

Educational Benefits of MnROAD

MnROAD Lessons Learned – December 2006

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1 Abstract

Since opening for operations in 1994, MnROAD has served the pavement community in many capacities. One frequently overlooked intangible benefit of MnROAD's first ten years of operations is the involvement of MnROAD in educating pavement engineers. The educational contributions of MnROAD are most noticeable in the close relationship between MnROAD and the University of Minnesota (UM). The UM/MnROAD partnership has assisted a large number of under- and post-graduate students in their classwork or research, and this partnership is directly responsible for the creation of two dedicated pavement professors in the Department of Civil Engineering at UM. Furthermore, MnROAD has been used throughout its lifespan as a staging facility for a variety of demonstrations and verification testing of a number of issues for all members of the pavement community. The number of MnROAD engineers who have moved on to other positions in pavement engineering and used their MnROAD experience to great success also suggests both the educational benefits and far-reaching influence of MnROAD in pavement engineering. Finally, MnROAD's extensive database and long history of well-documented research ensures that MnROAD will continue to educate pavement engineers far into the future.

2 Background

The body of work accomplished at MnROAD points to the fact that a great number of non-MnDOT engineers use MnROAD data on a day-to-day basis. However, one neglected fact of MnROAD's history is that even in its planning and construction phases, the MnROAD project was the product of a collaborative effort between MnDOT engineers and a host of consultants from the pavement industry and research-oriented institutions (including universities such as UM). The technical director of the MnROAD project, beginning in 1989, was Prof. David Newcomb of UM, and Prof. Newcomb played a large role in determining the project's original research objectives (as described in MnDOT Report 1990-03, "Work Plan for Research Objectives"). Prof. Newcomb's involvement from the beginning would later lead to a relationship between MnROAD and UM that would lead to a number of administrative changes at UM and in the UM's Department of Civil Engineering to benefit both MnDOT and UM.

In MnDOT Report 1990-03, the focus of the MnROAD facility is squarely set on the "improvement of pavement design methods" and "increasing pavement performance." Since opening to traffic, assessments of MnROAD's achievements have been held against the overall standard of "increasing pavement performance." While holding MnROAD activities to this standard is reasonable, in doing so the observer overlooks many intangible benefits of MnROAD. One benefit is the influence of MnROAD on the education of pavement engineers at a variety of stages in the careers of these engineers. Through MnROAD, professional and student engineers have received a wealth of

pavement experience in analyzing data, setting up field experiments, conducting field tests, or participating in demonstrations.

The following sections will provide greater detail on the educational experiences available at MnROAD: the education of students working at MnROAD or with MnROAD-related projects; the administrative changes brought about to expand the study of pavements and the research put into pavements; and contributions of MnROAD to the knowledge and careers of pavement engineers around the world.

3 MnROAD and Student Research/Participation

During its first ten years of operation, MnROAD has served as a training ground for many UM students in a number of engineering fields, most notably pavement engineering. These student workers have participated in activities that include the installation of load response and environmental sensors, the collection of pavement performance and environmental data, and the laboratory testing of materials used in MnROAD test sections. Some of these students were also graduate research assistants contributing to projects such as the analysis of collected data or the acquisition of the dynamic data from MnROAD's array of sensors.

Furthermore, many other graduate-level students have used MnROAD data for the sake of their master's or doctoral theses. In the civil engineering department alone, over 40 students conducted graduate-level research at the MnROAD facility or using MnROAD data over MnROAD's first ten years of operation. While a majority of these students' work is in pavement engineering, a handful of students also conducted work in non-pavement topics such as plant biology, GPS-assisted trucks, and systems for data acquisition and calibration.

MnROAD-related research conducted during MnROAD's first ten years of operation by former UM graduate-level students in the Department of Civil Engineering includes:

Bao, Wenjin	Calibration of Flexible Pavement Structural Model Using MnROAD Field Data
Birgisson, Bjorn	In-Situ Moisture Content Measurements at the MnROAD Site
Brown, Marcus L.	Best practices for the design and construction of low volume roads
Bruinsma, James	Review of Studies Concerning Effects of Unbound Crushed Concrete Bases on PCC Pavement Drainage
Chadborn, Bruce Allen	Asphalt Materials Characterization and Traffic Modeling
Clyne, Timothy R.	Best practices for the design and construction of low volume roads
De Sombre, Rachel	Parameters to Define the Laboratory Compaction Temperature Range of Hot-Mix Asphalt
Fagerness, Aaron	Performance, Analysis and Repair of Ultra Thin and Thin Whitetopping at MnROAD
Forst, Jesse	Calibration of Rigid Pavement Structural Model Using MnROAD Field Data
Glasgow, Drexel	Improved Techniques for Application of the Finite Element Method to Strain Prediction in Portland Cement Concrete Pavement Structures
Hovan, Jean-Michel	Pore Water Behavior in Spring Thaw

