Managing The City of Calgary’s Pavement Asset

Basics & Innovation

Planning & Infrastructure Engineer
Roads, Construction
Overview

- The City of Calgary’s Roads Asset
- Current State of Pavement Asset
- Challenges in Pavement Management
- Basics & Innovation
- Conclusion
## Pavement & Sidewalk Asset

<table>
<thead>
<tr>
<th>Asset Type</th>
<th>Surface Type</th>
<th>Size</th>
<th>Asset value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pavement</strong></td>
<td>Asphalt</td>
<td>14,500 Ln-km</td>
<td>$11 Billion</td>
</tr>
<tr>
<td></td>
<td>Gravel</td>
<td>225 Ln-km</td>
<td>$6 Million</td>
</tr>
<tr>
<td><strong>Back-Lane</strong></td>
<td>Asphalt</td>
<td>990 Ln-km</td>
<td>$14 Million</td>
</tr>
<tr>
<td></td>
<td>Gravel</td>
<td>2,010 Ln-km</td>
<td>$11 Million</td>
</tr>
<tr>
<td></td>
<td>Concrete</td>
<td>16 Ln-km</td>
<td>$29 Million</td>
</tr>
<tr>
<td><strong>Sidewalk</strong></td>
<td>Concrete</td>
<td>5,560 Km</td>
<td>$1 Billion</td>
</tr>
</tbody>
</table>
### Pavement Network Performance

- Paved network of 14,500 Lane-km → Asset value of $11 Billion

- Pavement Quality Index (PQI)* – measure of pavement quality, function of visual distress, roughness and structural condition

<table>
<thead>
<tr>
<th>Functional Class</th>
<th>Lane km (% Network)</th>
<th>Trigger PQI</th>
<th>2015 Avg. PQI</th>
<th>2016 Avg. PQI</th>
<th>PQI Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial</td>
<td>3,776 (26%)</td>
<td>6.0</td>
<td>6.2</td>
<td>6.3</td>
<td>Improving</td>
</tr>
<tr>
<td>Collector</td>
<td>3,058 (21%)</td>
<td>5.0</td>
<td>5.9</td>
<td>5.6</td>
<td>Declining</td>
</tr>
<tr>
<td>Industrial</td>
<td>463 (3%)</td>
<td>5.0</td>
<td>5.7</td>
<td>5.0</td>
<td>Declining</td>
</tr>
<tr>
<td>Local</td>
<td>7,204 (50%)</td>
<td>4.0</td>
<td>7.5</td>
<td>7.1</td>
<td>Declining</td>
</tr>
<tr>
<td><strong>Network</strong></td>
<td><strong>14,501</strong></td>
<td><strong>7.0</strong></td>
<td><strong>6.8</strong></td>
<td><strong>6.5</strong></td>
<td>Declining</td>
</tr>
</tbody>
</table>

*PQI: Pavement Quality Index (1 Min – 10 Max)
Distribution of Network Performance by PQI

![Graph showing the distribution of network performance by PQI for years 2014, 2015, and 2016. The graph displays the percentage of the network in different PQI ranges: 0-4, 4.1-5, 5.1-6, 6.1-7, 7.1-8, 8.1-9, and 9.1-10.0. The graph indicates the percentage of network performance that falls within each PQI range for the specified years.]
Performance by Roadway Use Type

% Roads in Good & Very Good Condition

- Bike way
- Bus Route
- Truck % > 10
- Traffic > 30000

<table>
<thead>
<tr>
<th>Year</th>
<th>Bike way</th>
<th>Bus Route</th>
<th>Truck % &gt; 10</th>
<th>Traffic &gt; 30000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>36%</td>
<td>39%</td>
<td>42%</td>
<td>45%</td>
</tr>
<tr>
<td>2013</td>
<td>29%</td>
<td>45%</td>
<td>55%</td>
<td>56%</td>
</tr>
<tr>
<td>2014</td>
<td>43%</td>
<td>51%</td>
<td>43%</td>
<td>51%</td>
</tr>
<tr>
<td>2015</td>
<td>39%</td>
<td>49%</td>
<td>39%</td>
<td>49%</td>
</tr>
<tr>
<td>2016</td>
<td>36%</td>
<td>57%</td>
<td>36%</td>
<td>57%</td>
</tr>
</tbody>
</table>

22/02/2017 Managing The City of Calgary’s Pavement Asset
Current Network Needs

- 78% of the network is above minimum level of service (LOS), 22% is below

Network Condition

<table>
<thead>
<tr>
<th>Category</th>
<th>Network Condition</th>
<th>Arterial</th>
<th>Collectors</th>
<th>Industrial</th>
<th>Local</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Good - Very Good</td>
<td>-41%</td>
<td>-35%</td>
<td>-51%</td>
<td>-5%</td>
</tr>
<tr>
<td></td>
<td>Below Acceptable LOS</td>
<td>-199 M</td>
<td>-136 M</td>
<td>-30 M</td>
<td>-43 M</td>
</tr>
<tr>
<td></td>
<td>Backlog ($, M)</td>
<td></td>
<td></td>
<td></td>
<td>Overall Backlog &gt; $400 M</td>
</tr>
</tbody>
</table>

