Assessment of Road Infrastructure Condition

Hawzheen Karim
D&I coordinator

Ph.D. Road design for Future maintenance
Background

- Maintenance outsourcing 1992
- 113 maintenance contracts
- Contract duration 4-6 years
- Assumed good condition during the bidding due to poor knowledge about the real condition
- Inaccurate variety specification/list
- First inspection conducted by the new contractor
  - Tactical pricing
  - Future conflicts between contractor and the authority
Assessment of Road Infrastructure

Aim of the study

The aim of this study is to:

- investigate the extent into which a laser scanning technology can be used to assess the condition of roads and road components and identify what and where deficiencies are.
- identify the abilities and limitations of the used equipment.

The objective is to:

- improve the knowledge about the condition of the road and the roadside in tender documents to provide a better basis for bid calculation
- establish an efficient and accurate delivery/quality assurance of maintenance contracts.
Assessment of Road Infrastructure

Methodology

- **Field measurements**
  - **Equipment**
    - Pavement Profile Scanner (Via PPS)
    - Sector Profile Scanner (Via SPS)
    - The Photo System (Via Photo)
    - Texture Scanner (Via TSC)
  - **Test site**
    - Linköping, South-east part of Sweden
  - **Scanned components**
    - Road barriers
    - Ditches
    - Pavement
    - Clear zone, etc.,
Methodology

Data processing

- Collected data was processed using a software created in Matlab.

- Conversion of coordination and data format using Feature Manipulating Engine (SAFE FME) to create LAS-files

- A viewer from Fugro was used to analyze and visualize collected data.
Resultat
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Analyses

The Analyses were focused on:

- **Quality**
  - Possibility to detect the road component
  - Visualization quality of detected component
  - Ability to detect the deviation from the required condition

- **Capacity**

- **Cost**
<table>
<thead>
<tr>
<th>Performance based requirement</th>
<th>Road components</th>
<th>Condition indicators</th>
<th>Required condition</th>
<th>Possibility to detect the components</th>
<th>Visualization quality of the scanned road component</th>
<th>Possibility to detect the deviation from required condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pavement</td>
<td>Rutting depth</td>
<td>≤ 2 cm along 60 cm of a strightedge</td>
<td>Yes</td>
<td>Good</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>International roughness index IRI</td>
<td>IRI ≤ 5 cm along 60 cm of a strightedge</td>
<td>Yes</td>
<td>Good</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Cracks width</td>
<td>&lt; 1 cm on paved road and &lt; 1 cm on bic path</td>
<td>Partly</td>
<td>Good</td>
<td>Partly</td>
<td>Partly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt; 2 cm on paved road and &lt; 1 cm on bic path</td>
<td>Partly</td>
<td>Good</td>
<td>Partly</td>
<td>Partly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&lt; 20 cm</td>
<td>Partly</td>
<td>Good</td>
<td>Partly</td>
<td>Partly</td>
</tr>
<tr>
<td></td>
<td>Potholes</td>
<td>Free from Pothole</td>
<td>Yes</td>
<td>Good</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Road edge</td>
<td>Level difference between pavement and edge</td>
<td>≤ 5 cm level difference a long 10 m road or ≤ 1 cm</td>
<td>Yes</td>
<td>Good</td>
<td>Partly</td>
<td></td>
</tr>
<tr>
<td>Curb</td>
<td>Damage</td>
<td>Damage free and intact</td>
<td>Yes</td>
<td>Good</td>
<td>Partly</td>
<td></td>
</tr>
<tr>
<td>Manholes</td>
<td>Level</td>
<td>0-1 cm under the pavement</td>
<td>Yes</td>
<td>Good</td>
<td>Partly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Damage</td>
<td>Damage free</td>
<td>Yes</td>
<td>Good</td>
<td>Partly</td>
<td></td>
</tr>
</tbody>
</table>

Accessibility: The road network should be travelable for vehicles with the granted traffic loads.
Analyses

**Quality:** About 90% of all components with their deviations can be registered and quantified.

**Capacity:** Capacity for measuring the secondary road network is estimated to be 50-75 km a day initially and up to 100 km when the stuff learn the work.

**Traffic safety and the working environment:** Unlike current methods for inventory of road components with visual inspection, the inspection stuff are better protected.

**Cost:** Test tracks and the base is getting to make a qualified assessment of the system's cost.
Limitations

- Difficulties to scan deep ditches or high shoulders
- Resolution
- Season related limitations
- Difficulties to visualize different measures connected together due to GPS-limitations
- Scanning speed
- Weather and retroreflection
Conclusions

- A great potential to detect and assess road components and identify the position of the components.

- The laser technology enables the assessment of the condition of road components by scanning and determining the deviation from the required conditions.

- Improving the working environment for the maintenance staff as the process does not require any personnel on the road or the roadside.
**Recommendations**

To have a cost efficient and accurate road condition assessment using laser scanning technology it is of great importance to develop:

- Software in order to recognize the component from the collected data, to detect the deviation and to calculate the extent of the deviations.

- Routines and hardware are recommended to increase the efficiency.
  - Scanner with a higher resolution has to be used to conduct the scanning process at higher speed for increased accuracy of scanning
Thank you for your attention

Contact

E-mail: hawzheen.karim@trafikverket.se

Tel: +46 702 36 36 28
Hawzheen Karim

- Research and Innovation coordinator, Swedish Transport Administration, 2013-

- R&D Svevia 2011-2013

- Maintenance leader, Swedish Road Administration 2002-2006
  - Ph.D. Road Design for maintenance, Royal Institute of Technology
  - M. Sc. Transport and Logistic Management, Chalmers institute of Technology
  - B.Sc. Civil engineering, Sallahaddin University, Iraq.