MnDOT’s Experience with IRI Specifications

Spring 2013 NCC Meeting
April 4, 2013
Philadelphia, PA

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MnDOT Concrete Engineer
Evolution of Smoothness

- No Equipment Certification → Profiler Certification (2002)
- Profile Index → International Roughness Index (2006)
- Pilot Projects for IRI → Full Implementation (2008)
- Moved from Bumps and Dips → Areas of Localized Roughness (2009)
- Separate Smoothness Specs. for Bituminous and Concrete → Combined Smoothness Specification (2010)
How did we get here?

- PI Spec at 0.2 blanking band
- MnDOT never used zero blanking band – concerns with effect of texture on IRI value
- Initial goal was to not change incentive $
- Contractor response…
  - We do not understand IRI
  - 50 inches/mile – we will never get it
  - Why change
# 2006 IRI Pilot Projects - Results

<table>
<thead>
<tr>
<th>Project location</th>
<th>Project Length</th>
<th>Total IRI Incentive</th>
<th>Total PI Incentive</th>
</tr>
</thead>
<tbody>
<tr>
<td>TH 212 in Glencoe</td>
<td>7.334 mi</td>
<td>$44,194.31</td>
<td>$54,542.21</td>
</tr>
<tr>
<td>(Passing Lane)</td>
<td></td>
<td>$47,734.83</td>
<td>$52,935.84</td>
</tr>
<tr>
<td>(Driving Lane)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TH 101 in Elk River</td>
<td>~1000 ft</td>
<td>-$2,076.74</td>
<td>$892.19</td>
</tr>
<tr>
<td>(under construction)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSAH 46 in Freeborn Cty</td>
<td>5.957 mi</td>
<td>$22,442.87</td>
<td>$22,769.72</td>
</tr>
<tr>
<td>(WB direction)</td>
<td></td>
<td>$18,639.09</td>
<td>$22,324.53</td>
</tr>
<tr>
<td>(EB direction)*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Some of PI data unavailable – only compared $ for like segments*
2007 Contractor IRI vs. PI

At 71.7 IRI changes from Incentive to Disincentive

< 50 Maximum Incentive for IRI

Incentive | Disincentive

> 90 Corrective Action

IRI (in/mi) vs. PI (0.2" BB)
## IRI – Review of 2007 Contractor data

<table>
<thead>
<tr>
<th>Segment IRI</th>
<th>Number of 0.1 mile segments</th>
<th>% of Total Segments</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;50</td>
<td>207</td>
<td>13%</td>
</tr>
<tr>
<td>≥50 and &lt;60</td>
<td>520</td>
<td>32%</td>
</tr>
<tr>
<td>≥60 and &lt;71.7</td>
<td>519</td>
<td>32%</td>
</tr>
<tr>
<td>≥71.7 and &lt;80</td>
<td>208</td>
<td>13%</td>
</tr>
<tr>
<td>≥80 and &lt;90</td>
<td>99</td>
<td>6%</td>
</tr>
<tr>
<td>≥90</td>
<td>70</td>
<td>4%</td>
</tr>
<tr>
<td>All</td>
<td>1623</td>
<td>100%</td>
</tr>
</tbody>
</table>

- 77% of segments are in incentive
- For 2008, no $$$ changes have been made to incentives
## How much will a smooth road cost?

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Project Length</th>
<th>Total Incentive at maximum bonus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban project with 4 lanes and center turn lane</td>
<td>1 mile (5 lanes)</td>
<td>$44,500</td>
</tr>
<tr>
<td>2 lane undivided road</td>
<td>5 miles (2 lanes)</td>
<td>$89,000</td>
</tr>
<tr>
<td>4 lane divided road</td>
<td>10 miles (4 lanes)</td>
<td>$356,000</td>
</tr>
<tr>
<td>CPR – 2 lane undivided road</td>
<td>5 miles (2 lanes)</td>
<td>$45,000</td>
</tr>
</tbody>
</table>
2399 Ride Specification
(Combined Bituminous/Concrete)
Needed Certifications

Operator
Online Certification
Every 3 years

Equipment
Certified Yearly at MnROAD

2013 Inertial Profiler Certificate

Date:
_________________________

Serial #:_______________________

VIN: _________________________

Manufacturer: _________________

Software: _____________________

Signature:_____________________
What Part of the Specification Applies?

