Pavement Management Systems

Quality Assurance/Quality Control and Quality Acceptance

By: John Ashley Horne
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Pavement Management Systems – QA/QC

- Various Data Collected for PMS
- Automatic Road Analyzer (ARAN)
- Data Collected by the ARAN
- Data Collection Vendor’s Quality Assurance/Quality Control
- Pavement Management System’s Quality Acceptance
Data Collected for PMS – cont’d

Overhead Clearances
(Collected in 2007)
Data Collected for PMS – cont’d

Ramps
(Collected 2000 and 2007)

Example: Ramp off of I-0010, District 61
Data Collected for PMS – cont’d

Geometric Information

Roadway Geometric Data
• Cross slope
• Road shoulder drop-off
• Horizontal Curves
• Vertical Curves
Data Collected for PMS – cont’d

Ground Penetrating Radar

(1995 Statewide)
(2009 District 05, remaining Districts over next 4 years)
Data Collected for PMS – cont’d

Friction Testing
Data Collected for PMS – cont’d

Rolling Wheel Deflectometer (RWD)
(collected 2009)
Data Collected for PMS – cont’d

Falling Weight Deflectometer (FWD)
Automatic Road Analyzer (ARAN)
Data Collected by ARAN

- Right of Way Images
  - Center view
  - Right view
- Pavement Images
- Electronic Data
  - Rutting
  - Faulting
- International Roughness Index (IRI)
- Global Positioning System (GPS) Coordinates
- Macrotexture
Data Collected by ARAN – cont’d

Right of way images

- Captured using two high definition cameras (1920 x 1080 pixel resolution)
- The images are recorded every 0.004 miles
Pavement Images

• Captured using two cameras
• 100% of the driven lane is captured
• Images stored for post processing
• Strobe lights minimize shadows
Rutting data is collected by the use of two scanning laser transverse profilers.

Roughness and faulting data is collected by two lasers, one in each wheel path.

GPS collected with corrections from LSU’s Center for GeoInformatics.

Texture collection utilizes high frequency lasers to measure the mean profile depth of road surface macrotexture.
Data Collection Vendor’s QA/QC

QA/QC - Calibration Site Test

• Tested three to five times
• Electronic sensor data, full Right-Of-Way (ROW) and pavement images
• The collected and evaluated data are compared with the original approved benchmark measurements
Tolerance for Acceptance

- Roughness should not deviate more than 10%
- Rutting and Faulting should not deviate more than 3 mm (0.1 inches)
- Pavement distresses are critiqued on a project level basis
Data Collection Vendor’s QA/QC

QA/QC – Maintaining Calibration

- Weekly verification site used to ensure the sensors employed by the ARAN stay within tolerance
- Monitor systems in real time during collection
- Compare current data to previous year’s data
- Regular verification of DMI calibration
- Inter-rater consistency is maintained
QA/QC – Pavement Distress Ratings

- WiseCrax
  - Longitudinal cracking
  - Transverse cracking
  - Fatigue cracking
- DRate
  - Patching
  - Distresses on concrete pavements
Data Collection Vendor’s QA/QC – cont’d

QA/QC – Pavement Distress Ratings

WiseCrax

• Used on asphalt surfaces
• Distresses rated by computer
  • Longitudinal cracking
  • Transverse cracking
  • Fatigue cracking
• Results are visually inspected and compared to previous year’s results
• Valid lane widths
• Duplicate records
• Correct rating scheme
• Distresses not detected
Data Collection Vendor’s QA/QC – cont’d

QA/QC – Pavement Distress Ratings

WiseCrax
Data Collection Vendor’s QA/QC – cont’d

QA/QC – Pavement Distress Ratings

DRate
• Used mainly on concrete surfaces
• Distresses rated manually
  • Longitudinal cracking
  • Transverse cracking
  • Patching (all pavement surfaces)
• Sections randomly sampled
• Results are compared to previous year’s collection
Data Collection Vendor’s QA/QC – cont’d

QA/QC – Pavement Distress Ratings

DRate
Data Collection Vendor’s QA/QC – cont’d

QA/QC – Pavement Distress Ratings
Visualization in Visidata
QA/QC – Right of Way and Pavement Images

