City of Saskatoon's Pavement Management System: Network Level Structural Evaluation

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Abstract:

Pavement management systems (PMS) combine economics and engineering to derive cost-effective solutions for road maintenance and reconstruction. Since 1993, the City of Saskatoon (COS) has employed a PMS that focuses on pavement surface deterioration and ride quality to measure the performance of the city's road network. However, reliably predicting the structural condition of roads based on surface distress information can be very difficult, and structural deterioration is the most operationally intensive and costly road asset failures to rehabilitate. The COS started using heavy weight deflectometer (HWD) measurements to assess the structural condition of the COS road network in 2006. Since it is difficult to distinguish between certain surface distresses from structural distresses, HWD structural information may be beneficial in assessing the condition of the road structure and the corresponding treatment needed. Therefore, using COS network level PMS surface distress data and condition ratings, the effect of using structural data as measured by HWD is examined in this study. Two neighborhoods in Saskatoon were analyzed using typical COS PMS surface distresses and HWD deflection measurements. This study found that structural condition cannot be reliably predicted based on surface condition surveys. Structural condition assessments complement and enhance the findings of surface condition assessments. The risks posed by using surface condition assessments can be mitigated by using structural condition assessments in addition to surface condition assessments. Ultimately, the use of structural asset management will reduce the risk of a significant road failure and subsequent high expenditures to fix such a failure.

Background:

COS PMS:

- Pavement surface deterioration and ride quality is surveyed to measure road network performance:
  - International Roughness Index (IRI)
  - Rutting depth
  - Cracking

Limitations of COS PMS:

- No assessment of cause of distresses
- Moderate cracking often unnoticed
- Permanent deformation and structural damage
- Structural capabilities not addressed
  - Bus routes
  - Subsurface moisture issues
  - Industrial traffic
- Actual structural condition can be overlooked
- Maintenance and preservation treatments not optimized

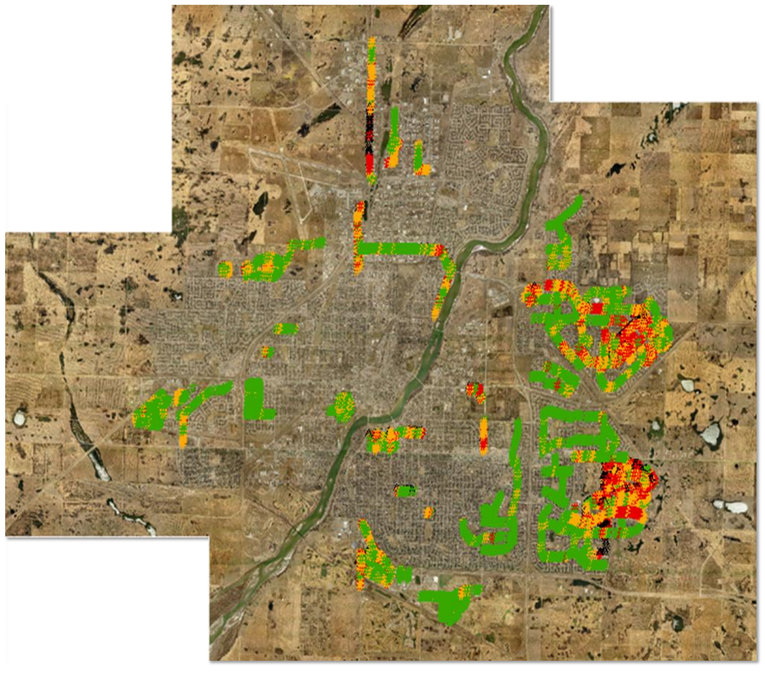
Poor selection of structural repair limit

4 year old roadway; Premature failure

7 year old roadway; Premature failure

Failure of patch constructed in 2001

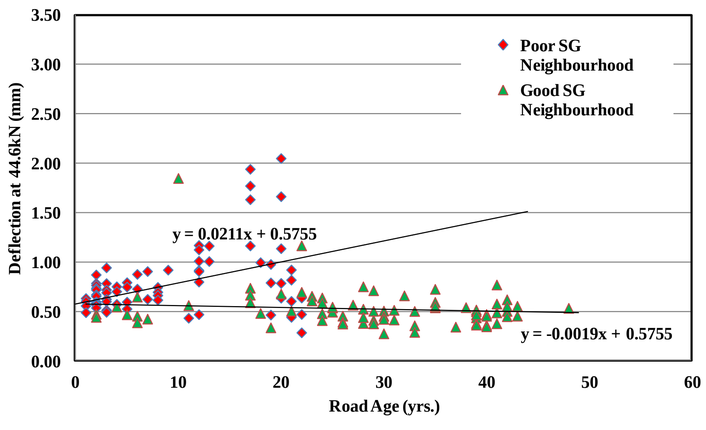
Failure of lane from single pass of crane



