



RESEARCH SERVICES SECTION

TECHNICAL SUMMARY

Technical Liaison:

Rebecca Embacher, Mn/DOT
rebecca.embacher@dot.state.mn.us

Administrative Liaison:

Clark Moe, Mn/DOT
clark.moe@dot.state.mn.us

Principal Investigator:

Joseph F. Labuz, University of Minnesota

PROJECT COST:

\$60,000



IC is best used with quality assurance measurement technologies such as LWDs that are quicker and safer than traditional methods.

Putting Research into Practice: Intelligent Compaction Implementation—Research Assessment

What Was the Need?

For a road to perform well over the long term, its subgrade and base layers need to provide a stable, uniform foundation for the pavement. This is achieved by compacting underlying layers (typically with a roller) and performing inspections to ensure that compaction is sufficient.

Compaction can be expensive and labor-intensive, and variability in the consistency of aggregate layer materials makes it difficult to achieve high-quality compaction with uniformity over a large area. Traditional inspection methods such as sand cone testing are inefficient, compromise inspector safety and do not adequately predict performance.

Mn/DOT has invested significant resources to develop alternative procedures using lightweight deflectometers and intelligent compaction. IC involves the use of rollers equipped with sensors that continuously measure subgrade stiffness and can automatically adjust compaction force accordingly. IC improves compaction uniformity and quality, increases compaction efficiency and safety, and consequently saves money on roadway construction and maintenance costs. IC rollers are also equipped with global positioning systems that map the location, time and quality of compaction over the entire surface of each layer. This data is stored for future use in forensic analysis, long-term pavement management and mechanistic pavement design.

Because IC is still a new technology, Mn/DOT and some counties have been performing pilot projects to further develop preliminary IC specifications.

What Was Our Goal?

The objectives of this implementation effort were to qualitatively assess and recommend improvements to Mn/DOT's pilot IC and LWD quality compaction specifications.

What Did We Implement?

This project leveraged previous Mn/DOT work on IC and deflectometer procedures and specifications:

- [“Enhancements and Verification Tests for Portable Deflectometers”](#) (2003-10)
- [“Validation of DCP and LWD Moisture Specifications for Granular Materials”](#) (2006-20)
- [“Moisture Effects on PVD and DCP Measurements”](#) (2006-26)
- [“Field Validation of Intelligent Compaction Monitoring Technology for Unbound Materials”](#) (2007-10)
- [“Resilient Modulus Development of Aggregate Base and Subbase Containing Recycled Bituminous and Concrete for 2002 Design Guide and Mn/Pave Pavement Design”](#) (2007-25) (A [technical summary](#) was produced for this report.)
- [“Development of Improved Test Rolling Methods for Roadway Embankment Construction”](#) (2008-08) (A [technical summary](#) was produced for this report.)

How Did We Do It?

Investigators synthesized information from literature about LWDs and IC along with Mn/DOT's current IC specifications. They used this information to develop a strategy for conducting interviews with field personnel at four Minnesota sites. Investigators then

continued

“Mn/DOT is on the forefront of intelligent compaction research, and this implementation will be an important resource for other state DOTs that are also exploring more efficient compaction technologies.”

–Rebecca Embacher,
Mn/DOT Assistant
Grading and Base
Engineer

“IC has the potential to significantly reduce highway construction costs by improving the quality and efficiency of compaction of subgrade materials.”

–Joseph F. Labuz,
Professor, University of
Minnesota Department
of Civil Engineering

Produced by CTC & Associates for:

Minnesota Department
of Transportation
Research Services Section
MS 330, First Floor
395 John Ireland Blvd.
St. Paul, MN 55155-1899
(651) 366-3780

www.research.dot.state.mn.us



IC rollers include accelerometers mounted on their drums to monitor vibration amplitudes and frequencies. An on-board electronic display system exhibits a color-coded map of stiffness data analyzed in real time to identify weak areas under the soil.

visited these sites to document activities, review selected records and conduct anonymous interviews with Mn/DOT staff and contractors. Finally, investigators analyzed field data to develop a report recommending changes to LWD and IC procedures.

What Was the Impact?

Recommendations to add to LWD and IC specifications and procedures included:

- Continue to promote LWDs for quality assurance of stiffness. LWDs are portable, efficient and accurate.
- Establish a procedure to determine the target LWD value.
- Eliminate calibration areas (control strips). A procedure needs to be established to determine IC target values to use for varying soil conditions.
- Simplify IC data evaluation and presentation. IC generates a significant amount of data; processing needs to be streamlined to facilitate real-time decision making.
- Calibrate the IC roller and related transducers. A calibration device should be developed to validate the measurements recorded by IC rollers.
- Support development of alternative IC methodologies. Instrumented test rollers equipped with a technology for continuous measurement of rut depths could provide complementary data.

What's Next?

This project relates to a larger, ongoing Mn/DOT effort to implement IC and LWD technology to ensure that roads are built with the greatest efficiency, quality and cost-effectiveness. As part of the next steps in this project, Mn/DOT is currently involved in outreach to inform local agencies, contractors and consultants; these efforts will include a one-day workshop with the construction industry to outline and receive feedback about Mn/DOT's plans for IC. A second workshop will be organized to better educate designers on how IC and LWD technology will influence pavement design.

This Technical Summary pertains to Report 2008-22, "Intelligent Compaction Implementation: Research Assessment," published July 2008. The full report can be accessed at <http://www.lrrb.org/PDF/200822.pdf>.

The research being implemented via this project can be found in the six Mn/DOT reports referenced in "What Did We Implement?" These can be accessed at <http://www.lrrb.org/PDF/200310.pdf>, <http://www.lrrb.org/PDF/200620.pdf>, <http://www.lrrb.org/PDF/200626.pdf>, <http://www.lrrb.org/PDF/200710.pdf>, <http://www.lrrb.org/PDF/200725.pdf> and <http://www.lrrb.org/PDF/200808.pdf>.