- Image quality
  - Brightness
  - Clarity
  - Missing images
- Monitored in real time
- ROW and pavement images should be synchronized
- Able to see cracking in ROW/pavement views
- Control section verification (right of way images)
- Proper image stitching (pavement images)
LADOTD Quality Acceptance

Quality Acceptance – Right of Way Images

- Semi-automated search for missing images
- Verify collection of control sections
  - Check beginning/ending
  - Images play in correct order
  - Sample images throughout control section
  - Control section collected in correct direction
  - Collected both directions
  - Pavement surface should be dry
• Images quality
  • Clarity
  • Brightness
• Missing images
• Pavement should synchronize with ROW
• All distresses should be visible
• Look for missed distresses
Quality Acceptance – Pavement Distress Data

• Distresses correctly identified/quantified
  • Type
  • Severity
  • Extent
  • Protocols were followed
• Thoroughly investigate issues
• Check database prior to import into Pavement Management’s software
Deficiencies are summarized and reported to data collection vendor for corrective action.

Issues are resolved at no additional cost.

Some issues may require recollection:
- Missing images
- Erroneous electronic data

All corrections are resubmitted for review.
Vision
iVision
Pavement Management Systems
Quality Assurance/Quality Control
and
Quality Acceptance

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PM Web Page and DTIMS Dash Board

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Deighton Water Model

- The level of water in each can represents the % of roads in that condition
- The taps represent the process of roads deteriorating
- The pumps represent the act of fixing a road
- Electricity represents the cost of fixing a road; the more height to pump the water the more electricity

**Problem:**
For a fixed amount of electricity (budget) how should you distribute the electricity to the pumps so that you maximize the level of water in the top cans?
My Water Model

- The level of water in each can represents the % of roads at that **Treatment Level**
- The taps represent the process of roads deteriorating to the next **Treatment level**
- The pumps represent the act of fixing a road
- Electricity represents the cost of fixing a road; the more height to pump the water the more electricity

**Hypothesis:**
If you fix the roads in the **bottom portion** of each of the cans (Treatment Levels), then those roads will not fall in to the next can (Treatment Level). Thus, keeping the overall cost down.
Pavement Management is under Multimodal Planning
Pavement Management is **not suppose** to be used **for** or **against** us in court.

**Pavement Management Systems Section**

**TITLE 23—HIGHWAYS**

**CHAPTER 4—HIGHWAY SAFETY**

Sec. 409. Discovery and admission as evidence of certain reports and surveys.

Notwithstanding any other provision of law, reports, surveys, schedules, lists, or data compiled or collected for the purpose of identifying, evaluating, or planning the safety enhancement of potential accident sites, hazardous roadway conditions, or railway-highway crossings, pursuant to sections 130, 144, and 152 of this title or for the purpose of developing any highway safety construction improvement project which may be implemented utilizing Federal-aid highway funds shall not be subject to discovery or admitted into evidence in a Federal or State court proceeding or considered for other purposes in any action for damages arising from any occurrence at a location mentioned or addressed in such reports, surveys, schedules, lists, or data.
Visiweb Quick Reference Screen, used to describe menus by hovering with mouse.
Visiweb Full Help, used to describe Visiweb in more detail by clicking On underlined blue words.
VisiWeb Application, then Visiweb will come up.

PMS Road Conditions, can call Visiweb if **Active Layer Tools** is set to **Visiweb**.

Zoom in to until you see Control Sections Numbers

Left Click on bolt then left click on Control Section Line
PMS Road Conditions, show condition based on Roughness (Tenth of a Mile Sectioning).
PMS Road Conditions, show condition based on Rutting (Tenth of Mile Sectioning).
PMS Road Conditions, show condition based on Perfindex (Tenth of Mile Sectioning).
PMS Road Conditions, show map based on PaveType (PM Pavetype by Tenth of Mile Sectioning).
PMS Road Conditions, show Treatment (PM Treatment Based on FY Budget)
PMS PDF MAPS, used to bring up premade maps for District or Parish using **Active Layer Tool**.