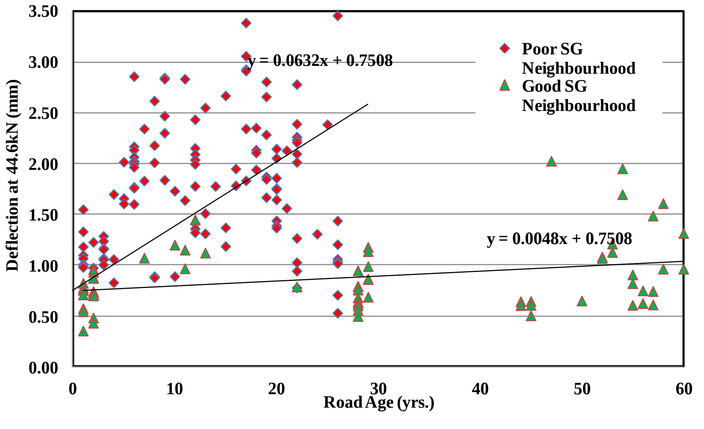
COS HWD Drop Locations

Determining Structural Capacity through Non Destructive Testing

- Heavy weight deflectometers (HWD) measures the deflection of a pavement structure when a load is applied, in a non-destructive manner.
- Deflections are used to quantify the structural capacity of the pavement.
- The COS has collected HWD data since 2006, using typical load spectra for Saskatoon.



Collector Roads



Local Roads

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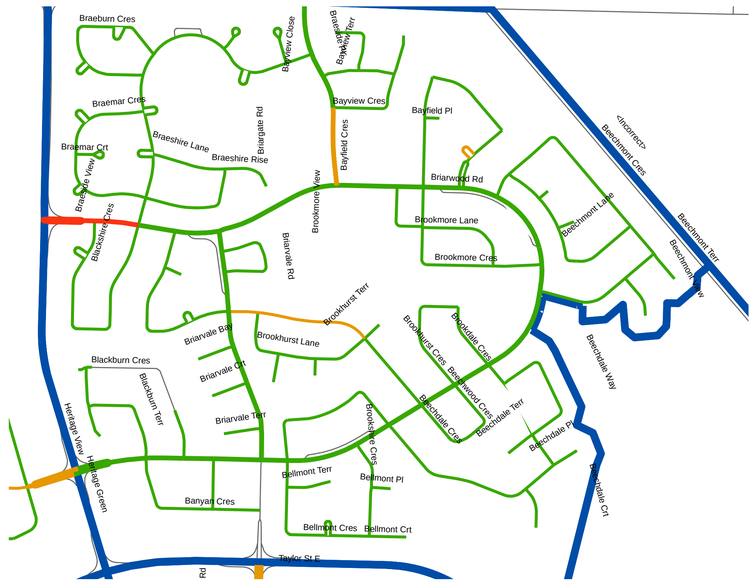
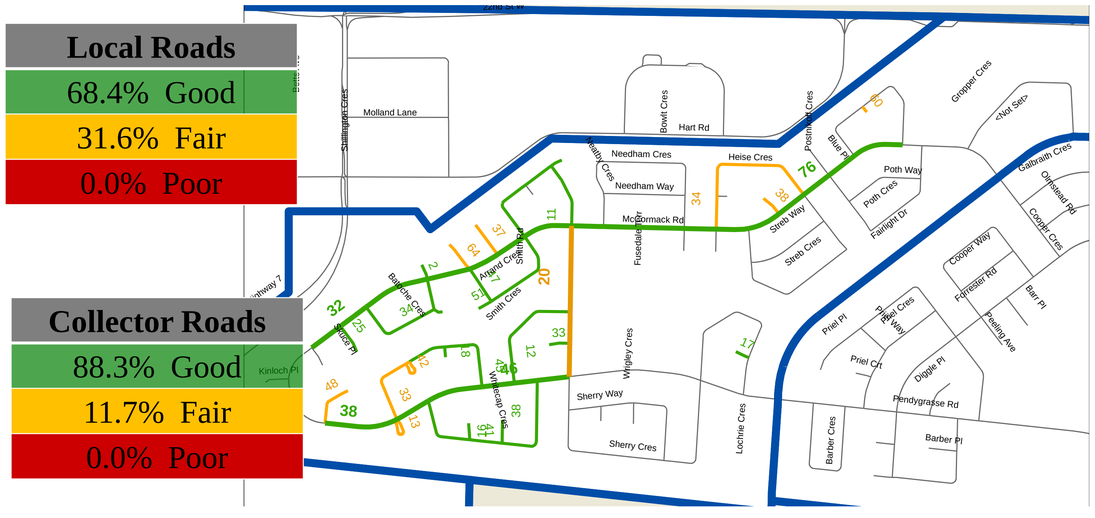
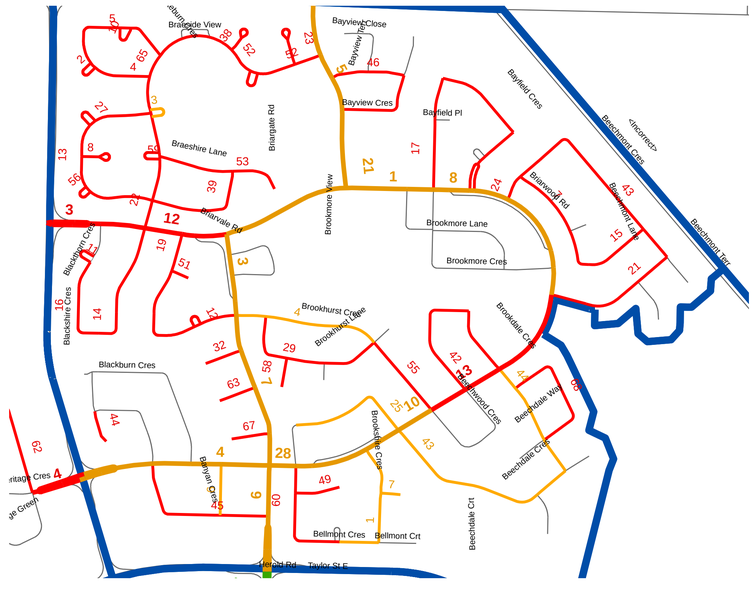
Network Level Surface and Structural Assessment:

