Slovenia, its roads and its expertise

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Slovenia’s roads

- Slovenia’s roads are managed by
  - the Slovenian Roads Agency,
  - the Motorway Company in the Republic of Slovenia DARS and
  - local municipalities

- The condition of pavements has been regularly assessed on the state road network (main and regional roads) for more than 15 years

- On motorways from 2005 every second year
Slovenian Roads Agency and DARS

- Almost 6,000 km of national roads
- The National Motorway Construction Programme (NMCP)
- The completion and improvement of motorways and other roads in mainly two directions: East to West, North to South
- Nearly 660 km when NMCP completed
Pavement monitoring

The register of public roads is maintained in accordance with the Public Roads Act since 1954

- longitudinal evenness,
- transverse evenness,
- skid resistance,
- surface defects,
- bearing capacity of the pavement structure
Longitudinal unevenness ZAG-VP
In the case of pavement management, the IRI (International Roughness Index) is calculated, in the case of quality control, both the irregularities under 4 m straight-edge and the IRI Index are calculated from measured profile. Criteria for evaluating road condition on the motorway network are defined in the so-called Technical Specifications for Roads. These criteria were prepared for measurements on in-service roads, newly constructed roads, and after the warranty period of 5 years.
Longitudinal unevenness

- Financial penalties introduced for motorways construction in 2004

- \[ TP = (0.65 \times (FD \text{ for } H4m)) + (0.30 \times (FD \text{ for } IRI20m)) + (0.05 \times (FD \text{ for } IRI100m)) \]
Longitudinal unevenness

Distribution of IRI values for the national roads of Slovenia, in 2004

Portorož, Slovenia
## QA/QC – Newly constructed road sections

<table>
<thead>
<tr>
<th>Traffic volume and load</th>
<th>Values for IRI 20m</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Limit</td>
<td>Upper limit</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>2,0</td>
<td>2,6</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>4,0</td>
<td>4,6</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Traffic volume and load</th>
<th>Values for IRI 100m</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Limit</td>
<td>Upper limit</td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>1,2</td>
<td>1,8</td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>2,0</td>
<td>2,8</td>
<td></td>
</tr>
</tbody>
</table>
Skid resistance – Slovenian SCRAMTEX

Portorož, Slovenia
Skid resistance

Device has been upgraded

- More information about the vertical load
  - Additional load-cell has been installed

- Recording the radii of curvature during measurements
  - Inductive transducer on the steering mechanism
Skid resistance

Skid resistance on main roads G1 and G2

<table>
<thead>
<tr>
<th>Road category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very good</td>
<td>6%</td>
</tr>
<tr>
<td>Good</td>
<td>13%</td>
</tr>
<tr>
<td>Fair</td>
<td>18%</td>
</tr>
<tr>
<td>Poor</td>
<td>17%</td>
</tr>
<tr>
<td>Very poor</td>
<td>46%</td>
</tr>
</tbody>
</table>

Portorož, Slovenia
### QA/QC – Acceptance criteria

<table>
<thead>
<tr>
<th>Measuring speed (km/h)</th>
<th>Upper limit (SR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>62</td>
</tr>
<tr>
<td>40</td>
<td>57</td>
</tr>
<tr>
<td>50</td>
<td>53</td>
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<td>60</td>
<td>49</td>
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<tr>
<td>70</td>
<td>46</td>
</tr>
<tr>
<td>80</td>
<td>43</td>
</tr>
<tr>
<td>90</td>
<td>40</td>
</tr>
</tbody>
</table>
Surface defects

Visual pavement condition evaluation according to the “Modified Swiss Index” methodology

Surface defects:
- cracking
- ravelling
- potholes
- patching

Weights (Gm):
- 0.4
- 0.3
- 0.1
- 0.2

\[
MSI = \sum_{m=c}^{p} G_m \cdot S_m \cdot A_m
\]
Surface defects

- The condition classes are named after the condition of the pavement
  - Very good
  - Good
  - Fair
  - Poor
  - Very poor

- The ranges of the condition classes depend on the Average Annual Daily Traffic (AADT).
Surface defects

Percentage of length after visual pavement distress evaluation

- Very poor
- Poor
- Fair
- Good
- Very good

Portorož, Slovenia
Bearing capacity – Slovenian FWD
Bearing capacity

- Measured only on Slovenia's main and regional road network
- 1 measurement per every 200 metres
- Each year one-quarter of the road network
- Condition of pavement structures is expressed by means of the residual pavement life
Bearing capacity

Traffic loading ESAL 82kN in one way

- Extremely heavy
- Heavy
- Medium
- Light
- Very light

Percentage of length after bearing capacity measurements

- Very poor
- Poor
- Fair
- Good
- Very good

Portorož, Slovenia
Slippery pavements in tunnels

- Significantly larger number of accidents due to slips in tunnels, especially of cargo vehicles
- Low skid resistance and texture depth
- The design speed of 100 km/h
Slippery pavements in tunnels

- **Analysis of traffic loads**
  - the results of the analysis indicated an annual traffic loading growth rate of 16.2% (determined over the period 2002-2006)
  - expected life of 20 years was actually reached after just three years
Slippery pavements in tunnels

- **Road surface treatments**
  - shot blasting
  - water blasting
  - bush hammering
  - rough diamond grinding (rough milling)
  - fine diamond grinding (fine milling)
Slippery pavements in tunnels

Portorož, Slovenia
Slippery pavements in tunnels

Portorož, Slovenia
Slippery pavements in tunnels

- Periodical skid resistance and texture measurements to verify the durability of the works carried out

- Maintenance and cleaning of the retextured pavement surfaces
  - more powerful cleaning equipment should be purchased, which would make it possible to clean the pavement surfaces at a higher pressure
Thank you for your attention