Left Click on bolt then left click on District or Parish
PMS PDF MAPS, example District 61 Pavement Roughness NFA (Non-Federal Aid)
PMS Reports button will direct to website call Dash Board
Summary of Dashboard Functions

1. Map Reports:
   - Virtual Core (GPR and Coring)
   - Needs Data (Highway Needs)

2. Summary Report

3. Detailed Report

4. Index Plot

5. LADOTD Specific Help

6. LADOTD Glossary

7. Current Condition Report
Under Map Reports

Select Map Reports
### View Highway Needs Data

#### Control Section: 001-01-1  Route: US0080  Parish: CADDDO
Limit From: Texas State Line (W of Greenwood)
Limit To: Flournoy (Jct LA 526)

<table>
<thead>
<tr>
<th>Sub Section</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<tbody>
<tr>
<td>Begin Log Mile</td>
<td>0.000</td>
<td>2.000</td>
<td>2.560</td>
<td>4.260</td>
<td>5.970</td>
<td>6.190</td>
<td>6.600</td>
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<tr>
<td>End Log Mile</td>
<td>2.000</td>
<td>2.260</td>
<td>4.260</td>
<td>5.970</td>
<td>6.190</td>
<td>6.600</td>
<td>9.270</td>
</tr>
<tr>
<td>Length (Miles)</td>
<td>2.000</td>
<td>0.560</td>
<td>1.700</td>
<td>1.710</td>
<td>0.220</td>
<td>0.440</td>
<td>2.670</td>
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<td>Major Collector</td>
<td>Major Collector</td>
<td>Minor Arterial</td>
<td>Minor Arterial</td>
<td></td>
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<tr>
<td>Urban/Rural</td>
<td>RURAL</td>
<td>RURAL</td>
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<tr>
<td>Shoulder Width (Left)</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
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<tr>
<td>Shoulder Width (Right)</td>
<td>6</td>
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<td>6</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>
This is how Needs Summary Log look like when it printed out including the map.

### LADOTD Needs Summary Log

**Control Section:** 003-01-1  **Route:** US0080  **Parish:** CADD

**Limit From:** Texas State Line (W of Greenwood)

**Limit To:** Flournoy (Jct LA 526)

<table>
<thead>
<tr>
<th>Sub Section</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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</tr>
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<td>6.600</td>
<td>9.270</td>
</tr>
<tr>
<td>Length (Miles)</td>
<td>2.000</td>
<td>0.560</td>
<td>1.700</td>
<td>1.710</td>
<td>0.220</td>
<td>0.410</td>
<td>2.670</td>
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<tr>
<td>District</td>
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<td>04</td>
<td>04</td>
<td>04</td>
<td>04</td>
<td>04</td>
<td>04</td>
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<td>Major Collector</td>
<td>Major Collector</td>
<td>Major Collector</td>
<td>Major Collector</td>
<td>Minor Arterial</td>
<td>Minor Arterial</td>
</tr>
<tr>
<td>Urban/Rural</td>
<td>RURAL</td>
<td>RURAL</td>
<td>RURAL</td>
<td>URBAN</td>
<td>URBAN</td>
<td>URBAN</td>
<td>URBAN</td>
</tr>
</tbody>
</table>
View Ground Penetrating Radar

Select GPR virtual core or the calibration core that you want to see in more detail.

The details of the GPR Visual Core will be shown by the GPR Data tab.

You may need to scroll down by using the side scroll bar to view the data.
The Actual Core used for calibration of GPR

This button used to go to the next GPR or actual core along the control

This highline identify the actual core is on
When the actual core is on, this is the detail information we will get.

Remember to active this tab if you want to see detail information of Core Visual.

Remember to active this tab if you want to see detail information of Core Data.

Press this button for copy of Core PDF report.

