



MiSTI

*U.S. DOT University Transportation Center for
Materials in Sustainable Transportation Infrastructure*





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Director's Message

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The UTC at Michigan Tech brings new opportunities for our faculty, staff and students to be engaged with the transportation industry in finding solutions for a more sustainable transportation infrastructure. Prior to establishing the UTC-MiSTI, Michigan Tech's transportation program was a solid affiliation of faculty and staff conducting research, education, and outreach. Michigan Tech hosts Michigan's Local Technical Assistance Program (LTAP) and the Region 2 Tribal Technical Assistance

Program (TTAP), both federally funded programs designed to bridge the gap between research and practice. The UTC will spawn new growth in both the number of people engaged in transportation activities and in the breadth of topics being explored. In many important areas, UTC personnel have become national leaders for developing sustainable technologies while internally, the efforts of UTC participants have elevated transportation to be a leading growth area for the University. Students applying for graduate school are now specifying "Transportation Materials" as their area of interest within the Civil Engineering graduate program. Faculty continue with increased effort to assume positions of leadership in premier national transportation organizations.

As the UTC has evolved, it has served as a catalyst for growth in other transportation programs at Michigan Tech. The strategic planning process that led to the UTC-MiSTI strategic plan fostered ideas outside the focus of the UTC-MiSTI that are subsequently being developed into initiatives by the Michigan Tech Transportation Institute. Whether it be through the direct efforts of the UTC, or through collateral efforts that grow from the UTC, Michigan Tech is creating the future of transportation through education, research, outreach, and service. As stated in our mission, through engagement with our stakeholders, the UTC-MiSTI has become leaders in developing a more sustainable transportation system for the state and the nation.

Mission: MiSTI will serve the transportation needs of future generations through innovative research, distinctive educational programs and engagement with industry.

Center Information

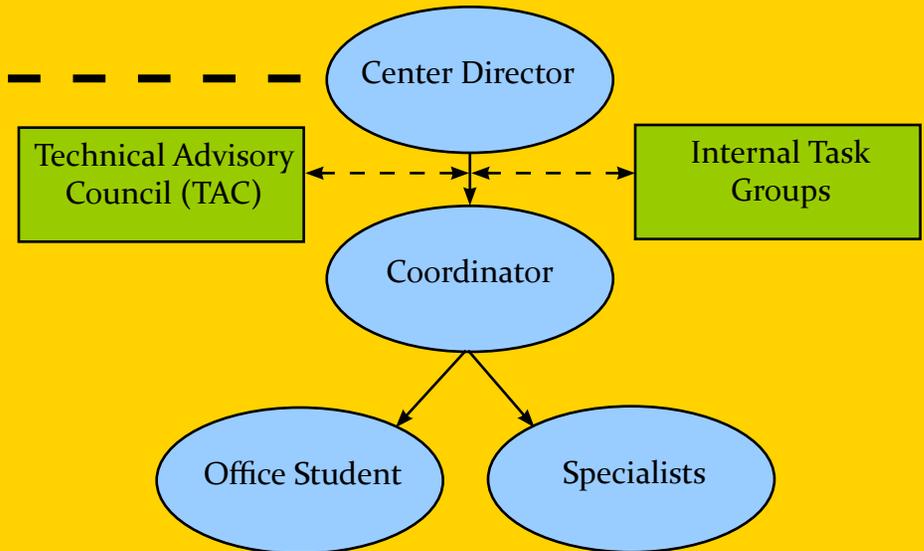
In 2006, through the SAFETEA-LU legislation, Michigan Technological University was awarded the University Transportation Center for Materials in Sustainable Transportation Infrastructure (UTC-MiSTI). Established to address state and national needs in the construction, repair and maintenance of surface transportation infrastructure, the UTC-MiSTI is a Tier II Center funded by the U.S. Department of Transportation (USDOT). The Center's annual operating budget includes up to \$500,000 in Federal support matched with an equal amount from non-federal and allowable cost share partnerships.

The UTC-MiSTI's strategic plan was approved on June 15, 2007 and provides a framework for activities that meet the transportation industry's needs for research, education, technology transfer, and workforce development. An electronic copy of the approved strategic plan can be viewed on the UTC-MiSTI Website at www.misti.mtu.edu

Management Structure

The UTC-MiSTI is a Tier II Center receiving up to \$500,000 per year from the USDOT. To minimize the Center's administration budget, a small administrative staff was established to oversee and coordinate the Center's activities. A faculty director dedicates 1/3 time towards the Center while a full-time center coordinator provides administrative support, program development, and implementation. Specialized skills like website development, print publication layout, and graphic design are contracted as needed. To advise the director in the areas of research, education, technology transfer, and Center administration, internal task groups consisting of three faculty for each area are convened as needed.

