



TECHNICAL SUMMARY

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LRRB PROJECT COST:

\$80,565



While MnROAD has a calibration vehicle, county dump trucks are also suitable for calibrating a WIM system.



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OFFICE OF TRANSPORTATION
SYSTEM MANAGEMENT

Portable Weigh-in-Motion System Accurate Enough for Low-Cost Screening

What Was the Need?

Heavy freight vehicles are a concern for many local agencies due to the damage they can cause to roads. Weigh-in-motion systems can provide useful data about freight vehicles that use a given road, but current systems are expensive. They are also permanent, requiring costly and intrusive pavement cuts or boring to install.

A University of Minnesota Duluth researcher developed a portable WIM system [prototype](#) that can be installed with tape and anchors in less than 40 minutes and that costs significantly less than permanent WIM systems. The prototype's portability gives agencies the flexibility to gather data at multiple locations without additional—and generally impractical—costs of purchasing a new system.

What Was Our Goal?

The goals of this project were to evaluate the University of Minnesota Duluth's portable WIM system in field conditions, and to test and refine installation and calibration procedures for it.

What Did We Do?

Researchers field-tested the portable WIM system in two phases. The first phase took place in 2013 at seven sites near existing automatic traffic recorders throughout the state. Data from those ATRs were used as a baseline to evaluate the WIM system's accuracy.

Between the first and second phases, researchers upgraded the system with significant software changes. The second phase, which took place in 2014, included three more sites near ATRs around the state as well as seven sites in Chisago County, which used road tubes to compare results.

Researchers also tested the use of several vehicles for calibrating the system, ranging from a half-ton pickup to a Class 10 truck with a loaded trailer, to determine if county-owned vehicles could be used for calibration runs. This step was important because while MnDOT has a designated test Class 9 truck weighted to 76,000 pounds and a driver who is skilled at maneuvering it to cross sensors at a consistent speed and location, that calibration vehicle will not always be available for local agencies.

What Did We Learn?

The first phase of the project attempted to deploy the system for a full week, which would eliminate the need to correct data for the day of the week when extrapolating the average annual daily traffic. In all but three of the tests in this phase, however, the pads were pulled up from the roadway by traffic, weather or vandalism. In the second phase, researchers deployed the system for 48 hours, which mitigated these issues. As a result, researchers recommend installing the system for 48-hour data collection periods.

The calibration tests found that Class 6 dump trucks, which most counties have access to, are well-suited to calibrating the system, requiring only three runs per lane to cali-

A portable weigh-in-motion system was found to be suitable for local agency use, with applications that include screening traffic on low-volume roads to collect data for pavement planning and to identify locations where overweight vehicles are likely to travel.

“A portable weigh-in-motion system that isn’t too expensive and isn’t too flimsy is the holy grail of the traffic-monitoring world. We collected a lot of data from the system in two summers, allowing us to see that the system is both accurate and durable.”

—Erik Minge,
Principal, Intelligent
Transportation Systems,
SRF Consulting Group, Inc.

“Permanent weigh-in-motion systems can be cost-prohibitive. With this portable system, the sensors are about \$10,000 per pad, and the system is a lot more flexible.”

—Benjamin Timerson,
Transportation Data
and Analysis Program
Manager, MnDOT Office
of Transportation System
Management



The portable WIM system can be installed in 25 to 40 minutes with 30 anchors and washers and four rolls of duct tape. Removing the pads takes about 15 to 30 minutes. Material costs per installation total about \$140.

brate it to a 95 percent confidence interval. The MnROAD test truck requires seven runs to achieve the same confidence, while a pickup truck required 100 runs. Researchers generated a calibration manual and worksheet to guide users through the process.

In general, traffic volumes recorded by the portable WIM system were within 6 percent of ATR data, speed accuracy was within 5 percent and the WIM system’s vehicle classifications generally matched baseline data.

Based on observations of wear on the system during the evaluation, researchers estimate that the pads can be successfully installed 50 to 100 times before replacement.

What’s Next?

While no WIM system is suitable for the enforcement of road weight restrictions, this system proved itself accurate enough for screening of low-volume roads to identify sites where overweight vehicles are likely to travel. The system can also provide improved data about vehicle class and weight that would be valuable for planning and pavement design, or to better understand the impacts of heavy freight vehicles on a particular road.

MnDOT has two of these systems available for local agency use. It is currently working with the Office of State Aid to publicize this resource to city and county engineers and work with them on implementation. Agencies with small engineering staffs may need to employ consultants to use the system for data collection due to lack of available staff time.

The system also has the potential to be commercialized. However, while it has attracted interest both nationally and internationally, there is a limited market for such a system, and finding a manufacturer that can produce it in appropriate quantities has been a roadblock to commercialization so far.

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