Location: 7.212

<table>
<thead>
<tr>
<th>Layer Thickness</th>
<th>Layer Type</th>
<th>Layer Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.75</td>
<td>AC</td>
<td>CLAY</td>
</tr>
<tr>
<td>6.00</td>
<td>BASE</td>
<td>CEMENT STABILIZED SAND</td>
</tr>
</tbody>
</table>

Date Cored: 07/Oct/2011  Depth:  LaneDirection: 1 - Primary

Nearest Town: Flourney  Stripping or Separation: N/A

Recored:  Reinforced:  Deterioration Noted:  

Notes: Tan lean clay
View and print the Core Log report

**Coring Log**

- **Parish**: Caddo
- **Control Section**: 001-01
- **Date Cored**: 10/7/2011
- **Highway**: US-80
- **CSLM**: 7.212
- **Nearest Town**: Flournoy
- **Lane Direction**: East
- **Core Position**: Right Lane - 2 ft Left of Edgeline
- **GPS**: Latitude 32.44616, Longitude -93.93454

**Core Data**

- **Pavement Type**: ☑ AC
- **Stripping or Separation in Asphalt**:
  - ☑ Stripping
  - ☑ Separation
- **Honeycomb or “D” Cracking in PCC**:
  - ☑ Honeycomb
  - ☑ “D” Cracking
- **Reinforcing Fabric Present**: ☑ Depth
- **Other Notes**

**Core Layer Data (From Top to Bottom)**

<table>
<thead>
<tr>
<th>Layer Type</th>
<th>Thickness (in.)</th>
<th>Layer Characteristics</th>
<th>Deterioration of Layer Materials?</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUBGRADE</td>
<td>0.00</td>
<td>CLAY Tan lean clay</td>
<td>☐</td>
</tr>
<tr>
<td>AC</td>
<td>7.75</td>
<td>AC</td>
<td>☐</td>
</tr>
<tr>
<td>BASE</td>
<td>6.00</td>
<td>CEMENT STABILIZED SAND CLAY</td>
<td>☐</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GRAVEL treated tan sand</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Total Core Thickness**: 13.75

**Stabilized Subgrade Beneath Pavement or Sub-base?**: ☑ Yes  ☑ No  ☑ Unknown
Generate Summary Report
After pressing the Summary Report button, the screen below will show two options to select, example: Needs.
The List of Years to select
Example: Run Needs Summary Report 2011 Statewide, primary direction for all road class, asphalt pavement type, all federal aid system, index roughness.

After filling all the information, press Submit Summary Form
Summary Report detail and it can be exported to Excel or Access.

<table>
<thead>
<tr>
<th>Functional Class</th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Very Poor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural Interstate</td>
<td>274</td>
<td>68</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>342</td>
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<tr>
<td>Rural Other Principal Arterial</td>
<td>279</td>
<td>280</td>
<td>102</td>
<td>0</td>
<td>3</td>
<td>664</td>
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<tr>
<td>Rural Minor Arterial</td>
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<td>720</td>
<td>343</td>
<td>13</td>
<td>4</td>
<td>1546</td>
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<tr>
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<td>2857</td>
<td>2760</td>
<td>341</td>
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<td>7904</td>
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<td>Rural Minor Collector</td>
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<td>2757</td>
<td>4722</td>
<td>1426</td>
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<tr>
<td>RURAL SUBTOTAL</td>
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<td>6682</td>
<td>7927</td>
<td>1780</td>
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<td>32</td>
<td>38</td>
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<td>1</td>
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<tr>
<td>Urban Interstate</td>
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<td>28</td>
<td>5</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Urban Other Principal Arterial</td>
<td>58</td>
<td>143</td>
<td>110</td>
<td>22</td>
<td>3</td>
<td>336</td>
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<tr>
<td>Urban Minor Arterial</td>
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<td>552</td>
<td>267</td>
<td>29</td>
<td>10</td>
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<td>34</td>
<td>37</td>
<td>8</td>
<td>1</td>
<td>100</td>
</tr>
</tbody>
</table>
Generate Detail Report
After pressing Detail Report, the screen below will show.

The Lists of Districts, Parishes, Routes, Control Sections, Years will show when you click on them.

