Task 2.2 – Non-destructive testing of Pavement conditions

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Tasks in WT2.2

- Inventory of non-destructive measurement techniques in European new member states

- Carry out harmonisation test for
  - skid resistance
  - longitudinal evenness
  - bearing capacity

- Recommendations for road operators/road authorities on non-destructive measurement techniques
Non-destructive pavement testing

- Tests are performed in-situ
- Tests are normally done in fluent traffic
- No influence on the pavement itself

- Quality assurance (new work approval, ...)
- Input for Pavement management systems

- A lot of different measurement techniques in use today
Inventory

- Skid resistance
  - Pendulum [the only one internationally standardized]
  - SCRIM
  - TRT
  - BV11
  - Griptester
  - RoadSTAR
Inventory

- Evenness
  - 4 m straight edge
  - Profilograph
  - Different kinds of profilometers (i.e. contactless, laser sensor/accelerometer based)
Inventory

- Bearing capacity
  - Falling weight deflectometer (FWD)
  - Deflectograph Lacroix
# Harmonisation test

<table>
<thead>
<tr>
<th>Time</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autumn 2007 – Spring 2008</td>
<td>Test design</td>
</tr>
<tr>
<td>January 2008</td>
<td>Addresses of device owners collected</td>
</tr>
<tr>
<td>February 2008</td>
<td>Invitation letters sent out</td>
</tr>
<tr>
<td>March – April 2008</td>
<td>Preparation for harmonisation test</td>
</tr>
<tr>
<td></td>
<td>• Selection of test sites</td>
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<tr>
<td></td>
<td>• Measurements</td>
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<tr>
<td></td>
<td>• Organisation</td>
</tr>
<tr>
<td>May 5th 2008</td>
<td>Briefing for participants at AIT</td>
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<tr>
<td>May 6th – May 8th 2008</td>
<td>Parallel harmonisation test for skid resistance, longitudinal evenness</td>
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<tr>
<td></td>
<td>and bearing capacity devices</td>
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<tr>
<td>May 12th – May 15th 2008</td>
<td>Reference measurements longitudinal evenness</td>
</tr>
<tr>
<td>August 8th 2008</td>
<td>Received last measurement result from participants</td>
</tr>
<tr>
<td>August 2008</td>
<td>Analysis started</td>
</tr>
<tr>
<td>February 2009</td>
<td>Analysis finished</td>
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</tbody>
</table>
Harmonisation Test

- Skid resistance
  - 9 participants
  - 6 surfaces with varying skid resistance and texture
  - 3 speeds (30-60-90 km/h)
  - Macro texture measured
  - Calculation of SRI
Harmonisation Test

- Skid resistance - devices
Harmonisation Test

- Longitudinal Evenness
  - Methodology: similar to FILTER
  - 6 participants
  - Reference: VTI Primal
  - 6 sections of 500 m lengths
  - IRI from 0.8 up to 10
  - Comparison of IRI, Profile, PSD
Harmonisation Test

- Longitudinal Evenness - devices
Harmonisation Test

- Bearing capacity
  - Methodology: COST 336 Protocol C5 “In situ FWD harmonisation procedure”
  - 7 participants
  - 6 sections with varying stiffness
  - Comparison of measured deflection bowls
  - No comparison of calculated E-Moduli
Harmonisation Test

- Bearing capacity - devices
Results – Skid resistance

- Good speed independence [0.01 ... 0.053]; avg=0.016
- Repeatability limit $r=0.05$ [slightly high]
- Reproducibility limit $R=0.24$ [very high]
- Trueness of Result? → no accepted reference value available
Results – Longitudinal Evenness

- IRI – one outlier, rest has a rather good compliance with reference

<table>
<thead>
<tr>
<th>Correlation Primal/Vehicle</th>
<th>Standard deviation [mm/m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>r=0.89</td>
<td>0.73</td>
</tr>
<tr>
<td>r=0.95</td>
<td>0.17</td>
</tr>
<tr>
<td>r=0.97</td>
<td>0.45</td>
</tr>
<tr>
<td>r=0.90</td>
<td>0.60</td>
</tr>
<tr>
<td>r=0.80</td>
<td>0.41</td>
</tr>
<tr>
<td>r=0.93</td>
<td>0.27</td>
</tr>
</tbody>
</table>

- Typical value from procurement tests in Sweden: std < 0.12 mm/m

- PSD-Analysis: good compliance for wavelengths < 5 m

- Devices are technically very similar – main source of error lies in the hand of the human factor. Quality assurance is essential.
Results – Bearing Capacity

- Apparent differences between the two types “KUAB” and “Dynatest”
- All FWD fulfilled reproducibility requirements.
- Short-time repeatability – all FWD passed.
Conclusions

- Advantages of harmonised measurement techniques are quite obvious – for road operator as well as for device operators
- Harmonisation needs agreed reference devices
  - there is none for skid resistance
  - there are static/quasi static devices for longitudinal evenness
  - FWDs are constructed very similar, average can be used
- Harmonisation methodology
  - needs improvement for skid resistance
  - works quite well for longitudinal evenness
  - works well for bearing capacity
- Quality assurance and trained personnel is essential for good results
Acknowledgements

- László Gáspár and Zsolt Bence for helping me with the skid resistance analysis
- Josef Stryk and Slavoljub Erjavec for carrying out the bearing capacity analysis
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