Koubaa, Amir	Assistance in the validation of the MnROAD database
Moreno, Angel Mateos	Load Equivalency Factors from the Structural Response of Flexible Pavements
Oman, Matthew	Advancement of Grading and Base Material Testing
Ovik, Jill	Seasonal Changes in Material Properties
Prakasha, Kuppalli S.	Dynamic Response Modeling
Schmidt, Sarah	Analysis of Built-in Curling and Warping in PCC Pavements
Sheehan, Matthew	Field Evaluation of Concrete Pavement Curling and Warping Responses
Shongtao, Dai	Digital Signal Processing for MnROAD Offline Data
Stroup-Gardiner, Mary	Investigation of HMAs at MnROAD
Timm, David	Development of Mechanistic-Empirical Design for Minnesota
Van Deusen, David	Load response instrumentation installation and testing procedures
Vandenbossche, Julie	Interpreting Falling Weight Deflectometer Results for Curled and Warped Portland Cement Concrete Pavements
Zhang, Wei	Reassessment of Diametrical Compression Test on Asphalt Concrete

Note that this list is far from complete. In addition, a number of UM students have pursued research at MnROAD in non-pavement related fields. The following list includes some of those students and the topic of their research at MnROAD:

Elfering, Jodi Mary	Improving The Design Of Roadside Ditches To Decrease Transportation Related Surface Water Pollution
Gale, Samuel	The Effect of Novel Soil Amendments on Roadside Establishment of Cover Crop and Native Prairie Plant Species
Lau, Wing C.	Development of Automated Procedures for Dynamic MegaDAC Calibration Data Recovery
Shankwitz, Craig	Autonomous Vehicle Guidance Evaluation
Wang, Dong	Mn/ROAD TDR Evaluation and Data Analysis

The influence of the above research is considerable, as many of the above projects were published by the MnDOT library and/or contributed to later projects at MnROAD. In many cases, these students' works are successive steps not only in a particular professor's research interests, but also in the ongoing interests of MnROAD and MnDOT. For this reason, the relationship between UM and MnROAD is very much "two-way": while MnROAD and MnDOT provide the facilities, data, and funding opportunities for students, students help MnROAD and MnDOT determine the viability of certain options and directions for future research. The accessibility of MnROAD and established UM/MnROAD relationship also ensures that many of these projects are completed in a relatively short period of time.

Furthermore, many of these projects have a profile that extends beyond the state of Minnesota. Some reports and papers based on the above projects have become TRB presentations or have been the basis for or result of NCHRP and other pooled fund studies. The relationship that MnROAD has established with UM students, then, goes beyond simple mentoring and convenience, as these students are in turn publishing and presenting their work and in doing so promoting MnROAD beyond the state level.

In addition to providing the facility for UM students, MnROAD is also available to the public and, most notably, professional engineers for tours, demonstrations, and

certifications. In this sense, MnROAD is a kind of continuing education facility as well. In particular, MnROAD's recent demonstrations of intelligent compaction (IC) technologies have been very influential in bringing IC to notice in North America. MnROAD also has served as a staging facility for IRI roughness profiler certifications for a number of years. Finally, MnROAD's visitor logs are evidence of the thousands of pavement professionals who have visited the MnROAD facility to ask questions and gather pavement and/or test track expertise from MnROAD engineers.

4 MnROAD Contributions to Educating Pavement Engineers

MnROAD's relationship with UM extends beyond its relationship with UM students into affecting the structure of the university itself. One of the main benefactors of MnROAD's influence in education is the Center for Transportation Studies (CTS), an administrative resource created at UM in 1986 to generate funds for, bring publicity to, and indirectly guide UM research in transportation economy, traffic safety and flow, transportation infrastructure (including pavements), and transportation planning. CTS experienced a significant growth spurt in the early 1990s that extended through MnROAD's first ten years of operation, and this growth spurt and the existence of MnROAD is clearly no coincidence. For this reason, CTS must be included in any discussion of MnROAD's influence on UM changes in administration.

One early tie between UM, CTS, and MnROAD is the initiative set forth, with the support of MnDOT and the Minnesota Asphalt Pavers Association, to create the Miles Kersten Chair in the Department of Civil Engineering at UM. The Kersten Chair was reserved exclusively for a professor of pavement engineering. The creation of this chair led to the hiring of Prof. David Newcomb, who, as mentioned in the Background section, was a driving force behind MnROAD as technical director of the project. The Kersten Chair initiative and increased funding (thanks in no small part to the opportunities created by MnROAD) later resulted in a second pavement position and the hiring of Prof. Mark Snyder in 1993.