The two newest features added to search are Control Section and Route.
Filter by Ranges

Uncheck Full Range check box, Min Value and Max Value check boxes will be show therefore entering the values needed. Apply the same procedure for the rest of the listed attributes.
Filter by Groups

<table>
<thead>
<tr>
<th>Index</th>
<th>All Groups</th>
<th>Very Poor</th>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Excellent</th>
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<tbody>
<tr>
<td>Alligator Cracking Index</td>
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<tr>
<td>Random Cracking Index</td>
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</table>

Uncheck the `All Groups` check box, all other check boxes will show to select. Apply the same for other categories in Index list.
This is an example of Detailed Report.

Press this button will give all the columns for more detail information.

Used to export table to Access and Excel

<table>
<thead>
<tr>
<th>Route</th>
<th>Control Section</th>
<th>Direction</th>
<th>From</th>
<th>To</th>
<th>From Description</th>
<th>To Description</th>
<th>Section Length</th>
<th>Pave Type</th>
<th>Rut_Avg</th>
<th>Faulting</th>
<th>RRL_Avg</th>
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<th>Random Index</th>
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<td></td>
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<td>Jct US 79 - Int Broadway &amp; Union</td>
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<td>P</td>
<td>4.95</td>
<td>9.5</td>
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<td>90</td>
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<td>94.32</td>
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</table>
How to get to Index Plot
Plot Index Roughness for the whole section.
This is Index Plot for Tenth Mile of Control Section 001-01-1
Ladotd Glossary
<table>
<thead>
<tr>
<th><strong>A_POTHOLE</strong></th>
<th>The total area of potholes measured in square feet.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AADT</strong></td>
<td>The Average Annual Daily Traffic (all vehicle types) supplied by the Traffic department.</td>
</tr>
<tr>
<td><strong>ALCR</strong></td>
<td>Alligator cracking index. The way in which the Department defines the condition of alligator cracking based on assigned trigger values. ALGCRK=MIN (100, MAX (0, 100-ALGCRK_L DEDUCT-ALGCRK_M DEDUCT-ALGCRK_H DEDUCT)) Scale (1-100) 100 Being Perfect</td>
</tr>
<tr>
<td><strong>ALGCRK_H</strong></td>
<td>High severity alligator cracking measured in square feet. (Maximum Value=3168 ft./per tenth mile)</td>
</tr>
<tr>
<td><strong>ALGCRK_L</strong></td>
<td>Low severity alligator cracking measured in square feet. (Maximum Value=3168 ft./per tenth mile)</td>
</tr>
<tr>
<td><strong>ALGCRK_M</strong></td>
<td>Medium severity alligator cracking measured in square feet.</td>
</tr>
</tbody>
</table>
Current Condition Report
Example: Selecting STATE_WIDE for Analysis Set, District 02 for Budget Scenario, Year 2011, the Current Condition Report will look like below: including 33 pages and continuing loading.

This Icon allows export the tables to Excel or PDF or Word.
Performance Curve Regression Utility

By: Christophe Fillastre
E-mail: Christophe.Fillastre@la.gov
Phone Number: (225)242-4577
Performance Curve Regression Utility

Introduction

• Function:
  – Developing performance curves for LADOTD pavements families and individual pavement without the need for external resources.

• Advantage:
  – More accurate curves
  – PMS Team would have full control over the input data
  – The reduction of outlying points
  – The type of curves being regressed

• Results:
  – A set of family and site specific performance curves for each condition index that can be used for analysis.
  – External functions are called by dTIMS CT expression during the generation of strategies.
Regression Utility: Opening Screen

View Family Results: Allows the user to view the results of the Family Regression and select the curve type to use or to override the generated curve with a user defined curve.

View Site Specific Results: Allows the user to view the results of the Site Specific Regression and use one of the generated curves, default the pavement section to the family curve or supply a user defined curve.