10 ft Straightedge

ALR

30 mph

50 mph

Change in $

-$

$-

Smoothness $+/-$
Smoothness Evaluation

- Both right and left wheel paths must be profiled at the same time with a certified Inertial Profiler.

- An IRI value will be computed for each wheel path, for each 0.1 mile segment, and then averaged. This average (MRI) will be used to calculate the segment pay adjustment.
Day of Profiling: Submittal

Profile Summary

Raw Data File (*.ERD File)
Within 5 Days of Completion of Paving: Smoothness Assurance Report
Data analyzed through Proval
Minnesota Smoothness Equation

Maximum MRI for full incentive ($890) at 50 in/mi

Disincentive ($0) at 71.17 in/mi

Max disincentive of (-$750) at 90 in/mi
Corrective Work above 90 in/mi back to 71.17 in/mi
# Areas Excluded from Smoothness Evaluation

## For All Pavements

- Paving in areas with a posted vehicle speed less than or equal to 45 mph
- Ramps and loops
- Acceleration and deceleration lanes less than or equal to 1,000 ft. in length
- Projects less than 1,000 ft. in length
- Bridge decks and approach panels – the occurrence of bridges shall not interrupt the continuity determination

## For Concrete Pavements

- Intersections constructed under traffic – begin and end exclusion 100 ft. from the intersection radius
Areas of Localized Roughness (ALR)

- Measured using a 25 foot moving straightedge
  - Bumps
  - Dips
  - Joints
<table>
<thead>
<tr>
<th>Equation</th>
<th>25ft [7.62 m] Continuous IRI, in/mi [m/km]</th>
<th>Corrective Work or Monetary Deduction, per linear 1.0 ft [0.3048 m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMA-A or HMA-B, and a posted vehicle speed &gt; 45 mph [73 km/hr]</td>
<td>&lt; 125.0 [1.97]</td>
<td>Acceptable</td>
</tr>
<tr>
<td></td>
<td>≥ 125.0 [1.97] and &lt; 175.0 [2.76]</td>
<td>Corrective work or $10.00, as directed by the Engineer</td>
</tr>
<tr>
<td></td>
<td>≥ 175.0 [2.76] and &lt; 250.0 [3.94]</td>
<td>Corrective work or $25.00, as directed by the Engineer</td>
</tr>
<tr>
<td></td>
<td>≥ 250.0 [3.94]</td>
<td>Corrective work or $100.00, as directed by the Engineer</td>
</tr>
<tr>
<td>PCC-A and a posted vehicle speed &gt; 45 mph [73 km/hr]</td>
<td>&lt; 125.0 [1.97]</td>
<td>Acceptable</td>
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Areas Excluded from Smoothness and ALR Evaluation

<table>
<thead>
<tr>
<th>For All Pavements</th>
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<tr>
<td>Paving in areas with a posted vehicle speed less than 30 mph</td>
</tr>
<tr>
<td>Turn lanes, crossovers</td>
</tr>
<tr>
<td>10 ft. on either side of obstructions in lane that obstruction is located</td>
</tr>
<tr>
<td>Side streets, side connections</td>
</tr>
<tr>
<td>150 ft. before intersections that end at a stop sign or a yield sign at a roundabout</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>For Concrete Pavements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undoweled shoulders less than or equal to 10 ft. in width</td>
</tr>
<tr>
<td>Headers adjacent to colored concrete</td>
</tr>
</tbody>
</table>
Corrective Work

■ Before Corrective Work:
  ■ Submit a written corrective work plan to the Engineer (Smoothness Assurance analysis)
  ■ Do not begin corrective work before the Engineer approves the plan

■ After profiling, submit:
  ■ Paper ProVAL summary report indicating the results of the ‘Smoothness Assurance: Short Continuous Histogram.
  ■ Final spreadsheet summary in tabular form, with each 0.1 mi. segment occupying a row
Alternate Bid