The Center's external Technical Advisory Council (TAC) includes representatives from state highway agencies in Michigan and Minnesota; Federal Highway and Rail Administrations; the portland cement concrete industry; bituminous and aggregate materials industries; along with representatives with knowledge of sustainability attributes and the use of recovered industrial materials. This mix of individuals was strategically selected to provide technical input from the core areas of infrastructure materials, while providing constituency input from major sectors of the transportation community engaged in constructing a safe, accessible, and sustainable transportation infrastructure.



2006-2007 Center Staff

Center Director	Tom Van Dam, PE, PhD
Center Coordinator	Elizabeth Hoy
Office Student	Brianna Drake
Specialists	John Valet-Graphic Designer John Ryyanen-Graphic Designer Clare Rosen-Graphic Designer Monte Consulting-Website and Logo

Technical Advisory Council *Under development*

Baseline Faculty

Dr. Theresa Ahlborn, P.E.	Associate Professor, Structural Engineering
Dr. George Dewey	Associate Professor, Structural Engineering
Dr. Ralph Hodek	Associate Professor, Geotechnical Engineering
Dr. Lawrence Sutter	Professor, Cementitious Materials
Dr. Tom Van Dam, P.E.	Associate Professor, Pavement Materials
Dr. Stanly Vitton	Associate Professor, Geotechnical Engineering
Dr. You Li	Assistant Professor, Structural Engineering
Dr. Zhanping You	Assistant Professor, Pavement Materials

University Partnerships

The **Department of Civil and Environmental Engineering** at Michigan Tech boasts the largest undergraduate civil engineering program in the state. Annual undergraduate enrollments average 450 students, while the graduate program, ranked 49th by U.S. News and World Report in 2006, averages 36 students. Michigan Tech offers Bachelor of Science, Masters, and Doctoral degrees in civil engineering with an option to concentrate in the areas of transportation or transportation materials. Transportation courses include pavement materials, transportation planning, public transit, and railroad engineering.



Spring 2007 Pavement Design, Construction, and Materials Enterprise Students and Advisors

Pavement Design, Construction and Materials Enterprise

(PDCM) provides a real world learning environment for undergraduate students by engaging students in teams to pursue solutions for industry-proposed problems. The PDCM averages enrollments of 30-40 students each semester. During their undergraduate education, students complete up to six credits of PDCM project work that counts towards their degree requirements. During enrollment in an Enterprise at Michigan Tech, students complete modules including leadership, project management, marketing and communications and problem solving.

The PDCM is a self-governing program where an executive body of students leads the organizations growth and development. A board of directors, comprised of industry professionals, meets twice a year on campus to receive program updates and review student projects, providing technical advice and guidance.