Exit Regression Analysis: Allows the user to exit the Regression Utility.
Type of Curve Equations Available

- Linear
- Log
- Polynomial
- Sigmoid
- Power
- User defined Sigmoid
- Default Curve (previous Curve used by PMS)
Log
Polynomial

Best Fit Eqn: $100 \cdot \exp(7.5 + 14 \cdot \log(1/\text{AGE}))$

User Defined Sigmoid Curve:

- $C_1 = 0$
- $C_2 = 0$
- $C_3 = 0$

Graph showing data points and a polynomial fit line.
Power

Best Fit Eqn: $100 \cdot e^{0.4172 \cdot \log(\frac{1}{AGE})}$

User Defined Sigmoid Curve:
- $C_1 = 0$
- $C_2 = 0$
- $C_3 = 0$

Graph showing data points and trend lines for Power and Sigmoid curves.
Default

The graph shows a plot of Alligator Index on the y-axis against a range of values on the x-axis. The blue bars represent 'Valid Values', and the purple line represents the 'Default Curve'. The equation for the best fit line is given as 100 + 0.5 * AGE. The user-defined sigmoid curve is also shown, with parameters C1, C2, and C3 set to 0, 0, and 0, respectively. The interface allows for toggling between various options such as toggle reduction, linear, log, polynomial, power, sigmoid, and official curve.
Past Family Curves

**PAVEMENT TYPE**

1. Jointed Concrete
2. Asphalt Pavement
3. Composite Pavement
4. Continuously Reinforced Concrete

**FUNCTIONAL CLASS**

1. Interstate
2. Arterial
3. Collector

**ASPHALT SURFACED PAVEMENTS**

1. Alligator Cracking
2. Random Cracking
3. Roughness
4. Rutting
5. Patching

**CONCRETE SURFACED PAVEMENTS**

1. Longitudinal
2. Transverse
3. Roughness
4. Patching
Past Family Curves

ASPHALT SURFACED PAVEMENTS

2 Asphalt Surfaced Pavements
X
3 Functional Class
X
5 Pavement Distress
=
30 Asphalt Surfaced Family Curves

CONCRETE SURFACED PAVEMENTS

2 Concrete Surfaced Pavements
X
3 Functional Class
X
4 Pavement Distress
=
24 Concrete Surfaced Family Curves

Total of 54 Family Curves
# Future Family Curves

<table>
<thead>
<tr>
<th>PAVEMENT TYPE</th>
<th>FUNCTIONAL CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Jointed Concrete</td>
<td>1. Interstate</td>
</tr>
<tr>
<td>2. Asphalt Pavement</td>
<td>2. Principal Arterial</td>
</tr>
<tr>
<td>Concrete</td>
<td>5. Minor Collector</td>
</tr>
<tr>
<td></td>
<td>6. Locals</td>
</tr>
<tr>
<td></td>
<td>7. Other</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ASPHALT SURFACED PAVEMENTS</th>
<th>CONCRETE SURFACED PAVEMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Alligator Cracking</td>
<td>1. Longitudinal</td>
</tr>
<tr>
<td>2. Random Cracking</td>
<td>2. Transverse</td>
</tr>
<tr>
<td>3. Roughness</td>
<td>3. Roughness</td>
</tr>
<tr>
<td>4. Rutting</td>
<td>4. Patching</td>
</tr>
<tr>
<td>5. Patching</td>
<td></td>
</tr>
</tbody>
</table>
Future Family Curves

**ASPHALT SURFACED PAVEMENTS**

2 Asphalt Surfaced Pavements  
X  
7 Functional Class  
X  
5 Pavement Distress  
=  
70 Asphalt Surfaced Family Curves

**CONCRETE SURFACED PAVEMENTS**

2 Concrete Surfaced Pavements  
X  
7 Functional Class  
X  
4 Pavement Distress  
=  
56 Concrete Surfaced Family Curves

**Total of 126 Family Curves**
We ran the software four times

• Regular Running
• No Age Greater Than 20 Years
• Removed Age 20 Years and Index Greater or equal to 80
• Without Sigmoid Curves
The Parameters Setting
Regular Run

• Best fit of All curve types.

