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In our first year, the UTC-MiSTI focused on developing the Center’s strategic plan. As presented here in this annual report, our second year has focused on program development to accomplish that strategic plan. The Center personnel have actively pursued the establishment of the Center’s website, newsletters and other publication to facilitate technology transfer. The Summer Scholars program has been refined to enhance undergraduate and graduate student education and foster new research in the area of sustainability and transportation materials. The Center supported the first University wide Transportation Forum at Michigan Tech, designed to broaden the transportation activities on campus and create awareness of the opportunities for multidisciplinary approaches in creating solutions to meet the needs of state and national transportation agencies.

Over the past year, the Center secured a number of externally sponsored research projects addressing sustainability in transportation infrastructure materials. Also, MiSTI was a major sponsor of Michigan’s first Construction Career Days event, hosting more than 1700 high school students for two days of transportation and construction career exploration. These and other strategic program activities are featured in this, our second, annual report laying the foundation for addressing the fundamental question and meeting the goals of the national UTC program.
A key accomplishment in fiscal year two was the identification of the industry representatives to serve on the Center’s Technical Advisory Council (TAC). This council’s role is to guide the Center on the identification of research needs in the theme area of the Center (sustainability and transportation infrastructure materials) to support state and national transportation agency needs. The TAC met for the first time on the Michigan Tech campus in May 2008. With their guidance the 2008 Summer Scholars internal research initiatives were selected.

The Center’s 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 and 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 safe, accessible, and sustainable transportation infrastructure.
People Highlights

In January, 2008, Dr. Lawrence Sutter (top left) was confirmed by RITA as the new Director of the UTC-MiSTI replacing Dr. Thomas Van Dam. Dr. Sutter also serves as the Director of the Michigan Tech Transportation Institute (MTTI) which houses the Michigan Local Technical Assistance Program (LTAP), the Technology Development Group (TDG) and the newly established Rail Transportation Program (RTP).

In September 2007, Dr. Pasi Lautala (top right) was appointed the Director of the Michigan Tech Rail Transportation Program. The RTP’s mission is to provide a multidisciplinary educated workforce and conduct applied research to support the needs of the rail industry.

Dr. Jacob Hiller (middle left) joined the faculty of the Department of Civil and Environmental Engineering at Michigan Tech in September 2007. Dr. Hiller’s research focuses on pavement mechanics and the interaction between materials, analysis and performance.

Timothy (TJ) Bates (middle right), MS, was selected as the UTC-MiSTI Student of the Year. TJ attended the 87th annual TRB conference in Washington DC where he received his award from Council of University Transportation Center’s President Ron Diridon, RITA Administrator Paul Brubaker, (TJ) and the former Secretary of Transportation Norman Mineta (lower picture).
UTC-MiSTI partners with the Department of Civil and Environmental Engineering (CEE) at Michigan Tech in the delivery of educational programs, research, and workforce development activities. During the Center’s strategic planning process, a goal of increasing the number of graduate students studying materials and sustainability was identified. An agreement was reached with CEE to match graduate student support between the department and the Center, thereby leveraging the UTC funding to help grow graduate education programs.

In addition to providing stipend and tuition support to graduate students, the UTC-MiSTI supports graduate student involvement at conferences and meetings including the annual meeting of the Transportation Research Board and trainings like the National Center for Asphalt Technology’s Professor Training Program.

UTC-MiSTI is a dedicated partner in the undergraduate program as well, providing student leadership scholarships, undergraduate research project support, travel support for outreach and curriculum enhancement through site and field visits.

Figure 1 Plan to leverage departmental resources to grow the graduate program in transportation materials and secure internal cost share to meet the University’s 1:1 required cost share commitment for the Center.

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<td>467</td>
<td>444</td>
<td>402</td>
<td>391</td>
<td>377</td>
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<td>457</td>
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Figure 2 Civil Engineering (CE) and Michigan Technological University (MTU) enrollment data.

Is the UTC-MiSTI impacting the number of students enrolled in Civil Engineering degrees at Michigan Tech? The answer is possibly at the undergraduate level, and most certainly at the graduate level. The Center’s strategic plan outlined a path to grow the number of graduate students working in the area of materials and sustainability by leveraging departmental resources to fund graduate positions. Figure 1 outlines this plan. Figure 2 represents a historical review of enrollment numbers before and after the establishment of the UTC at Michigan Tech.
In June of 2008, the UTC-MiSTI began its second Summer Scholars Program. The purpose of the program is to provide undergraduate students with an opportunity to participate in university 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. Sixteen students were selected including nine undergraduates, two Masters students and five Doctoral students. Students worked with faculty on research teams addressing problems related to sustainability in transportation infrastructure. The Summer Scholar projects are funded internally by the UTC-MiSTI as research projects intended to serve as the basis for proposals to external agencies for broader support and investigation. Topics explored this summer included: the use of crushed recycled portland cement concrete as an aggregate for asphalt pavements; a method to determine the amount of recycled asphalt pavement materials in hot mix asphalt; use of limestone in concrete pavement mixes; life cycle inventory for transportation structures; energy footprint of road construction; characteristics of carbon in fly ash; and, fracture resistance of concrete made with recycled aggregates. Project summaries are available on the Center’s website at www.misti.mtu.edu

