GIS-Based Pavement Distress Mapping: City of Houston (COH) Pavement & Storm Water Preservation Plans

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COH Street Pavement Rating System: Past/Present/Future

• In the past, COH collected pavement data with a city-owned pavement data collection vehicle
• Now collecting PCI separated out
• PCI is adopted by APWA (American Public Works Association)
• Based on ASTM D6433 published standard (American Society for Testing and Materials)
• PCI is a “Numerical Indicator” that rates surface condition of the pavement
COH Performed Pavement Assessment on All MAJOR & LOCAL Roads in 2015-2016

- 1,231 Centerline Miles of Major Roads
  - Multi-Pass Collection on 3 lane or greater roads
- 4,900 Centerline Miles of Local Roads
  - Bi-directional passes on all local roads
- IRI data collected with 5 laser profiler
- StreetSaver Plus utilized as the Pavement Management Information System (PMIS)
- Right-of-Way Imagery collected concurrently with all pavement data collection
PCI Rating…

1. PCI provides present condition of pavement surface
2. PCI helps determine what treatments and where (right treatment on the right pavement at the right time)
3. PCI allows for feedback on maintenance treatments (validation of current practices)
4. PCI is used to evaluate materials & designs
Additional PCI information:

- Repeatable methodology
- Pavement distresses are objectively scored based on type, severity, and extent
- Every street is rated with the same standard
- PCI score range is 0 (worst possible condition) to 100 (best possible condition)
- PCI can be used as a tool/aid to rank streets relative to each other
PCI, IRI & ADT Distinctions

 PCI (Pavement Condition Index)
 Physical Assessment

- Pavement Surface Distresses based on type, severity & quantity
- Leading Indicator (generally)
- Engineer’s use for Treatment Determination

IRI (International Roughness Index)
Functional Assessment

- Ride Quality Measurement
- Lagging Indicator (generally)
- Citizen/Driver’s notice
- Important dimension to assess road conditions.

ADT/AADT (Average Daily Traffic/Annual Average Daily Traffic)
Demand Assessment

- Asset’s capacity over long term
- Maximum return on funds invested
- Deliver the required levels of service
COH PMIS and its Life Cycle

All Pavement segments

Distress Survey

Set priority based on needs, funds including cost

Feedback

Upload treatment plans, costs, resurvey strategy

Create different funding scenarios and it’s overall effect

Needs:
Physical (PCI)
Functional (RQM)
Demand (ADT)
Automated Distress Inspection

Rutting Data with a 5-laser Profiler
Automated Distress Inspection
Quantifiable Results, Low subjectivity, High repeatability
### ASTM D6433-09 PCI Description Groups

**Distress:** Type Severity Quantity

<table>
<thead>
<tr>
<th>Pavement Condition Index (PCI)</th>
<th>CONDITION DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>GOOD</td>
</tr>
<tr>
<td>86</td>
<td></td>
</tr>
<tr>
<td>85</td>
<td>SATISFACTORY</td>
</tr>
<tr>
<td>71</td>
<td></td>
</tr>
<tr>
<td>70</td>
<td>FAIR</td>
</tr>
<tr>
<td>56</td>
<td></td>
</tr>
<tr>
<td>55</td>
<td>POOR</td>
</tr>
<tr>
<td>41</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>VERY POOR</td>
</tr>
<tr>
<td>26</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>SERIOUS</td>
</tr>
<tr>
<td>11</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>FAILED</td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
Collected Data Integrated with ESRI
PCI – Scale – Repair Strategy

PCI

Preservation / Preventive Maintenance $

Minor Rehabilitation / Resurface $

Major Rehabilitation $$$$ 

Reconstruction $$$$$$ 

Age
## COH Major Roads PCI Results

<table>
<thead>
<tr>
<th>Pavement Condition Index (PCI) Range</th>
<th>Condition Description</th>
<th>Percent of Network</th>
<th>Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td>86-100</td>
<td>Good</td>
<td>45.52%</td>
<td></td>
</tr>
<tr>
<td>71-85</td>
<td>Satisfactory</td>
<td>34.35%</td>
<td></td>
</tr>
<tr>
<td>56-70</td>
<td>Fail</td>
<td>12.93%</td>
<td></td>
</tr>
<tr>
<td>41-55</td>
<td>Poor</td>
<td>4.84%</td>
<td></td>
</tr>
<tr>
<td>26-40</td>
<td>Very Poor</td>
<td>1.85%</td>
<td></td>
</tr>
<tr>
<td>11-25</td>
<td>Serious</td>
<td>0.44%</td>
<td></td>
</tr>
<tr>
<td>0-10</td>
<td>Failed</td>
<td>0.07%</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

### City of Houston, TX PCI Example Map (Major Roads)
# COH Local Roads PCI Results

<table>
<thead>
<tr>
<th>Pavement Condition Index (PCI) Range</th>
<th>Condition Description</th>
<th>Percent of Network</th>
<th>Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td>86-100</td>
<td>Good</td>
<td>21.17%</td>
<td></td>
</tr>
<tr>
<td>71-85</td>
<td>Satisfactory</td>
<td>31.04%</td>
<td></td>
</tr>
<tr>
<td>56-70</td>
<td>Fail</td>
<td>23.27%</td>
<td></td>
</tr>
<tr>
<td>41-55</td>
<td>Poor</td>
<td>13.12%</td>
<td></td>
</tr>
<tr>
<td>26-40</td>
<td>Very Poor</td>
<td>5.94%</td>
<td></td>
</tr>
<tr>
<td>11-25</td>
<td>Serious</td>
<td>1.36%</td>
<td></td>
</tr>
<tr>
<td>0-10</td>
<td>Failed</td>
<td>0.10%</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>100%</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Legend: Good = Green, Satisfactory = Light Green, Fair = Yellow, Poor = Orange, Very Poor = Red, Serious = Dark Red, Failed = Gray*
COH Major Roads PCI Results
COH Local Roads PCI Results

City of Houston, TX
PCI Example Map (Local Roads)

Legend
- Good
- Satisfactory
- Fair
- Poor
- Very Poor
- Serious
- Failed

Legend
- Good
- Satisfactory
- Fair
- Poor
- Very Poor
- Serious
- Failed
COH Right-of-Way Imagery Asset Tagging Results
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Treatment history layer will be displayed as we move forward...
Takeaways:

- Pavement is one of the most expensive and customer utilized assets an organization is required to maintain.
- Pavement management needs to be objective and repeatable over time.
- Pavement management cannot happen in isolation; it needs to be planned in conjunction with right-of-way assets that are directly impacted by repair or rehabilitation activities: curb and gutter, ROW obstructions, ADA ramps and compliance, stormwater drainage.
- Every asset occurs at some location in space; GIS is a powerful tool for maintaining these assets and understanding their locational variances.
In summary,

- Results uploaded into a Pavement Management Information System (PMIS) to manage data
- Surveys & calculate PCI using distresses
- GIS layer creation for Treatment history
- Database management for MR & R
- Manage Roadside ditches, C/G & Inlets
- Identify missing assets using video
- Condition assessment of few SW assets without boots on the ground and display on GIS
- Streamline complicated infrastructure asset management using technology & hardware tools
Visualize Pavement Preservation including ROW assets tagging efforts through GIS:
Questions?