• Under Reduce Data:
  – Rule 1  Age<=5 and Index Value<= 50
  – Rule 2  Age<=7 and Index Value<=30
  – Rule 3  None Used
  – Rule 4  Age>=10 and Index Value>=95
  – Rule 5  Age>=15 and Index Value>=90
  – Standard Deviation 1 – Remove data less than 2 standard deviations from mean
  – Standard Deviation 2 – Remove data greater than 1 standard deviation from mean
The Parameters Setting For Runs

• No Age Greater Than 20 Yrs:
  – Same as Regular Running with Rule6 Age>=20 and Index Values>=0

• Removed Age 20 Years and Index Greater or equal to 80:
  – Same as Regular Running with Rule6 Age>=20 and Index Values>=80

• Without Sigmoid:
  – Same as Removed Age 20 Years and Index Greater or equal to 80. Best fit of all curve types except sigmoid.
Asphalt Surfaced Pavements

• Two types:
  o Asphalt
  o Composite

• Five types of distresses:
  o Alligator Cracking
  o Random Cracking
  o Roughness
  o Rutting
  o Patching

• Seven functional classes:
  o Interstate
  o Principal Arterial
  o Minor Arterial
  o Major Collector
  o Minor Collector
  o Locals
  o Other
Asphalt Local Alligator

ASP_LOC_Alligator

- POINT_VALUE
- Regular Running
- No Age Greater Than 20 yrs
- Remove Age 20 yrs & Index Greater or Equal to 80
- Without Sigmoid Curves
Asphalt Local Roughness

ASP_LOC_Roughness

0 10 20 30 40 50 60 70 80 90 100 110 120
0 10 20 30 40 50 60

- POINT_VALUE
- No Age Greater Than 20 Yrs
- Regular Running
- Remove Age 20 Yrs & Index Greater Or Equal to 80
- With out Sigmoid Curves
Asphalt Principal Arterial Alligator
Asphalt Principal Arterial Roughness

![Graph showing Asphalt Principal Arterial Roughness](image-url)
Site Specific Curve Analysis
Future Site Specific Curves

**Asphalt**

- 4,447 Specific Sites
- x 5 Distresses
- = 22,235 Curves

**Composite**

- 2,032 Specific Sites
- x 4 Distresses
- = 8,128 Curves

**Jointed Concrete**

- 1,110 Specific Sites
- x 4 Distresses
- = 4,440 Curves

**Continuously Reinforced Concrete**

- 31 Specific Sites
- x 3 Distresses
- = 93 Curves

Total of 34,896 Site Specific Curves
Asphalt Locals Alligator Sites Specific Curves
012-30-1-00.00 (LA 0031)
Asphalt Locals Alligator Sites Specific Curves
850-04-1-00.00 (LA 0678)

ASP_LOC_Alligator

POINT_VALUE
100 - \exp(7.5 - 13 \times \ln(1/\text{AGE}))
Asphalt Locals Roughness Sites Specific Curves
850-04-1-00.00 (LA 0678)
Asphalt Locals Alligator Sites Specific Curves
849-29-1-00.00 (LA 0359)

ASP_LOC_Alligator

POINT_VALUE  100 \cdot \exp(5 + 13 \cdot \ln(1/\text{AGE}))
Asphalt Locals Roughness Sites Specific Curves
849-29-1-00.00 (LA 0359)
Asphalt Locals Alligator Sites Specific Curves
391-01-1-01.00 (LA 0098)

ASP_LOC_Alligator

POINT_VALUE  100 - \exp(8 + 13.5 \times 1.5 \ln(1/\text{AGE}))
Asphalt Locals Roughness Sites Specific Curves

391-01-1-01.00 (LA 0098)

ASP_LOC_Roughness

POINT_VALUE    100 \cdot \exp(5 + -5.5 \cdot \ln(1/\text{AGE}))
Asphalt Locals Alligator Sites Specific Curves
270-03-1-00.00 (LA 0441)

ASP_LOC_Alligator

POINT_VALUE = 100 - EXP(8 + 14 * 1.5^LN(1/AGE))
Asphalt Locals Roughness Sites Specific Curves
270-03-1-00.00 (LA 0441)
Location of Site Specific Asphalt Locals
Asphalt Locals Alligator
Sites Specific Curves vs. Family Curves Without Sigmoid

3.5” ASP/In-Place Cement Stab Base
ADT 2,400
Hwy Speed 60 mph
Pct Trucks 16%

3.5” ASP/8.5” In-Place Cement Stab Base
ADT 2,100
Hwy Speed 50 mph
Pct Trucks 16%

