Development of a Pavement Management Information System for the City of Toledo

Presented By:
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City Pavement Management History

- In 2002 the city entered into an agreement with the University of Toledo (UT) to provide the city with pavement condition data.
  - The data was International Ride Index (IRI) data. The data was never used by the city. It provided no information on pavement condition or defects and was of little value.

- In 2008 the city entered a new agreement with the UT
  - In addition to IRI data, UT would provide Pavement Condition Rating (PCR) data, which provided useful information on pavement condition and defects to assist in decisions at a project level
  - The PCR data was useful when looking at an individual street but no means was provided to analyze our entire system and make policy level decisions such as budgeting, or decisions such as what streets to include in our paving programs, thus the data was used on a limited scale.

- In late 2016 Engineering Services decided it needed better information and a full scale pavement management system
  - An RFP was sent out in the spring 2018 and the consulting firm Engineering Research International (ERI) was selected.
  - Since being selected ERI has been collecting detailed Pavement Condition Index (PCI) data and inputting into the MicroPaver pavement management software and preparing the software so that we can analyze policy level decisions and assist in better selecting work for our paving programs.
Pavement Management System

Strategic framework for managing transportation infrastructure, aligning resource allocation to maintain and/or improve the system to a specific level

Predictive, not reactive (making informed decisions)

Principals:
- Policy Driven (Strategic)
- Performance Based
- Option Oriented
- Data Driven
- Transparent

Earning the public’s trust

Pavement management is the process of planning the maintenance and repair of a network of roadways or other paved facilities in order to optimize pavement conditions over the entire network for a given set budget.
PRESENTATION OUTLINE

- Pavement management System
- Background
- Field Data collection
- Data Processing
- Data Reporting
- Challenges and Achievements
- Recommendations
Life of Pavement

$1 of preventive maintenance here…
PAVEMENT MANAGEMENT SYSTEM

Fully Operable, State-of-the-Art Pavement Management Solution

- Evaluate the Current Pavement Condition
- Determine the Rates of Pavement Deterioration
- Project Future Pavement Conditions
- Determine Maintenance and Rehabilitation Needs
- Determine the Costs of Maintenance and Rehabilitation
- Determine the Effects of Budget Reductions and Deferred Maintenance
- Identify and Prioritize Pavement Maintenance and Rehabilitation Projects
- Track Performance of Various Pavement Designs and Materials

The main function of any pavement management system is pavement condition tracking and suggesting the suitable maintenance works.

The Importance of Timing: Getting the Most BANG for Your $’s

Effective Pavement Management: “Right Road, Right Treatment, Right Time”
Network 1                             Network 2                       Network 3                    Network 4                 Network 5

Major and Connecting Streets **
(aka Arterials and Collectors)

Major Streets signed with US or State Routes

Major Streets not signed with Routes

Connecting Streets

Local streets (most with Curb/Gutter)

Local Access Streets (aka Residential Streets)

Assessed Local streets (mostly tar & chip with ditches)***

* Street types in **BOLD lettering** qualify for CIP funding.
** Major and Connecting Streets qualify for federal and state transportation funding in addition to CIP funding.
*** Almost all unimproved streets are maintained using assessed tar and chip treatment.
BACKGROUND

- ODOT has been rating Network 1, 2 & 3 using the ODOT Pavement Condition Rating (PCR) system since 2003.

- City of Toledo in partnership with University of Toledo has been rating the City streets since 1998.

- In 2017, City of Toledo hired ERI to develop a pavement Management System using MicroPAVER to perform a more comprehensive analysis of the entire street network which will allow the City officials to use best practices to prioritize projects and improve the condition and safety of pavement assets while minimizing costs over its entire life span.
## City Pavement Assets

<table>
<thead>
<tr>
<th>Network No.</th>
<th>Centerline Miles</th>
<th>Lane Miles</th>
<th>Number of Sections</th>
<th>Pavement Area (Sq.ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>88.60</td>
<td>274.29</td>
<td>1,162</td>
<td>17,379,340.95</td>
</tr>
<tr>
<td>2</td>
<td>117.55</td>
<td>346.21</td>
<td>1,728</td>
<td>21,935,657.97</td>
</tr>
<tr>
<td>3</td>
<td>92.89</td>
<td>196.87</td>
<td>1,189</td>
<td>12,473,709.62</td>
</tr>
<tr>
<td>4</td>
<td>647.46</td>
<td>1,289.67</td>
<td>7,553</td>
<td>81,713,443.98</td>
</tr>
<tr>
<td>5</td>
<td>200.45</td>
<td>397.70</td>
<td>2,406</td>
<td>25,198,489.89</td>
</tr>
</tbody>
</table>

**Notes:**
1. The above breakdown is based on the inventory defined in the MicroPAVER database.
   (City’s latest Centerline shapefile dated 12/15/2017 has to be updated with final corrections to network and FC definitions)
   - Centerline Miles = sum of all Section Lengths within each network (Includes parallel sections)
   - Lane Miles = Section Area / 12
2. Network 0 includes private streets, trails, Interstate, Alleys?
3. Combined Centerline Miles of Network 1 thru 5 = 1,146.95
4. Combined Lane Miles of Network 1 thru 5 = 2,504.74
5. Combined Number of Sections of Network 1 thru 5 = 14,038
Automated Pavement Data Collection Vehicle

Equipment & Technology:
- High Resolution Cameras
- Laser Road Imaging System (LRIS)
- Five (5) Laser Sensors
- GPS Navigation System
- Distance Measuring Instrument (DMI)