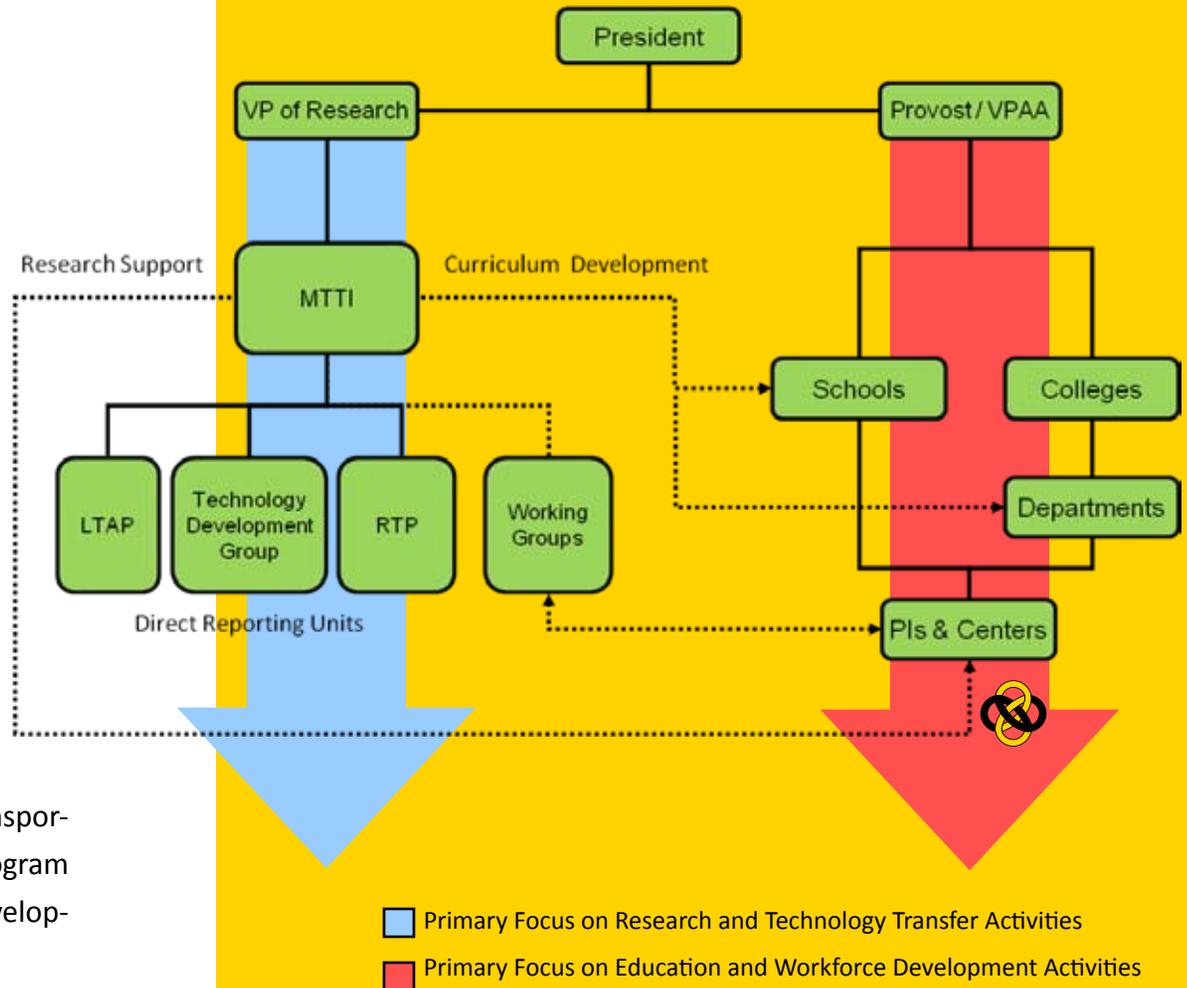


“The PDCM has given me an opportunity to develop my professional skills while learning more about pavement materials.”
Rhen Hoehn

University Partnerships

The **Michigan Tech Transportation Institute (MTTI)** was formed in 1998 to foster transportation research and education at Michigan Tech. MTTI serves as an umbrella organization facilitating a multi-disciplinary environment for collaborative, transportation initiatives across disciplines. Through 2006, MTTI researchers have conducted more than \$21 million in sponsored research. Current investigators include faculty from the Department of Civil and Environmental Engineering, School of Business and Economics, School of Forestry and Environmental Sciences, and the Departments of Mathematics and Social Sciences.

MTTI is organized into six working groups, each addressing a broad area within transportation. They include structures, materials, social impacts, environmental impacts, technology transfer, and transportation systems. Through the transportation systems working group, MTTI will be launching its first multi disciplinary transportation program in rail transportation at the University in the fall of 2007. This program will include education, research, and workforce development activities.



Organizational overview of the reporting structure for transportation activities at Michigan Tech



LTAP Director Terry McNinch is seen above conducting one of many professional development and training workshops for transportation professionals in Michigan. Below, Bryan Hewitt from the Midwest Bureau of Indian Affairs, Ashland office instructs workshop participants during an Indian Reservation Roads inventory field session hosted by the Michigan Tech Tribal Technical Assistance Program.



University Partnerships

Michigan's **Local Technical Assistance Program (LTAP)**, hosted at Michigan Tech, bridges the gap between research results and practical application. LTAP conducts more than 80 workshops and training seminars across the state annually, reaching more than 4,000 transportation professionals. They provide training and technical assistance to local and municipal road workers throughout the state delivering knowledge on maintenance and construction practices, safety training, and road and bridge engineering. The LTAP program is also funded through SAFETEA-LU legislation with matching funds from the state and University.

