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Paving the Way to Success: Cooperation Leads to Pavement Research Center

Their football teams will still be rivals, but the Civil Engineering Departments at MSU and U of M have joined efforts to create MDOT's new Pavement Research Center of Excellence (PRCE). The Center captializes on the leadership each university provides—MSU in flexible pavements and U of M in rigid pavements. Dr. Gilbert Baladi of MSU serves as the new Center's coordinator as well as co-director of flexible pavements. Dr. Will Hansen of U of M serves as co-director of rigid pavements, the Center's other arm.

Michigan's pavement problems are the impetus behind the creation of the Pavement Research Center of Excellence (PRCE). Pavements aren't lasting as long as they should. MDOT intends to analyze the failures to determine the causes. A more complete understanding of pavement deterioration should lead to better corrections of the problems in the short term and better pavements in the future. Of special interest are the roles that materials, design, the environment, and traffic loading play as contributing factors. As Dr. Baladi states, "If we understand the cause, we understand the prescription."

Because materials research is an essential component for some of the PRCE's projects, Michigan Technological University will be involved informally as a third arm. MTU will conduct materials research for MSU and U of M as a subcontractor. "We're doing something that hasn't been done before," says MDOT's Jon Reincke. As Engineer of Research for the Materials and Technology Division, Reincke forged the cooperative links among the universities. By combining their areas of expertise, the Center will build on the unique strengths each university contributes. This is the first such large scale collaboration established among these universities.

Working Together to Solve Problems That Affect All of Michigan

Establishing a cooperative relationship among three of Michigan's research universities has been a first step in making the center a reality. "First and most important, I'd like to see the three universities and MDOT work together to solve state problems," says Dr. Baladi. Cooperation is essential to the Center's success because much of the research demands collaborative efforts. Although one university will take a lead role as the principal investigator for a project, in most cases one of the other universities will serve as either a co-principal or a subcontractor.

This cooperation provides a new opportunity for the research faculty to meet their colleagues at the other universities, which has not always been possible because of busy schedules. Dr. Baladi also sees the universities' opportunity to interact with MDOT as a positive development. He looks forward to working together as one unit. The exchanges of technical information will flow both ways between the universities and MDOT to everyone's benefit.

Getting Research Off the Shelf and Onto the Road

One problem in the past has been that research results haven't always been readily implemented. Research all too often has ended up on the library shelf rather than being placed in the proper hands. Broad representation on each project's advisory team should assure easier implementation of research in the future. These advisory teams are involved from the beginning of the projects, from fine tuning the original proposals to seeing each project through to completion. If implementation requires training, it is built into the initial proposal to guarantee that the research isn't shelved.

Including from the outset those key people who will implement the end product means that the product users will already know where it came from, how it developed, and how it should be used. "Implementation is improved when the users help shape and guide the research," says Reincke.

Continuity and Stability: Seeing Research Through to the End

Development of the Center solves another problem MDOT has experienced working with universities in the past—lack of continuity and stability. Prior experiences weren't always satisfactory because faculty moved on to other projects or universities, taking their knowledge with them. These turnovers disrupt the continuity of the projects and destroy a historical perspective of development when no one sees the project through from inception to completion.

As the center's influence expands regionally, it should encourage retention of research faculty and attract additional funding, providing increased stability and visibility for the Center. MDOT and the universities are optimistic about the Pavement Research Center's impact at a regional level. Jon Reincke is "hopeful and encouraged that this Center of Excellence will not just be serving Michigan, but the region as well." Other states share common pavement problems with Michigan, so as the Center finds solutions to these problems, other states will follow Michigan's lead.

A Creative Solution to a Challenging Situation

A few years ago, MDOT faced a challenging situation. Retiring staff weren't replaced and their areas of expertise were left unfilled. Research that could no longer be handled in-house needed to be done by universities or outside contracts. At the same time, the Engineering Operations Committee had compiled a list of nine research areas that research dollars needed to address. So just when MDOT's research needs were expanding, its research capability was shrinking.

The engineering committee presented its list to the Michigan Transportation Research Consortium, and the idea for establishing research centers of excellence emerged. MDOT believed that five out of the nine areas could support sufficient research to merit their own centers. The five recommended areas included intelligent transportation systems (ITS), traffic and safety, pavement, transportation materials, and structures (including construction management).

Finding the Funds: The Timing Was Right

In a fortuitous parallel development, MDOT received increased funding from the federal government through the Federal Highway Administration's (FHWA) State Planning and Research Program to conduct research and development. The new formula earmarked 25% of the available funds to be spent on research. The department's research budget increased substantially, which guaranteed that some of the centers could be adequately funded. The first two centers of excellence to be established are ITS at U of M and Traffic and Safety Operations at MSU.