-78% of the network is above minimum level of service (LOS), 22% is below.
Budget Allocation – Major Vs Local

- Local roads → Relatively better
- Focus on major roads
Network Condition Vs. Levels of Funding

22% of network below acceptable LOS

- **Do Nothing**
- **$36 M (Current)**
- **$41 M**
- **$51 M**


- **Reduced service**
- **Maintain service**
- **Enhanced service**
Growing Network

- Budget has not kept pace with the growth
- Redevelopment adds to rehab needs
- Backlog is equivalent to 10 years rehab (current) budget, > $400 M
- Conflicts delaying rehab – utility upgrades, major projects etc.
Proactive or Reactive?

- Preventive Maintenance is essential to cost-effectively maintain roads
- Need to address poor roads to improve the LOS to citizens

“Invest in preventive maintenance and rehabilitate pavements well before they become noticeably rough to maximize pavements at lowest life cycle cost”

Federal Highway Administration
Pavement Excavation – Redevelopments

- Study showed 22% reduction in service life → accelerates rehab trigger
- Affects LOS, ride quality cause safety concerns
Other Challenges

- Very Thin Asphalt Layer
- Water Main Break
- Rutting @ Bus Stops
- Damage From Non-Standard Vehicles
Pavement Construction Problems

Paving in Rain

On Poor Base

Bleeding

Dumping Asphalt in non-designated areas

Pavement Settlement
Pavement Construction Problems

Asphalt Mix Issues

Insufficient Tack Coat
Concrete Sidewalk Construction Problems

Saturated Base + Pavement Cracking

Saturated Base
Challenges Recap

- Growing road network & insufficient funds
- Pavement excavation - redevelopments
- Construction practices not conforming to specifications
Pavement Assessment

- Pavement rehab program prioritization follows:

<table>
<thead>
<tr>
<th>Network Level</th>
<th>Project Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Overall PQI</td>
<td>- Tier I – Visual inspection</td>
</tr>
<tr>
<td>- PQI based on service classification (Arterials, Collectors, Locals etc.)</td>
<td>- Tier II – Visual inspection + Limited testing</td>
</tr>
<tr>
<td>- PQI based on road use (Bike, Bus, Truck, etc)</td>
<td>- Tier III – Detailed investigation – Visual inspection, IRI, FWD, GPR, Boreholes, Coring etc.</td>
</tr>
<tr>
<td>- PQI at the Community level</td>
<td></td>
</tr>
</tbody>
</table>

- Combined approach to treat poor roads yet maintain good roads
Preventative Maintenance

Crack Sealing

Spray Patching

Micro Surfacing
Tier II & III – Pavement Treatments

Tier II
Localized Deep Base Repairs

Tier II Mill & Inlay

Tier III Reconstruction
Innovation

Materials
- Rut resistant asphalt mixes
- Fiber reinforced asphalt mix
- Fiber glass grid
- Trackless tack coat
- Geogrids and composite geogrids

Data Collection
- Semi-automated distress survey on Local roads

GIS for Pavement Management System
- HPMA - GIS integration, photo capability
- Web-application integrating field data collection with GIS server (testing phase)
Fair cost recovery on utility cuts

- Pavement Degradation Fees
- Surface restoration Fees applicable for roads with Visual Condition Index (VCI) $\geq 7.0$

Coordination

- Improved coordination with stakeholders, avoid cuts after paving
- GIS based eMaps tool for conflict identification & planning

Customer Service Using ArcGIS App

- Real-time project updates to citizens
- Live update from the field from iPad’s & iPhone’s
### Improvements to Construction Practices, Specifications

**Material QA/QC**

- Sidewalk: Test sections with granular base & varying concrete thickness, fibergrid reinforcement
- Pavement Designs: Evaluating mechanistic empirical designs

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#### Pedestrian Strategy

- **45 x 45 cm PEDESTRIAN DETOUR**
- **Sidewalk**: Test sections with granular base & varying concrete thickness, fibergrid reinforcement
- **Pavement Designs**: Evaluating mechanistic empirical designs
Conclusion

- Basics – Achieve good quality through good construction practices
- ~$40 M Pavement Rehab Program, about 10 Contracts
- Pedestrian accommodation strategy is a priority
- Evaluate alternative materials for pavement and sidewalk
- Improvements to Roads, Construction Standard Specifications
- Technology to fill data gaps, coordination and customer service
- Collaborate with road builders, universities, other municipalities or agencies
Thank You!