As a counter part to the National LTAP program, the **Tribal Technical Assistance Program (TTAP)** provides similar training and technical assistance to tribal transportation and planning personnel. Michigan Tech hosts the Region 2 TTAP, which serves the 31 states within the Bureau of Indian Affairs (BIA) midwest and eastern regions. The Michigan Tech TTAP is housed within the Department of Civil and Environmental Engineering and is funded by the Federal Highway Administration and the BIA.

Twenty-five universities host a UTC and a LTAP or TTAP program on their campus. Michigan Tech and Oklahoma State University are the only two universities to host all three programs.

Research Facilities

Benedict Laboratory offers 15,000 square feet of space dedicated to cement and concrete research. A 5-ton overhead crane services the 80 x 60 ft structural high-bay testing area. Equipment for mechanical testing is available for compression, tension, bending, and fatigue testing of all engineering materials. In addition, state-of-the-art facilities for casting, curing, and testing Ultra High Performance Concrete are also housed in the lab. A variety of computer operated mechanical load frames are also available. Advanced pieces of equipment include an air-void analyzer (AVA), freeze-thaw chamber, a Grace Adical calorimeter, and instrumentation for measuring the coefficient of thermal expansion of materials. The lab also has available a 3 inch diameter Split Hopkinson Pressure Bar for determining dynamic fracture properties. The concrete facilities are AMRL accredited and undergo CCRL proficiency testing to maintain the highest quality of scientific research.



Benedict laboratory provides 15,000 ft² for concrete mixing, curing and testing. MS student Paul Koning is shown above preparing a batch of concrete for testing.



PhD students Baron Colbert and Shu Wei Goh, above, secure monitoring sensors to a specimen in Michigan Tech's HMA Performance Testing Laboratory. Michigan Tech maintains AMRL accreditation within these facilities.

Research Facilities

Michigan Tech maintains AMRL accredited laboratories for Hot Mix Asphalt (HMA), aggregate, and concrete mixing and testing.

The **Geotechnical Dynamics Laboratory** is used for studying the dynamic behavior of soils and contains digitally controlled dynamic testing systems. The facility is capable of performing tests for the design of road bases subjected to repeated loading and studying soil/structure interaction during earthquakes.

The **Asphalt Binder Rheology Testing Laboratory** is AMRL accredited and has capabilities for performing Superpave binder grading and advanced testing.

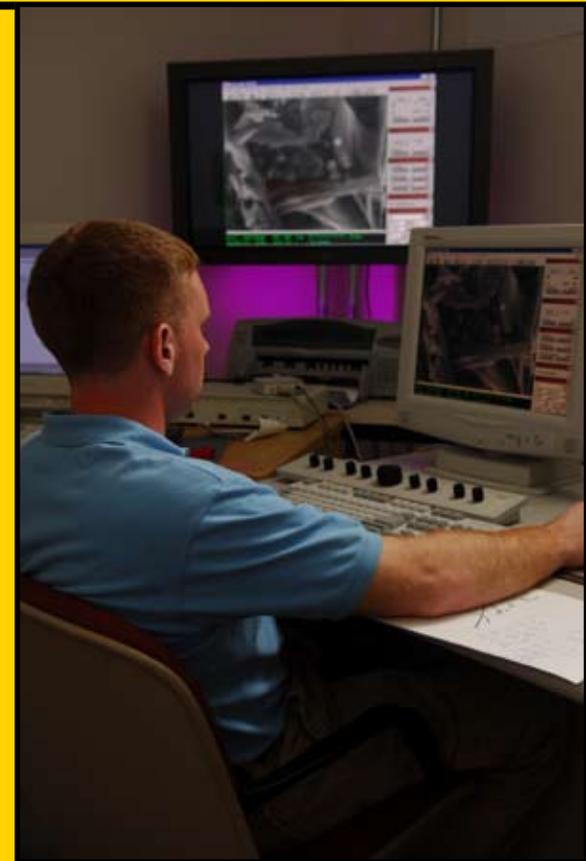
In the **HMA Volumetric Laboratory**, the specific gravity of aggregates and HMA mixtures can be determined, as well as the mixing and compaction of HMA.

The **HMA Performance Testing Laboratory** is capable of performing advanced mixture characterization and performance testing. These facilities are capable of performing standard Superpave mixture designs and other advanced material characterization or performance tests. The tests can be conducted at a wide range of temperatures.

