Road vehicle noise reduction by low noise road surfaces in Japan

Integrated noise reduction measures

Road vehicle running noise

Integrated Measures

Road vehicle

Tyre

Pavement

Traffic management

Road construction

Building construction

Road environment
# Measurement conditions

## Test road surfaces

<table>
<thead>
<tr>
<th>Road surfaces</th>
<th>Max. chipping size</th>
<th>Thickness</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dense asphalt</td>
<td>13 mm</td>
<td>50 mm</td>
<td>Conventional road in Japan</td>
</tr>
<tr>
<td>One layer drainage</td>
<td>13 mm</td>
<td>50 mm</td>
<td>Practical use</td>
</tr>
<tr>
<td>Two layer drainage</td>
<td>Upper : 5 mm</td>
<td>Upper : 20 mm</td>
<td>Partial use</td>
</tr>
<tr>
<td></td>
<td>Lower : 13 mm</td>
<td>Lower : 30 mm</td>
<td></td>
</tr>
<tr>
<td>Porous elastic</td>
<td></td>
<td>20 mm</td>
<td>Under development for practical use</td>
</tr>
</tbody>
</table>
Surface profiles of test roads

Dense asphalt | One layer | Two layer | Porous elastic

Test road vehicles

<table>
<thead>
<tr>
<th>Vehicles</th>
<th>Engine</th>
<th>Vehicle weight (GVW)</th>
<th>Tyres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Car</td>
<td>Gasoline engine</td>
<td>1,775 kg</td>
<td>205/65R16 95S</td>
</tr>
<tr>
<td>Hybrid car</td>
<td>Gasoline engine + Motor</td>
<td>1,515 kg</td>
<td>165/65R15 81S</td>
</tr>
<tr>
<td>Medium truck</td>
<td>CNG engine</td>
<td>4,712 kg</td>
<td>195/85R16</td>
</tr>
<tr>
<td>Heavy dump truck</td>
<td>Diesel engine</td>
<td>19,895 kg</td>
<td>10:00-20</td>
</tr>
<tr>
<td>Heavy cargo truck</td>
<td>Diesel engine</td>
<td>19,470 kg</td>
<td>11R22.5</td>
</tr>
</tbody>
</table>
Test road vehicles

Constant speed running noise
Constant speed running noise (60 km/h)

Frequency characteristics of constant speed running noise (60 km/h)
Speed dependence of running noise on each road surface

**Car**
- Dense asphalt: $L = 11.9 + 32.2 \log_{10} V$
- One layer drainage: $L = 27.5 + 22.7 \log_{10} V$
- Two layer drainage: $L = 25.2 + 23.3 \log_{10} V$
- Porous elastic: $L = 13.2 + 26.9 \log_{10} V$

**Heavy cargo truck**
- Dense asphalt: $L = 25.3 + 28.2 \log_{10} V$
- One layer drainage: $L = 32.9 + 22.8 \log_{10} V$
- Two layer drainage: $L = 26.0 + 24.6 \log_{10} V$
- Porous elastic: $L = 24.6 + 24.5 \log_{10} V$

Start-acceleration running noise
Acceleration running noise

Frequency characteristics of start-acceleration noise
Comparison with radiation noise on dense asphalt pavements of public roads

Effect of low noise road surfaces (Cars)

Effect of low noise pavements (Heavy trucks)

![Graph showing the effect of different types of pavements on sound power levels](image)

Total length of major urban roads paved with one-layer drainage asphalt in Japan

Main trunk road in Tokyo constructed by two-layer drainage pavement
Conclusions

1. The noise reduction effects of two layer drainage pavement and the porous elastic pavement are large. The level difference between these low noise pavements and dense asphalt pavement is 5 to 8 dB for constant speed running, and 3 to 4 dB for start-acceleration running.

2. It is technically possible to reduce vehicle noise by about 10 dB by integrating the latest noise reduction technologies for vehicles, tyres and the pavements.

3. In Japan, the construction standard for public roads is changing from the dense asphalt to drainage pavement. In Tokyo, two-layer drainage pavement has recently been used to achieve further noise reduction on main trunk roads.