Prior to 1989, the Department of Civil Engineering at UM had no professors in pavement engineering and very few students engaged in pavement activities. By 1993, the civil engineering department had two dedicated pavement positions, and by 2004, the civil engineering department had graduated over 35 graduate-level students who worked in MnROAD-related pavement issues alone (does not account for graduate students involved in non-MnROAD-related pavement topics). It is difficult to imagine that these pavement positions and these students would have existed were it not for the close involvement of MnROAD engineers with CTS and UM and the involvement of UM students with MnROAD.

In 2004, a task force commissioned to expand the governance of and increasing research opportunities at MnROAD, led to the creation of the Transportation Engineering and Road Research Alliance (TERRA). TERRA is a pooled-fund consortium of industry representatives, MnDOT officials, UM representatives, local and out-of-state governments, and research institutions. The introduction of TERRA not only provided

additional research funds to MnROAD, TERRA also brings a variety of industrial and institutional research interests much closer to MnROAD's attention. As it has done for UM, MnROAD is acting as a database and test facility for a new subset of pavement engineers—namely, the members of TERRA. However, this activity does not exclude UM researchers: in many cases, PRI professors and students benefit from their experience with MnROAD and expertise in cold-regions pavements by being given the opportunity to conduct the research needs proposed by TERRA members. However, TERRA also presents MnROAD with the opportunity to pass along valuable pavement and test track expertise to some of TERRA's members, such as the government of Norway and Iowa State University, and act as an educational resource for even more of the pavement community.

A recent change at UM due to the involvement of MnROAD and CTS is the creation of the Pavement Research Institute (PRI). UM, CTS, and MnDOT/MnROAD officials recognized a need for PRI soon after the founding of TERRA, and as a result the Department of Civil Engineering at UM and CTS created PRI. PRI's main goal is to position pavement engineers at UM for TERRA projects. While some of these goals may be coincident with CTS interests, PRI's sole focus is determining TERRA projects (which is by their nature are MnROAD research interests) that fit the interests of UM's pavement engineers. PRI is thus another valuable link that strengthens and enriches the bond between UM and MnROAD.

While these many institutional and organizational changes are significant, there are other less complicated processes by which MnROAD is advancing its educational influence in pavement engineering. The most noticeable of these processes is the introduction into the pavement community of former MnDOT employees who have worked closely with MnROAD data or the MnROAD facility. The advancement of these previous MnDOT employees in industry, government, and academic positions in pavement engineering addresses both the large amount of pavement expertise to be experienced at MnROAD and the benefit of obtaining this experience. Furthermore, the involvement of these employees in high-visibility projects serves as a reminder of MnROAD's influence throughout the pavement community.

MnROAD has also been involved in pavement conferences in the state of Minnesota and throughout the United States. In particular, MnROAD has been closely involved with Accelerated Pavement Testing workshops: beginning in 1999, MnROAD has given a great deal of support to the International Conference on Accelerated Pavement Testing held in Minnesota. MnROAD has also been an important figure in the presentations at the annual Minnesota Pavement Conferences held jointly by CTS and MnDOT since 1997.

5 Conclusions and Recommendations

While MnROAD has done a great deal to educate existing and future pavement engineering professional, MnROAD's involvement with both industry and institutional research interests would certainly benefit from increased one-on-one involvement with

these agencies, rather than simply engaging them through TERRA. One method of improving this involvement would be to extend in-roads to these agencies through increased participation of MnROAD engineers at conferences in pavements. However, this recommendation may be moot, as in preparing for its Phase Two, MnROAD is actively pursuing new relationships in pavement research. An example is MnROAD's current relationship with the Center for Transportation Research and Education (CTRE) at Iowa State University, a relationship that has the potential to be very fruitful in educating pavement engineers and exploring new research projects at MnROAD.

A final recommendation is for MnROAD to continue and bolster its relationship with UM and take advantage of UM's history with MnROAD, familiarity with MnROAD and on-going research interests, and its general proximity to MnROAD and resulting knowledge of the local materials that go into a given MnROAD test cell. While a number of changes have taken place at UM that would not have been possible without MnROAD, there are further changes that could take place at UM with the continued support and partnership of MnROAD: for instance, thanks in part to its relationship with MnROAD, UM has opportunity to build an even stronger program in pavement engineering within its Department of Civil Engineering, a program with more dedicated pavement professors and undergraduate and graduate-level students. This growth will only take place with continued research opportunities from MnROAD, and it is hoped that both UM and MnROAD appreciate the benefits that one can provide for the other.

In conclusion, MnROAD's ability to educate students and professionals in pavement engineering has been evident from the conception of MnROAD. Its existence contributed to administrative changes at and increases in the number of dedicated pavement engineering students at UM, and it has hired and trained many pavement engineers who have gone on to apply the expertise gained through MnROAD at other jobs in industry, consulting, and academics. MnROAD itself has brought pavement issues to the pages of Minnesota's newspapers, and in doing so taught its citizens and legislators about the need to understand cold-regions pavements in order to improve intrastate roadways.

6 References

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