
Sometimes we have snow...

Thank you for your attention!