Research Facilities

Materials Characterization Research at Michigan Tech is supported by full-time research staff and state-of-the-art equipment — specifically chosen to provide thorough and rigorous analysis of portland cement and bituminous pavement materials. Petrographic facilities include all necessary sample preparation equipment required to produce polished sections or thin sections. Microscope facilities include a petrographic polarizing light microscope and a stereo microscope, both equipped with video cameras and digital image capture and processing systems. The stereo microscope is also equipped to perform hardened air content determination according to ASTM C457. X-ray diffraction and XRF facilities are also available.

Other equipment and testing capabilities include a FEI XL40 environmental scanning electron microscope (ESEM) equipped with an EDAX energy dispersive x-ray analyzer system (EDS) for determining phase chemistry and a TSL orientation image mapping (OIM) system for determination of crystallographic orientation of phases using electron backscattered Kikuchi patterns. A Fullam tensile and compression stage is available for the ESEM, as well as a variety of temperature-environmental stages that provide a full range of environmental conditions. An Oxford/Horiba XGT-2000W x-ray analytical microscope allows researchers to perform x-ray microanalysis of specimens, x-ray mapping, and x-ray imaging down to a 10 micrometer resolution at atmospheric pressure. This is a newly developed instrument for imaging and analyzing materials using a focused x-ray flux.



MS student TJ Bates is examining the microstructure of a concrete specimen in Michigan Tech's Materials Characterization Facilities.

Education

In June of 2007, the UTC-MiSTI launched the Summer Scholars Program. The purpose of this pilot program was to provide undergraduate students with an opportunity to participate in university based research and for graduate students and faculty to gain a better understanding of the attributes of sustainability and how they are applied to transportation materials. Fifteen students were selected, including six undergraduates, six Masters students and three Doctoral students. Students worked with faculty on research projects related to sustainability in transportation infrastructure materials.

Top Row:

Matt Smith (MS) Rapid bridge construction using decked bridge girders
 Baron Colbert (PhD) Aggregate polishing and friction
 Corrie Craft (MS) Sustainable concrete materials in developing worlds

Second Row:

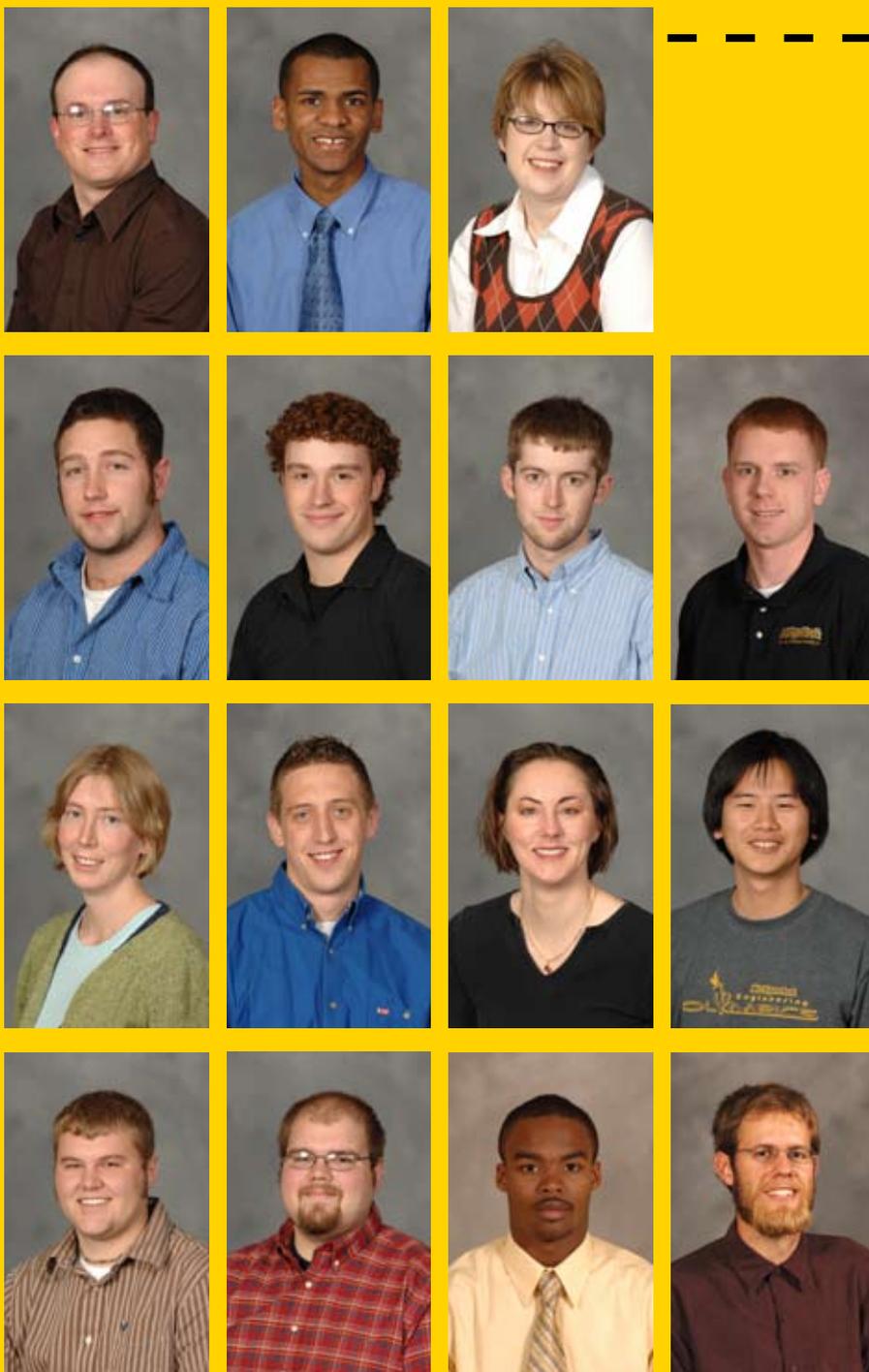
Duane Campbell (BS) Freeze-Thaw testing to ASTM standards comparison
 Jake Vermillion (MS) Air-void analysis of concrete
 Christopher Warren (BS) Reduction of cementitious materials content in PCC
 TJ Bates (MS) Reduction of cementitious materials content in PCC

