Road Deterioration model review for Queensland

Impact of reduced maintenance strategy on pavement surface condition

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Background

Purpose

- Provide a revision to the current road deterioration (RD) model used in QLD, to give Transport and Main Roads greater confidence in performance prediction – **PART 1** (this presentation – Y1 outcome to date)

- Provide Transport and Main Roads with a method to demonstrate the impact of reduced maintenance on the condition of its road network – **PART 2** (Y2 outcome)
Project highlights

- Y1 scope focus in SEQ regions
- Develop analysis methodology
- Utilising ARMIS historical data and latest technology in Data Collection
- Review of Deterioration Models in Queensland
RD model review

Pavement Management System (PMS)

Road Deterioration (RD)

Crack
Rut
Rough

Structural (TSD data)

Methodology:

1. Determine historical RD trend
   - ARMIS time series data
   - Filtering for irrelevant data and noise
   - Selected sections with usable trend

2. Trend based on RD model
   - HDM4 vs Austroads vs LRDS
   - Other studies (ALT, Transport and Main Roads’ seal life, NACOE P2)
Historical time series data

Selected section for Analysis (scatter)

General Filtering Rules:

<table>
<thead>
<tr>
<th>Filter</th>
<th>Cracking</th>
<th>Rutting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consistency; Location and method of collection</td>
<td>7,500</td>
<td>60,000</td>
</tr>
<tr>
<td>Pavement Configuration (Granular pavement only)</td>
<td>1,800</td>
<td>13,800</td>
</tr>
<tr>
<td>Consecutive time series data (min. of three points)</td>
<td>500</td>
<td>7,450</td>
</tr>
<tr>
<td>Positive deterioration</td>
<td>189</td>
<td>5,500</td>
</tr>
<tr>
<td>Availability of deflection data</td>
<td>1,500</td>
<td></td>
</tr>
</tbody>
</table>
Model review

Austroads Cracking Deterioration Model

\[ \Delta crx = 100 - 200 \times (1 + \exp((a1 \times crxAGE / ((200 - TI_i)/25))^{3.5}))^{-1} \]

• Influenced by:
  – Climate, Thornthwaite Moisture Index \((TI)\)
  – Crack Age: Surface Age – Seal Life (Crack Initiation)
  – Seal Life: bitumen hardening equation (risk factor, temperature, bitumen durability and stone size – Olivier, 2004)
Model review
Seal Life prediction vs Historical data

1. Cracking initiated earlier than predicted
2. Another 3+ yrs for cracks to be visible
3. \( CrxAge = Seal\ Age - Seal\ Life - ?\ yr \)
Model review

Austroads Cracking Deterioration Model vs Trend

\[ \Delta \text{crx} = 100 - 200 \times (1 + \exp((a1 \times \text{crxAGE} / ((200 - TI_i)/25)^{3.5}))^{-1} \]

\[ a1 = 0.65 \]

Seal Life = 4 yrs

\[ a1 = 0.74 \]

Seal Life = 9 yrs

\[ a1 = 0.95 \]
Model review

Austroads Rutting Deterioration Model

\[ \Delta \text{rut} = (\text{AGE}_i - 1)^{b_1} \times b_2 \times \left( \frac{TI_i + 100}{\text{SNC0}} \right) + b_3 \times \text{MESA} - b_4 \times \text{me} \]

- Influenced by:
  - Pavement Age
  - Climate, Thornthwaite Moisture Index (TI)
  - Combined pavement and subgrade strength (Structural Model)
  - Traffic loading
  - Maintenance expenditure
Model review

Austroads Structural Model - interim relationship

- Utilising the TSD survey result to calculate SNC network wide
- A one-to-one relationship between TSD collected data and FWD was used

Note: At the time of submission (June 2016) the author is progressing with the work on confirming suitability of the above model for QLD based on collected TSD data. An updated version of this slide with the result is envisaged by Aug 2016
Model Review

Austroads Rutting Deterioration Model vs Historical trend

$$\Delta rut = (AGE_i - 1)^{b_1} \times b_2 \times ((Ti + 100) / SNC_0) + b_3 \times MESA - b_4 \times me$$
Project outcome so far

- Identified ‘Calibration section’ from Cracking and Rutting models
- Preliminary Cracking model
- Preliminary Rutting model
- Key areas for further research/linkage:
  - Utilising Automatic Crack Detection (ACD) to refine Crack Initiation prediction
  - Use of TSD data (NACOE P40)
  - Approach when dealing with stabilised pavement modelling (NACOE P2)
Y1 task completion

- Finalise model review for SEQ:
  - Cracking & Rutting
  - Structural & Roughness
  - Field Validation of calibration sites

Y2 commencement

- Include data from up to 2 regions with climate and surface type variation
- Implementation of RD model to PMS
- Analysis of outcome – demonstration of impact of reduced maintenance strategy on network condition
Thank you

Any feedback, thoughts, suggestions…
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