3.5” ASP/8.5” In-Place Cement Stab Base
ADT 650
Hwy Speed 70 mph
Pct Trucks 16%

3.5” ASP/8.5” In-Place Cement Stab Base
ADT 3,300
Hwy Speed 60
Pct Truck 16%
Asphalt Locals Roughness
Sites Specific Curves vs. Family Curves Without Sigmoid

3.5 " ASP/ In-Place Cement Stab Base
ADT 2,400
Hwy Speed 60 mph
Pct Trucks 16%

3.5 " ASP/8.5" In-Place Cement Stab Base
ADT 2,100
Hwy Speed 50 mph
Pct Trucks 16%

3.5 " ASP/8.5" In-Place Cement Stab Base
ADT 650
Hwy Speed 70 mph
Pct Trucks 16%

3.5 " ASP/8.5" In-Place Cement Stab Base
ADT 2,700
Hwy Speed 70
Pct Trucks 16%

3.5 " ASP/8.5" In-Place Cement Stab Base
ADT 3,300
Hwy Speed 60
Pct Trucks 16%
Location of Site Specific Asphalt Principal Arterials
Asphalt Principal Arterial Alligator
Specific Sites Curves vs. Family Curves Without Sigmoid

3.5" ASP Overlay
existing 7.8" ASP/2" PCC
ADT 20,800
Hwy Speed 45 mph
Pct Trucks 16%

3.5" ASP Overlay
existing 7.8" ASP/2" PCC
ADT 21,300
Hwy Speed 45 mph
Pct Trucks 16%

3.5" ASP/8.5" In-place
Cement Stab Base
ADT 6,900
Hwy Speed 45 mph
Pct Trucks 16%

3.5" ASP/6" In-Place
Cement Stab Base
ADT 4,200
Hwy Speed 55 mph
Pct Trucks 16%

3.5" ASP CONC O/LAY
ADT 29,800
Hwy Speed 35 mph
Pct Trucks 16%
Asphalt Principal Arterial Roughness
Specific Sites Curves vs. Family Curves Without Sigmoid

3.5" ASP Overlay
existing 7.8" ASP/ 2" PCC
ADT 20,800
Hwy Speed 45 mph
Pct Trucks 16%

3.5" ASP Overlay
existing 7.8" ASP/ 2" PCC
ADT 21,300
Hwy Speed 45 mph
Pct Trucks 16%

3.5" ASP/ 8.5" In-place
Cement Stab Base
ADT 6,900
Hwy Speed 45 mph
Pct Trucks 16%

3.5" ASP/ 6" In-Place
Cement Stab Base
ADT 4,200
Hwy Speed 55 mph
Pct Trucks 16%

3.5" ASP CONC O/LAY
ADT 29,800
Hwy Speed 35 mph
Pct Trucks 16%
SURVEYOR
Used to Inventory Assets
Capabilities of Surveyor

• Measuring Point features
  – Examples of point features:
    • Signs
    • Intersections
    • Manhole cover...

• Measuring Liner features
  – Examples of liner features:
    • Lane Width
    • Bridges
    • Barriers
List of assets inventoried using Surveyor in District 04, 05, 07, 08, and 61

- Bridge
- Curbs
- Grade
- Horizontal Curve
- Intersections
- Ladotd_point_assets
- Lane_widths
- Lanes_number
- Medians
- On_route_parking
- Pavement_type
- Rail_road_crossing
- Shoulders
- Sidewalks_and_ramps
- Sight_distance
- Speed_limit_signs
- Terrain_type
- Tolls_crl_issues
- Turn_lanes
- Vertical_curve
Surveyor-Train the Trainer

- March or April
- Train DOTD person in a section to train the others
- Train Trainer to inventory the assets that are important to their business or engineering decisions.
SURVEYOR
Measuring Linear Assets

Step 1: Maximize the image stream window

Step 2: Click on zoom to original size button

Step 3: Select the Ortho-Align Button

Step 4: Choose the Linear Asset from the Drop-Down Menu

Step 5: Click on the Ruler

Step 6: Select Start Point on Ground in Lower Corner of the Image Stream Window