Third Row:

Anne Peairs (MS) Road subbase soil stabilization using class C fly ash
 Jordan Leep (BS) Reliability based evaluation of loading configurations for long-span bridges
 Melanie Kueber (PhD) Recycled fibers and fly ash use in pavement materials
 Shu Wei Goh (PhD) Development of Superpave performance specifications for WMA

Fourth Row:

Kyle Ellis (BS) Effects of deicing chemicals on asphalt and PCC pavements
 Alex Kiehri (BS) Examination of performance based engineering and sustainability
 DaVaughn Dixon (BS) Construction management and planning
 Paul Koning (MS) Comparative study of anchorage strengths of epoxy coated hooked bars



Research

Michigan Tech has a successful record of providing applied research for the transportation industry. Core areas of expertise include geotechnical, portland cement concrete, bituminous materials, and pavement and infrastructure design. Clients include state departments of transportation, the Federal Highway Administration, Innovative Pavement Research Foundation, and private industry. The award of the UTC to Michigan Tech is providing an opportunity to expand this competency to steer research towards helping state and national transportation agencies address their need for more sustainable transportation systems. The Center hopes to provide leadership in the areas of recovered industrial materials use, developing a better understanding of the environmental impacts of transportation materials, and develop metrics for qualifying and quantifying sustainability in transportation while improving performance mobility and safety.



MS student Corrie Craft and Dr. Yogini Deshpande examine a concrete specimen that failed a compression test.

In February 2007, Dr. Yogini Deshpande was hired as a Post Doctoral Research Assistant by the UTC-MiSTI, the Department of Civil and Environmental Engineering, and the Center for Structural Durability. Her area of specialization is in cementitious materials and sustainability. Dr. Deshpande received her PhD from Purdue University.



Workforce Development

A goal of the UTC program is to increase the number of people seeking careers in fields supporting transportation. Through its strategic planning process, the UTC-MiSTI outlined six activities that the Center would undertake to meet this goal including:

- K-12 outreach
- Enhanced undergraduate and graduate student recruitment
- Curriculum development
- Partnership with industry to provide students with real-world experiences (site visits, field trips, co-ops and internships, and scholarships)
- Research partnership expansion to provide opportunities for students from diverse backgrounds and disciplines to be engaged in transportation research
- Technology transfer activities to provide professional development for current professionals

Through these activities, the UTC-MiSTI will increase the number of people engaged in transportation education and research and increase awareness of opportunities for careers in a transportation field.