Resolution:
- Forward Camera Images – 2448x2048
- Downward Camera Images - 4071x3981

Continuous Image Capturing

State-of-the-art Imaging Technology
Pavement Images were collected from April 7th to June 2nd, 2017

GPR data was collected in conjunction with ADS at no additional cost to the City. The collected data will be available for:

- Continuous pavement layer thickness determination
- Identify of uniform pavement sections
- Layer separation (debonding) analysis
- Utility detection at shallow depths when possible
- Voids analysis
- Verification of construction history data
- Sinkhole investigation
Data Reduction

- **Semi-Automated Approach**
  - Images were processed through the automated crack detection software and then trained raters checked manually distress type, severity, and quantity

- **Value-Added information extraction**
  - Presence of Sidewalk
  - Curb Height
  - Location of Sinkholes
Customized PCI scale for COT

- **100**: Excellent
- **85**: Good
- **70**: Fair
- **55**: Poor to Failed
<table>
<thead>
<tr>
<th>PCI RANGE (CATEGORY)</th>
<th>Recommended M&amp;R Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>86-100 (Excellent)</td>
<td>Do-Nothing</td>
</tr>
<tr>
<td>71-85 (Good)</td>
<td>Preventive Maintenance</td>
</tr>
</tbody>
</table>

*Crack Seal*
<table>
<thead>
<tr>
<th>PCI RANGE (CATEGORY)</th>
<th>Recommended M&amp;R Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>56-70 (Fair)</td>
<td>Preventive Maintenance</td>
</tr>
<tr>
<td></td>
<td>Localized Patching and</td>
</tr>
<tr>
<td></td>
<td>Surface Treatment</td>
</tr>
<tr>
<td></td>
<td><strong>Major M&amp;R</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Mill and Resurfacing</strong></td>
</tr>
<tr>
<td>0-55 (Poor to Failed)</td>
<td><strong>Major M&amp;R</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Mill and Resurfacing or Complete Reconstruction</strong></td>
</tr>
</tbody>
</table>
Pavement Management Software

MicroPAVER™ Software

- MicroPAVER™ Pavement Management System developed by the U.S. Army Corp. of Engineers. MicroPAVER™ is the most widely used PMS in the U.S. and worldwide.

- City’s latest GIS shapefile was used for PAVER inventory database development
Pavement Area by Network (SqFt)
Weighted Average PCI By Network
Weighted Average IRI By Networks
Weighted Average PCI By Pavement Surface Type Networks 1-4
Weighted Average PCI By District Networks 1-4
Network 4 - 2028 Average Network PCI 40 (Poor to Failed)
Network 4 - 2038 Average Network PCI 38 (Poor to Failed)
Challenges & Achievements

- Distress survey took longer time than expected due to bad condition of streets

- Inventory required for MicroPAVER™ database was not readily available in the latest shapefile
  - Surface Type was assigned based on the review of the historical data capture records and 2017 inspection data
  - Last Construction Date was assigned based on the review of the historical data capture records.

- The street segmentation in ODOT shapefile is not same as the City’s latest shapefile
  - 2017 ODOT PCR data was assigned to City’s Network 1, 2 & 3 segments using a comprehensive excel macro and manual assignments where needed
Challenges & Achievements

- Historical Data Capture records were not easily integrated with the City’s latest shapefile
  - Historical records were assigned to City street segments using a comprehensive excel macro

- There are several sections within Network 4 where the surface types from the field inspection data did not match with the latest construction record
### Pavement Condition Rating Vs. Pavement Condition Index

<table>
<thead>
<tr>
<th>ODOT PCR</th>
<th>ASTM D6433 PCI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Condition Rating Scale 0-100</td>
<td>Condition Rating Scale 0-100</td>
</tr>
<tr>
<td>14 AC Distresses</td>
<td>20 AC Distresses</td>
</tr>
<tr>
<td>12 PCC Distresses</td>
<td>19 PCC Distresses</td>
</tr>
</tbody>
</table>

Deduct Values assigned based on extent and severity of Distress

**Figure 1.** Pavement Condition Rating (PCR) Scale

**Condition:**
- **Very Good**
- **Good**
- **Fair**
- **Poor**
- **Very Poor**

**Standard PCI™ Rating Scale**

- **Good**
- **Satisfactory**
- **Fair**
- **Poor**
- **Very Poor**
- **Failed**

**Suggested Colors**
- Dark Green
- Light Green
- Yellow
- Light Red
- Medium Red
- Dark Red
- Dark Grey

**Pavement Condition Index (PCI), Rating Scale, and Suggested Colors**

- **Good**
- **Satisfactory**
- **Fair**
- **Poor**
- **Very Poor**
Conversion Procedure – PCR to PCI

- Convert the ODOT PCR data using some pre-established co-relations with ASTM D 6433-11 PCI values but without any pavement distresses.

- Convert the ODOT PCR data using some pre-established co-relation with ASTM D 6433-11 PCI values but with pavement distresses

- Establish new ODOT PCR to ASTM D 6433-11 PCI relationships using pavement distresses but without field verification of the distress data

- Establish new ODOT PCR to ASTM D 6433-11 PCI relationships using pavement distresses but with some field verification of the distress data
Recommendations

- Annual updates to database by the City staff
- Annual monitoring by the City staff for road deterioration
- Re-run repair & funding scenarios annually
- Coordinate repaving with other CIP projects
- Update road condition imaging periodically (every 3 years)
Questions?

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