4. Procedures for the evaluation of automated crack detection systems

The British Experience

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International Workshop on Automated monitoring of pavement surface cracking conditions - Quebec
13 August 2006

Surface Condition Survey Timeline in UK

Survey lane coverage in the UK

TRL input to the Delivery of TRACS

- Specification
- Acceptance
- Quality Auditing
- Ongoing Research
TRACS - Specification

- An “end result” specification for measurement of:
  - Section location
  - Geographical position
  - Raw longitudinal profile
  - Raw transverse Profile
  - Raw texture Profile
  - Raw cracking
  - Derived parameters
    - For cracking
      - Crack intensity
      - Crack map

Acceptance

Profile - Reference Surfaces

Cracking

Cracking - Reference

- Need to establish a reference
  - Current manual surveys difficult to compare with automated surveys
  - HARRIS shows scaling required
  - Still differences due to opinions and estimates of inspectors
  - Development of grid method

Visual inspection using wire grid to establish reference crack data
Cracking - Reference Surveys

- Manual grid surveys:
  - Two inspectors survey the grid (20m) the first carries out the survey over each 500mm square the second records the results.
  - 13 Sites, of length 18km covering flexible, composite and concrete constructions and different surface types
  - Mostly surveyed at night, over three week period

Cracking assessment

- Surveys carried out soon after manual surveys
- Data delivered as crack map
- 500mm grid placed over crack map in software to obtain areas of cracking
- Areas of cracking from contractor and manual surveys summed over 50m lengths
- Contractor provided with sample data to investigate sensitivity
  - Resulted in good agreement on these sites but poor agreement on other sites. Contractor provided with further data to adjust sensitivity

Cracking - Assessment

- Systems generally record less cracking than the reference
  - Typically <15% on acceptance using final sensitivity
  - Issue of surface type
  - For assessment the data is classed in terms of high, medium and low levels of cracking
  - System assessed in terms of
    - The number of subsections that are showed to have high, medium and low levels of cracking that were also shown to contain this level of cracking in the reference survey
    - Also plots of the “relative area” of cracking recorded

Cracking - crack map
Cracking - Assessment
- Assessed as percentage of sections having high and low levels of cracking that agree with the reference

<table>
<thead>
<tr>
<th>Sensitivity Level 1</th>
<th>Sensitivity Level 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percentage of sub-sections in the reference data containing a high level of cracking that were also reported to contain a high level of cracking by TRACS</td>
<td>73% 72%</td>
</tr>
<tr>
<td>Percentage of sub-sections in the reference data containing a high level of cracking that were reported to contain a higher than average level of cracking by TRACS</td>
<td>80% 77%</td>
</tr>
<tr>
<td>Percentage of sub-sections in the reference data containing a high level of cracking that were reported to contain a higher than average level of cracking by TRACS</td>
<td>88% 85%</td>
</tr>
</tbody>
</table>

Network tests - repeatability

<table>
<thead>
<tr>
<th>Route</th>
<th>High level</th>
<th>Medium level</th>
<th>Low level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>0.5</td>
<td>2.5</td>
<td>68</td>
</tr>
<tr>
<td>Urban</td>
<td>0.5</td>
<td>2.5</td>
<td>40</td>
</tr>
</tbody>
</table>

Rural | 0.2 | 1.25 | 61 | 67 |
| Urban | 0.2 | 1.25 | 56 | 58 |

And comparison with reference

Current reference sites
Now provided
- By manual analysis of video images
- Over at least 70 lane kilometre

QA developments
- Basic system carried over to local authority use i.e. TTS and SCANNER
- And for TRACS2
NB. It is required that the system be fully automatic with no human intervention in the processing stages

Summary of quality procedures (1)
External processes
- Acceptance tests
- Accreditation
  - Quarterly TRACS2
  - Annually SCANNER
  - Or after major equipment change
- Independent audits by HARRIS
- Weekly progress reports to auditor

Summary of quality procedures (2)
Internal processes
- Daily repeat surveys
- Weekly repeat surveys
- Monthly repeat surveys
Additionally
- Monthly meetings between contractor, client and auditor
- Annual revision of specification
UK Highways Agencies views on introduction to local authority roads

1 TRACS payment schedule
- "The Contractor shall carry out annual surveys on all of the following: -
  • Both directions of Single Carriageways
  • Lanes one and two in each direction on Dual Carriageways
  • All Slip Roads"
- For Single Carriageways this has been interpreted to mean lane 1 in each direction regardless of the number of lanes.
- Payment is based on a kilometerage basis and is made to the Contractor on acceptance of processed data into the client's database.

2 Requirements for data to be accepted
- Accuracy – measurement of data to tolerances as specified in Contract documents
- Quality – checks against longitudinal and co-ordinate tolerances as specified in Contract documents
- Surveys – fully completed within financial year
- Processing – fully completed within 30 days of collection

3 Critical success factors
- Solid research base
- Sound business case
- Performance contract
- Underlying data management regime
- Audit regime
- Strong intelligent client

4 Summary of issues for local authorities
- Clear understanding of why you are collecting cracking data – is it just for Performance Indicators or for sound operational reasons
- Data quality – need accredited vehicle with data to required accuracy
- Strong performance contract – what incentives are there to deliver, what penalties should be considered?

TRL’s messages on evaluation of automated crack systems
- Consider need
- Define requirement
- Implement quality audit procedure
- Apply procedure with understanding!
Why worry about cracks?

They can last 2000 years!

Thank you for listening!

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