Fourth grade students gain first hand experience working with fresh concrete during a visit to Michigan Tech's laboratories. The students are exposed to concrete preparation and testing and they also learn about its strength and microstructural properties. The UTC-MiSTI helps support their field trip to the University. Above, students are placing fresh concrete in molds used to form their very own stepping stone.

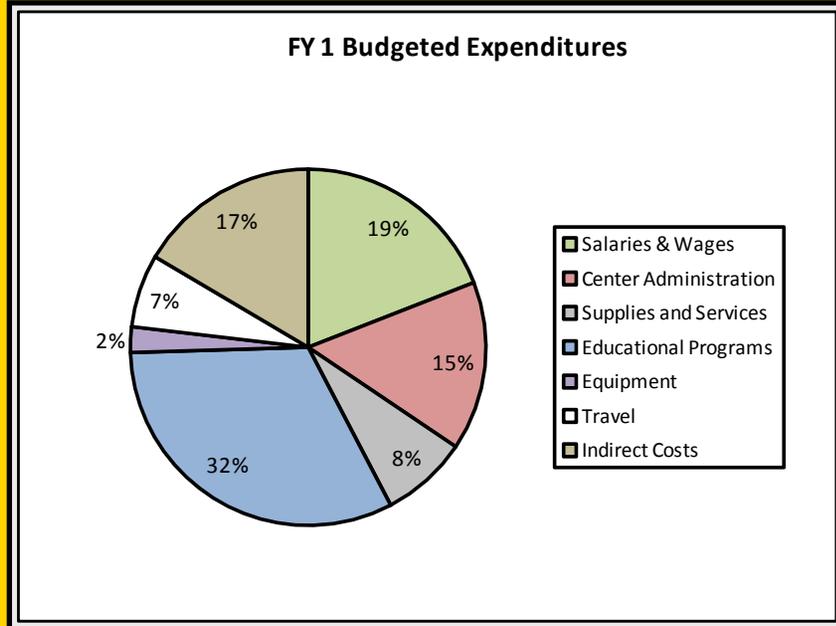
Technology Transfer

The UTC-MiSTI outlined eight technology transfer (T2) activities in its strategic planning process. In 2006-2007, progress was made towards goals (2), (3), (6), and (8). The Center contracted a consulting firm to assist in the development of the Center's website. The Center's website was launched in the fall of 2007. An assessment of strategic affiliations was made and the Center participated for the first time in an AASHTO-RAC meeting, sponsored an exhibit at the National Local Technical Assistance Program Association (NLTAPA) conference, attended the annual Council of University Transportation Centers (CUTC) meeting, and sent key Center staff to the annual Transportation Research Board (TRB) meeting in Washington, DC. This list of affiliations continues to grow and will be featured in an upcoming issue of the Center's newsletter. Plans for a fall 2007 Transportation Forum, held on the campus of Michigan Tech, began in the spring of 2007.

In the fall of 2007, the Center completed its first series of project summaries, which are available on the Center's website. Each summary provides an overview of research, both externally funded and internal initiatives (Center supported), that faculty and staff are currently engaged in.

UTC-MiSTI's 8 Strategic T2 Goals

1. Hire a Technical Writer to assist in the transfer of scientific research results to a variety of targeted audiences
2. Development of a Center website to feature news and Center activities
3. Development of Center publications including newsletters, annual reports, project summaries, technical briefs, and news releases
4. Development of a contact management system to provide quicker and more efficient communication with Center stakeholders and transportation professionals
5. Development of online seminars to further knowledge transfer
6. Strategic positioning of faculty and staff in key organizations to foster industry contact and feedback related to Center activities
7. Coordinating two conferences, years three and four, to bring researchers and industry professionals together to explore research needs and develop future partnerships
8. Host a campus transportation forum to increase the awareness of transportation on campus to facilitate multidisciplinary collaboration towards meeting the needs of state and national transportation organizations



— — — FY 1 Budget

The Center's FY 1 total operating budget was \$860,000 which included \$430,000 in Federal funds and an equal amount of required cost share secured through a variety of sources. The largest portion of the budget, 32%, was allocated to support educational programs including site and field visits for students, scholarships to attract students to explore transportation, materials and sustainability, and the Summer Scholars Program. Salaries and wages for technical staff, the Center director compensation, and faculty support accounted for 19%. Seventeen percent went towards indirect costs. Center administration accounted for 15% which includes salary compensation for the Center's full-time Coordinator. Other expenses include 8% going towards supplies and services and 7% budgeted for travel and outreach. Equipment purchases represent 2% of the total expenditures.

