



## RESEARCH SERVICES SECTION

# TECHNICAL SUMMARY

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## IMPLEMENTATION PROJECT COST:

\$24,416



The old Profile Index method uses a 25-foot California profilograph to measure smoothness via a wheel (center) pushed along the pavement.

# Putting Research into Practice: Implementing the International Roughness Index for Concrete Pavement Evaluation

## What Was the Need?

Mn/DOT awards bonuses to contractors for constructing particularly smooth pavements and assigns penalties for rough pavements. Such incentives and disincentives lead to pavements that provide a smoother ride and last longer. This results in a net taxpayer savings, even with the incentive payouts.

Until recently, Minnesota and other states employed the Profile Index to determine which pavements should receive bonuses or penalties. PI smoothness ratings were generated by a 25-foot California profilograph pushed over the road surface. Profilograph measurements involve filters that simplify the received data, and these filters can hide important pavement features that may affect ride quality. Incentive payments based on PI measurements were being granted for some roads that riders experienced as rough.

Many states are now switching from PI to the International Roughness Index, which uses sophisticated van- or lightweight vehicle-mounted laser profilers to produce a store of data for inspectors to analyze. Mn/DOT had recently begun to use IRI to evaluate asphalt pavement smoothness, but its use for concrete pavement is more complex, requiring an implementation project to better characterize its value and modify the construction specification.

## What Was Our Goal?

The objective of this project was to develop a specification for using IRI to measure the smoothness of newly constructed portland cement concrete pavements, specifically PCC pavements with anticipated traffic speeds of over 45 mph. By transitioning to IRI, Mn/DOT hoped to eliminate incentive payments for pavements that exhibit low ride quality and, as a result, to increase the overall quality of Minnesota's roads.

## What Did We Implement?

Mn/DOT had previously investigated the effects of surface texturing and joints on concrete pavement smoothness and ride comfort, and had compared IRI and PI measurements for various pavements. Mn/DOT staff used these findings to create the 2006 IRI pilot specification. This and other efforts supported Mn/DOT's decision to transition to an IRI specification.

## How Did We Do It?

To develop the IRI specification, investigators reviewed the efforts mentioned above and:

- Compared other states' IRI incentives to each other and to the 2006 pilot specification.
- Compared IRI and PI measurements and how they related to pavement surface qualities, including the length of waves (repeating surface deviations) in the pavement surface caused by design or construction factors; this is a very common way for pavements to exhibit imperfections, and the wavelength has a great deal to do with whether riders perceive the imperfection.
- Performed additional analyses, such as how tining (cutting small grooves into the concrete surface to improve traction in wet weather) affects the IRI surface profile.

*“With the transition to IRI, we will get a better picture of the true pavement smoothness and how it feels to drivers, whereas with the Profile Index, it was sometimes questionable.”*

—W. James Wilde,  
Associate Professor,  
Minnesota State  
University, Mankato

*“Highway 59 in Morris, for instance, exhibited ‘chatter phenomena’ due to a basic wave form in the pavement surface, but it had passed incentives under the PI metric. Because of this, we knew we needed to change the incentive specification to an IRI metric.”*

—Bernard Izevbekhai,  
Principal Research Operations Engineer, Mn/DOT

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IRI smoothness data can be collected using high-speed, van-mounted laser systems, which excel at detecting the types of roughness experienced by vehicle occupants.

- Modified the 2006 pilot specification to create a recommended standard Mn/DOT specification for determining IRI incentives.
- Produced a cost-benefit analysis of this specification.

### What Was the Impact?

This project provided Mn/DOT with the desired specification and produced analyses to increase confidence in it among project and materials engineers at the state, city and county levels.

Investigators reported that while only a handful of states were using IRI for concrete pavement evaluation, many more would be transitioning soon. Their varying practices presented some options to Mn/DOT in how, when and who should perform IRI measurements; how long the tested pavement sections should be; what levels of smoothness should trigger incentives; and what areas should be excluded from testing (for example, near bridges).

The project confirmed that PI and IRI measurements of the same section of pavement often depict the section very differently. The report evaluated the effects of transitioning to IRI in terms of how 15-, 25- and 50-foot pavement surface waves would show up in the surface profile, index calculation and incentive/penalty pavement computation. The wavelength that generally affects PI the most is 25 feet, while 15-foot waves have the greatest effect on IRI readings.

### What's Next?

A two-part additional implementation effort is in progress:

- Investigators are consolidating the concrete and asphalt IRI specifications into a single one. This will simplify contracting and construction processes, allowing pavements to be built more efficiently.
- Mn/DOT is developing a training program and certification program for profile machine operators.

One research idea raised by this project was to evaluate whether higher maximum incentive bonuses would cost-effectively produce even smoother pavements.

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*This Technical Summary pertains to Report 2007-09, “Implementation of an International Roughness Index for Mn/DOT Pavement Construction and Rehabilitation,” published April 2007. The full report can be accessed at <http://www.lrb.org/PDF/200709.pdf>. Appendix A of this document presents the IRI pilot specification, originally released in 2006, that was implemented by this project. Additional research implemented by this project is available from the project liaisons upon request.*