	Parkridge	Briarwood
Description	Till Subgrade, Low Water Table Constructed mainly from 1979 to 1983 No roads reconstructed since initial construction	Clay Subgrade High Water Table Constructed between 1989 and 2010
Surface Condition	**Local Roads** 95.6% Good 0.7% Fair 3.7% Poor **Collector Roads** 85.1% Good 14.9% Fair 0.0% Poor	**Local Roads** 94.3% Good 5.7% Fair 0.0% Poor **Collector Roads** 58.4% Good 33.8% Fair 7.8% Poor
Structural Condition	**Local Roads** 68.4% Good 31.6% Fair 0.0% Poor **Collector Roads** 88.3% Good 11.7% Fair 0.0% Poor	**Local Roads** 0.0% Good 17.3% Fair 82.7% Poor **Collector Roads** 0.0% Good 72.7% Fair 27.3% Poor







Conclusions:

- For Briarwood roads:
  - HWD structural condition ratings of the majority of roads indicate that significant rehabilitation and reconstruction are needed in the near future.
  - Briarwood is performing structurally fair or poor after 5 to 20 years of service.
  - The surface condition ratings only indicate that surface treatments will likely be needed for a number of Briarwood's collector roads.
- For Parkridge roads:
  - HWD structural condition ratings show that the roads are generally in good condition, and will not require major structural treatments in the near future.
  - Parkridge is performing structurally good after as much as 30 years of service.
- Structural conditional cannot be reliably predicted from surface conditions state, particularly in weak structural field state conditions.
- Results of structural condition assessments compliment and enhance the findings of surface condition assessments. Risks posed by surface assessments can be mitigated by adding structural assessments to existing PMS.
- Structural assessments will better optimize maintenance treatments across an expanding urban network.
  - Proactive planning versus reactive approach.
- Structural assessments are valuable for:
  - Performance prediction to optimize road treatments,
  - Valuable feedback on structural designs of roads, and
  - Validation of long-term pavement performance.

City of Saskatoon

The authors would like to thank the City of Saskatoon and the University of Saskatchewan Centre in Excellence for Transportation and Infrastructure for funding this project as well as for their assistance in this research.

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