FY1 Baseline Performance

During the first year of the UTC-MiSTI at Michigan Tech, a number of benchmark data points were improved. Faculty and staff increased the number of papers being presented (4) at technical conferences and meetings by 73%. Through the UTC-MiSTI, specifically the Summer Scholars Program, the number of students engaged in transportation research (6) grew by 41%. Significant growth, 64%, was also realized in the number of PhD students (8) enrolled at the University in transportation studies.

The decline in research awards in FY1 (2), in comparison to the Baseline Year, is attributed to the natural cycle of conducting research where efforts are shifted from securing awards to conducting research, publishing reports and presenting findings. Through tactics outlined in the Center's strategic plan, an increase in faculty, staff, and students working in the area of transportation materials will allow this data point to improve in future years.

A few additional highlights worth noting include the development of a new course (5) by Dr. Vitton in Aggregate Engineering and improvement in Technology Transfer (10 and 11) through involvement in the 2007 Michigan County Engineers' Workshop by Dr. Van Dam, and Dr. You's leadership in organizing a symposium on Pavement Mechanics for the ASCE Engineering Mechanics Division Conference.

Page 17 highlights the eight faculty that contributed to this baseline reporting.

		Baseline Year	This Report	% Change
		2005-06	2006-07	
	Research Selection			
1	Basic	0	0	0%
	Advanced	0	0	0%
	Applied	14	12	-17%
2	Total Project Award (million)	2.6	1.3	-100%
	Research Performance			
3	Published Reports	17	14	-21%
4	Papers Presented	9	33	73%
	Education			
5	Undergraduate Courses	7	8	13%
	Graduates Courses	11	11	0%
6	Students Engaged in Research	22	37	41%
	Human Resources			
7	Masters Programs Offered	1	1	0%
	Doctoral Programs Offered	1	1	0%
8	Students Enrolled in MS Program	13	13	0%
	Students Enrolled in PhD Program	4	11	64%
9	MS Degrees Granted	5	2	-150%
	PhD Degrees Granted	0	0	0%
	Technology Transfer			
10	Seminars, Workshops etc. Conducted	1	2	50%
11	Number of Participants	75	169	56%



Tess Ahlborn, PhD, PE, is an Associate Professor in the Department of Civil and Environmental Engineering at Michigan Tech. She also directs the Center for Structural Durability. Her areas of research include prestressed concrete, ultra high performance concrete and bridge engineering.



George Dewey, PhD, is an Associate Professor in the Department of Civil and Environmental Engineering at Michigan Tech. He serves as the advisor of the Pavement Design, Construction and Materials student Enterprise. His areas of research include pavement design and structural engineering.



Dr. Ralph Hodek, PhD, PE, is an Associate Professor in the Department of Civil and Environmental Engineering at Michigan Tech. He is the chair-elect of the ABET Applied Science Accreditation Council. His areas of research include the use of cement kiln dust as a base stabilizer and geotechnical engineering.



Yue Li, PhD, is an Assistant Professor in the Department of Civil and Environmental Engineering at Michigan Tech. His areas of research include structural engineering, risk analysis, natural and man-made hazard mitigation, and structural monitoring and condition assessment.



Lawrence Sutter, PhD, is a Professor and Director of the Michigan Tech Transportation Institute. His areas of research include the effects of deicing chemicals on pavement materials, use of fly ash and other recovered industrial materials in pavements, and materials characterization.



Tom Van Dam, PhD, PE, is an Associate Professor in the Department of Civil and Environmental Engineering at Michigan Tech. He serves as the Director of the UTC-MiSTI and the Transportation Materials Research Center. His areas of research include pavement and airfield design and sustainability.



Stanley Vitton, PhD, PE, is an Associate Professor in the Department of Civil and Environmental Engineering at Michigan Tech. His areas of research include geotechnical engineering, geo-mechanics, slope stability, and dust management.



Zhanping You, PhD, PE, is an Assistant Professor in the Department of Civil and Environmental Engineering at Michigan Tech. His areas of research include bituminous materials, asphalt binders, use of recycled asphalt pavements, and sustainability related to asphalt materials and applications.



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