- A single equation is used for both concrete and asphalt.
- The maximum incentive for one mile is $2700 per lane-mile.
- A regular concrete project – the maximum incentive for one mile is $8900 per lane-mile.
- On average, asphalt currently has a $700 per lane-mile bidding advantage with the current 2399 specification.
Maximum MRI for full incentive ($890) at 50 in/mi
Alternate Bid - Maximum MRI for full incentive ($270) at 33 in/mi
Disincentive ($0) at 71.17 in/mi
Alternate Bid - Disincentive ($0) at 60 in/mi
Max disincentive of (-$750) at 90 in/mi
Corrective Work above 90 in/mi back to 71.17 in/mi
Alternate Bid
Max disincentive of (-$150) at 85 in/mi
Corrective Work above 86 in/mi back to 60 in/mi
Do we need urban IRI requirements

Until combine concrete/bit spec – speed limit of 42 mph and greater had smoothness specs

Asphalt pavements didn’t require smoothness for 45 mph or less
Where are we now?

- It has been 5 years since we went fully into IRI
- This summer we will evaluate the ride data and look at revising incentive equations
- I expect we will raise the bar
IRI Ride Specs
Summary of State Reports
National Concrete Consortium
Philadelphia, PA
Spring 2013
Contractor vs. Agency Testing

Data provided by NCC Survey
When Contractor Testing... How often does the Agency check?

- 25% of all projects – CO
- 10% of all projects – IL
- 10% of each project – IA, NE
- 10% of lane miles – MO
- Within 90 days of data going in system – PA
- As necessary – LA, MN, TX
- Each profiler yearly - WI
When is testing done?

- **Up to Contractor**
  - CA, CO (QC), IL TW, LA, MN, MO, NE, OH, WI

- **Daily**
  - IA

- **Completion of paving or major phase**
  - CO, MI, ND, PA, SD, TX, UT

- **Within 3 days of paving**
  - IL

- **Within 48 hours of paving**
  - KS, WA
If not tested the day after paving, do you know how much difference there is by the time it is open to traffic?

- **Colorado**
  - Gets slightly smoother $\sim 0$ to 5 in/mi HRI

- **Louisiana**
  - Within $\pm 6$ in/mi up to 6 months after paving
Concrete Texture Impacts on Profile Measurements

Conventional Laser

New Triod Laser
Do you see an influence on the type of pavement texture?

- Use line laser - No difference
  - CA, MN, MO, OH

- Single Point Laser
  - 5 to 30 in/mi (CO)

- Longitudinal tining has influence
  - MI, TX
What equipment/laser setup are you using for concrete?

- Inertial Profilers
  - Roline – CA, CO, MI, ND, NE, OH, SD, WI
  - Triod or Roline Lasers – MN
  - Single Point, Wide Spot, Triod, or Roline – IL, TW, LA, PA, TX
  - California Profilograph Simulation – IL, UT
Equipment Certification

Data provided by NCC Survey

Yes (14)
No (5)

Data provided by NCC Survey
Operator Certification

Data provided by NCC Survey

Yes (10)

No (9)
IRI Spec vs. PI Spec

Data provided by NCC Survey
What do you base your incentive payments on?

- % of bid price (4)
- $/0.1 mile segment (14)

Data provided by NCC Survey
International Roughness Index

- Maximum IRI for bonus or incentive
- Maximum IRI for no Corrective Work or Disincentive

Graph showing International Roughness Index (IRI) in in./mile for different states. States include:
- California
- Colorado
- Iowa
- Louisiana
- Michigan
- Minnesota
- Missouri
- Nebraska
- North Dakota
- Ohio
- Pennsylvania
- Texas
- Wisconsin
Different Spec for Mid-Speed Urban (40-50 mph)?

Yes (12)  No (7)

Data provided by NCC Survey
Do you require Proval?

- Yes
  - All states that use IRI generally use or encourage
- No
  - TX has own software
Any Additional Deductions for Grinding to Meet IRI

< 0.1 mile segment – 20% deduction for marred surface

Data provided by NCC Survey
Can section be re-profiled to attain smoothness bonus?

- Yes (6)
- No (13)

Data provided by NCC Survey
Thanks!

Questions??

"Happiness" is riding on a SMOOTH road!