IC, LWD, DCP: On the Rise
New Technologies in Road Foundation Construction Promote Improved Quality and Productivity

Overview
As one of the most important processes in roadway construction, compaction is critical to achieving high-quality and uniform pavement materials. Agencies are using new technologies for quantifying quality during construction that offer a number of benefits.

Intelligent compaction (IC) is one of those technologies. IC:
- Uses smooth drum or pad-foot rollers equipped with a measurement system
- Includes global positioning system (GPS) mapping and software to document results
- Allows real-time corrections, manual or automated, during compaction by integrating measurement and control systems
- Maintains a continuous record of roller-generated measurements and roller passes using color-coded plots and electronic files

The Light Weight Deflectometer (LWD) and Dynamic Cone Penetrometer (DCP) also play a role in IC by providing independent quality assurance test results to the agency owner. They also can be used independently without IC. These testing devices measure quality more precisely, quickly, and safely than traditional methods, such as sand cone testing.

The LWD measures elastic deflection during construction, and the DCP measures shear strength.

Benefits
IC, LWD, and DCP technology improves the compaction of pavement materials and increases uniformity with benefits that include:

- **Highway maintenance savings**
  Projects in Europe and the U.S. show improved pavement material compaction, which helps prevent premature pavement failures, reduces maintenance costs, and further extends pavement life.

- **Increased productivity and construction cost savings**
  The immediate measurement results help to determine optimum compaction quickly, using a minimum number of passes. This optimization increases the amount of roadway that can be constructed in a typical day and consequently lowers contractor costs.

- **Better information to make adjustments**
  IC provides a continuous record of measurements, allowing contractors and owners to identify weak areas and make adjustments to stabilize these areas.

Minnesota Projects
As a leader in both research and implementation, Minnesota has moved from research and demonstration to full implementation. In 2004, the Minnesota Department of Transportation (Mn/DOT) completed its first demonstration project, with three additional demonstration projects in 2005. Three pilot projects took place in 2006:

- TH 64 Reconstruction near Akeley
- I-494/Valley Creek Road Interchange Reconstruction in Woodbury
- MnROAD

In 2006, Mn/DOT developed an implementation plan to further deploy IC and LWD tech-
As part of the implementation, four construction projects in 2007 used IC and LWDs:

- US 10 Expansion in Staples
- US 10 Realignment in Detroit Lakes
- TH 60 Reconstruction near Worthington
- TH 36 Reconstruction through North St. Paul

Local government also recently applied IC and LWD to the subgrade on CSAH 2 in Olmsted County and to the base and hot-mixed asphalt wearing and base courses on CSAH 4 in Kandiyohi County.

Specifications, Tools, and Training
Specifications and tools have been developed to support the increasing use of IC, LWDs and DCPs.

IC
Mn/DOT has developed a pilot specification for IC use, available at: www.dot.state.mn.us/materials/gbintellc.html

LWD/DCP
A recent project, Using the Dynamic Cone Penetrometer (DCP) and Light Weight Deflectometer (LWD) for Construction Quality Assurance, resulted in draft specifications for the use of both the LWD and DCP. These specifications cover the use of these devices for granular and fine-grained soils, as well as target stiffness values for these tests.

During 2008, Mn/DOT used the LWD on about 20 construction projects for subgrade and select granular testing. In addition, Olmsted County also used the LWD on the subgrade and select granular for CSAH 2.

DCP performance and applications also have improved as a result of extensive DCP testing and research at Minnesota construction sites.

Equipment
The Minnesota Local Road Research Board and Mn/DOT have purchased several LWDs that are available for loan to counties and cities. Contact the Mn/DOT Research Services Section or visit www.dot.state.mn.us/materials/research_LWD.html for additional information.

Training
Certification training classes for the DCP and LWD are available through the Mn/DOT Technical Certification Program. Information about classes is available at: www.dot.state.mn.us/const/tcp

For More Information
IC implementation in Minnesota, with links to IC research in Minnesota
www.dot.state.mn.us/materials/gbintellc.html

LWD implementation in Minnesota, including vendors, with links to LWD research in Minnesota
www.dot.state.mn.us/materials/gblwd.html

Information on DCP research and development in Minnesota
www.dot.state.mn.us/materials/researchdcp.html

IC overview
www.intelligentcompaction.com