When MDOT was ready to accept proposals from the research universities to "house" the Pavement Research Center, it suggested that MSU and U of M might want to consider submitting a joint proposal. They did so, and the contract was awarded to the two universities.

As Reincke explains, however, MDOT was also impressed with Michigan Technological University's proposal which approached pavement research from a different angle—that of materials. Early on, discussions regarding MTU's involvement in the Center were met with enthusiasm. Although a fourth center of excellence for transportation materials could possibly be started in the future, pavements have serious materials problems now. MTU's materials research would go hand-in-hand with the structural dynamic components research. Although it is not an official third arm of the center, the contract allows MTU to be added at any time as a sub-consultant on the research projects. Reincke expects Michigan Tech to remain a life partner in the PRCE.

Project Selection Process: TAG, You're It!

A Research Advisory Council (RAC) oversees the Center's operation. The Council is comprised of representatives from MDOT, MSU, U of M, Michigan Tech and the FHWA. The RAC's primary role is to grant approval to the Center's projects and select the principal investigator for each project. Many projects require partnering between the universities, so the Research Advisory Council also determines co-principals as needed.

The project selection process begins with MDOT's standard annual call for research. The call has been opened up to include agencies beyond MDOT, such as universities and industry. Research problem statements

What Was the *MATES*. . .

After a year hiatus, the old *MATES* has reemerged with a new name and a new look. We hope the new name reflects better what this publication has done since 1986—namely, provide a record of the research conducted by/for MDOT. Our mission hasn't changed. It is still to disseminate in a timely manner, technical information regarding advancements and changes in the transportation industry.

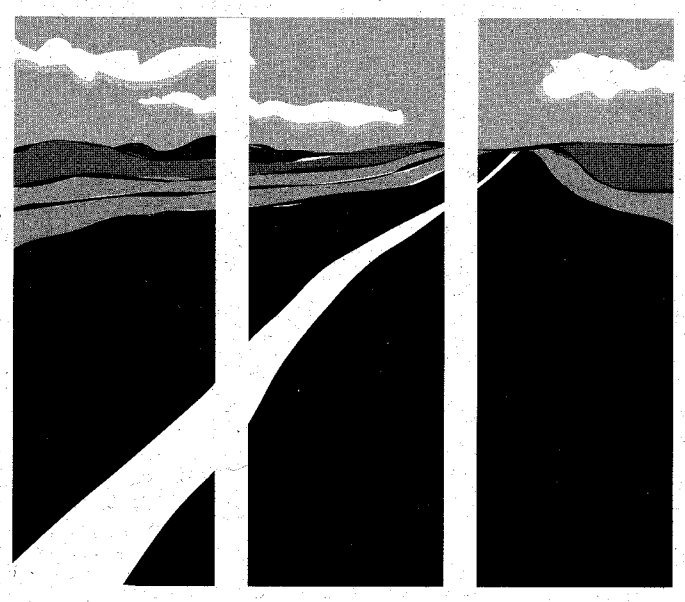
dealing with pavement are directed to the center. The Department reviews the statements and prioritizes them according to MDOT's research needs.

Although the universities will conduct research that MDOT once did in-house, MDOT still retains control of awarding the projects. Generally, universities apply for grants to subsidize their own research interests. In this case, the universities are assigned projects for MDOT. Most of the funding is provided by MDOT, but the universities involved in the projects must also provide funding, although not at a one-to-one ratio. Because the projects remain MDOT-driven, the research is more product-oriented and practical than the fundamental research usually conducted at universities. Dr. Hansen finds this new focus exciting. He believes that "the outcome of this research will clearly benefit the riding public."

In some cases, MDOT's needs blend well with research already being conducted at the universities. For example, according to Dr. Baladi, over the past five years Michigan State has worked on a mechanistic design program called MICHPAVE for MDOT. One of the Pavement Research Center's projects will be to improve the design process to take better advantage of MICHPAVE as well as a related backcalculation program called MICHBACK.

Once the problem statements are prioritized, the RAC meets to approve the Center's work program. Projects are assigned to a principal investigator, and a Technical Advisory Group (TAG) is assembled. The TAG team is comprised of MDOT experts, one of whom serves as project manager, and one or more district representatives likely to see the impact of the research project in the field, along with potential end-product users. The group's first task is to convert the problem statement into a research project.

The principal investigator, with his or her research team and the TAG team, develops the final proposal, including all the tasks that will be done, what the time frame is, who will work on it, what the research product is, and any special implementation features. This proposal is resubmitted to the Research Advisory Council for approval. Presently, MDOT's Engineering Operations Committee gives final approval on the projects, but as the Center gets underway, the RAC may have ultimate approval authority.



Into the 21st Century

Throughout the Center's developmental process, MDOT was encouraged by the commitment each university made to the research partnership. A cooperative effort such as the one undertaken faced many obstacles to success. Reincke, however, was impressed by everyone's desire to establish new bonds and create what was hoped would be a long-term union between the universities to conduct pavement research for the benefit of Michigan's highway users. "Now that the Pavement Research Center of Excellence is a reality," says Reincke, "the department's mission to provide the highest quality transportation service will continue to be realized into the 21st Century."

1995 PRCE Projects

Six multi-year projects were selected to begin in 1995. The projects are in various stages of development, with most of them still being revised by their Technical Advisory Groups before being sent to the Research Advisory Council for final approval.

Michigan Pavement Rehabilitation Methods and Selection Process

Principal Investigator: MSU

Subcontractors: U of M and MTU

Problem: MDOT lacks a comprehensive process that coordinates how and why a particular fix is selected to rehabilitate either a flexible, rigid, or composite pavement. Projects are currently selected and prioritized based on a rehabilitation approach that matches available revenue with a limited menu of fix alternatives. MDOT has recently published a pavement fix guide which provides a list of the possible pavement fixes but without adequately addressing the cause and effect of pavement deterioration. Thus, an information/analysis package of how to determine the cause and effect of the existing pavement condition is needed.

Objective: To develop a decision matrix guide for the selection of the most appropriate pavement fix alternatives.

Mechanistic Design Implementation Plan for Flexible Pavements and Overlays

Principal Investigator: MSU

Problem: MDOT recognized the need to change from an empirical-statistical design method (AASHTO) to a mechanistic approach, where fatigue analysis is based on the engineering properties of materials used to construct the pavement structure. The change was recommended in order to make more accurate predictions of design service life and to better control the performance of the pavement in accordance with its design criteria. A formal comprehensive implementation plan is needed to identify the steps necessary for the change to take place and be acceptable to all participants, including the Michigan Asphalt Paving Association (MAPA).

Objective: To formulate a plan to produce a design procedure that will provide the most economical (lowest life-cycle cost) pavement structure or overlay that meets the design criteria.

High Early Strength Concrete

Principal Investigator: MSU

Subcontractor: MTU

Problem: In recent years, early opening of concrete pavements and pavement repairs to traffic has been emphasized, particularly in urban areas where lane closures lead to high levels of congestion and increased users' costs. Concrete used for rapid repair applications must meet minimum strength levels before the pavement can be opened to traffic. Typically, high early strength is obtained by a number of techniques including using a high cement content, a low water-cement ratio, and accelerating admixtures. Later-age strength and durability must also be adequate to ensure long-term performance. It has been found that the intensified rate of early strength gain may damage the concrete structure resulting in poor long-term performance. It is important to consider such adverse effects in selecting the accelerated strength gain procedures.

Objective: To provide an in-depth understanding of how the development of early strength gain affects the structure and properties of concrete.

Determine Causes of Faulted Cracks in Jointed Reinforced Concrete Pavements on Open-Graded Bases

Principal Investigator: U of M

Subcontractor: MTU

Problem: Jointed reinforced concrete pavements develop transverse cracks over time at some distance (12-15 ft) from the transverse joints due to a number of factors, including curling, warping, and load-related stresses. Once cracking has been initiated, load transfer across the crack is mostly due to aggregate interlock. However, these cracks will deteriorate further with time and traffic. MDOT has observed rapid deterioration of transverse cracks during recent years on a number of highway projects including recycled and virgin aggregate concrete pavements placed on open-graded base course material.

Objective: To determine the causes of early crack deterioration, especially faulting, when an open-graded base is present.

Test Method to Determine Existence of Segregation in Bituminous Mixtures

Principal Investigator: MSU

Problem: When segregation isn't discovered until after several miles of roadway have already been paved before the problem can be corrected, the result is miles of inferior pavements. Currently, testing for segregation is done off-site, delaying the identification of the problem and delaying the start of corrective measures. What is needed is a test procedure that will reduce the time to identify segregation.

Objective: To develop a new on-site test procedure to determine more quickly whether segregation is occurring.

Training, Seminars, Special Investigations, Technology Transfer, and Center Coordination

To meet the Center's goals of cooperation and technology transfer, some funding will be used to provide seminars or other training events to increase contact and communication between MDOT and the universities. Research faculty may tour MDOT project sites or visit districts to assess MDOT's needs, especially identifying and solving problems.

Finding solutions to some local problems may be better handled on a short-term, consulting basis rather than a long-term research project basis. The special investigations component of the Pavement Research Center will provide time and expertise to be available on a local level.

Suggestions or questions concerning *M&T Research Record* should be directed to Jon Reincke, Engineer of Research; 517-322-1632, FAX 517-322-5664

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