Top Row: Kelly Heidbrier (BS), Jennifer Fuller (BS), Shandre Huff (BS), Amanda Hartman (BS*); Second Row: Chris Gilbertson (PhD), Jullian Mills-Beale (PhD), Stephanie Schiel (BS), Eric Krieger (BS); Third Row: Shu Wei Goh (PhD), Elise Nyland (MS), Boris Simov (MS), Kari Klabeoe (BS); Fourth Row: Baron Colbert (PhD), Rhen Hoehn (BS), Melaine Kueber (PhD), Darrell Cass (BS)

All students are pursuing degrees in Civil Engineering unless noted otherwise.
*Pursuing a degree in Environmental Engineering
Research

A New Approach to Specifying Fly Ash for Use in Paving Concrete (NCHRP 18-13)

The use of fly ash as a supplementary cementitious material in portland cement concrete can increase desirable characteristics of the concrete including increased strength, mitigation of alkali silica reactions, and offer cost savings. Fly ash, a created through the generation of electricity from coal combustion, increases the sustainability of portland cement concrete by reducing the amount of portland cement consumed and processed. This reduces CO₂ emissions and provides a beneficial use for fly ash, which otherwise is land filled.

Before fly ash utilization can be increased, new material specifications based on the chemical and physical properties of the fly ash need to be developed. These attributes influence the constructability, performance, and durability of the pavement. Another factor is the varying properties of fly ash. These properties are influenced by the coal combustion process and the coal source. Fly ash produced in one plant may vary greatly in characteristics from ash produced at a nearby plant. Changing environmental regulations imposed on electricity generation facilities compounds this problem.

The objective of this project is to provide improvements in the specifications and test protocols to determine the acceptability of fly ash for use in highway concrete.

PhD students Melanie Kueber (Civil Engineering) and Zeyad Ahmed (Environmental Engineering) performing chemical and physical property tests on Fly Ash.

For more information on this and other UTC-MiSTI research projects, visit our website publication link. There you will find one page project summaries on each project being conducted by the Center.
It is quickly becoming apparent that the transportation industry is on the verge of a workforce crisis. An increasing number of transportation professionals are nearing retirement. Interest in engineering and science education on the part of incoming college students is stagnant, resulting in reduced support for replacing mid and upper level positions in the industry. Changes in our transportation system are requiring more diverse participation to engage in developing solutions for our transportation system. The UTC program as a whole is taking a lead role in helping to address the issue of workforce development, at all stages, from K-12 to knowledge transfer for practicing professionals.

Construction Career Days (CCD) is a national program developed by the American Association of State Highway Transportation Officials. In 2007, 26 states offered CCD programs. In April of 2008, the UTC-MiSTI supported Michigan’s first CCD effort through the sponsorship of school transportation expenses for more than 1700 students to attend this two day career and education awareness event. The event featured hands-on activities, heavy equipment demonstrations and information about educational and apprentice programs. The Center’s participation was matched and augmented by the involvement of Michigan’s Local Technical Assistance Program, which provided leadership and support on the coordinating committee and on-site, event logistics, support.
Technology Transfer

In fiscal year two of the UTC-MiSTI, the Center launched its website featuring profiles of faculty and students engaged in the transportation activities of the Center. The publications page provides links to the Center’s first annual report, newsletters and project summaries. Other technology transfer highlights include:

UTC-MiSTI participated as an exhibitor at the National Local Technical Assistance Program Association (NLTAPA) annual meeting in Chicago and at the Mid-Continent Conference hosted by the University of Wisconsin-Madison.

Drs. Van Dam and You traveled to China to present on the topic of sustainability in infrastructure materials. This international workshop, held at Chang’an University, provided insight and exchange on best practices for long life concrete pavements. Other U.S. presenters and members of the International Society for Concrete Pavements (ISCP) included: Dr. Shiraz Tayabji, Dr. Dan Zollinger, and Dr. Mark Snyder.

Michigan Tech supported the technical delivery of a web conference between U.S. universities and government officials, and their counterparts in Brazil. This exchange provided information on current research and education related to renewable alternative fuels. Dr. David Shonnard, Professor, Department of Chemical Engineering at Michigan Tech and Director of the Wood-to-wheels program was a featured presenter.
FY 2 Total Budget Allocations

- Salary & Benefits: 50.2%
- Travel: 31.8%
- Expendable: 11.4%
- Tuition & Scholarships: 3.9%
- Facilities & Administrative: 2.7%

FY 2 Salaries & Benefits

- Center Administration: 32.1%
- Faculty: 20.9%
- Technical Professional: 16.9%
- Undergraduate Hourly: 15.6%
- Graduate Hourly: 7.8%
- Graduate Stipends: 4.1%
- Benefits: 2.6%

FY 2 Budget Highlights

The Center’s FY 2 total operating budget was $816,600.00 which included $408,300.00 in Federal funds and an equal amount of required cost share secured through a variety of sources. These sources include internal University support (i.e. more than $227,000 in FY 2), and externally funded research expenditures. The largest portion of the budget, 50%, was allocated for salaries and wages. The lower chart shows a breakdown of salaries and benefits including 32% for Center administration, a combined total of 25% in student support and 17% for technical professional services including post doctoral support and laboratory technicians.

UTC-MiSTI budgeted approximately 12% (i.e. $93,000.00) in student scholarships and tuition for graduate research assistantships. Travel support provided for Center administration to attend meetings and conduct outreach, and for student support to attend conferences and trainings.
UTC-MiSTI on the Move

Outreach and leadership to advance the state of transportation are underlying goals of the national UTC program. The establishment of the Center at Michigan Tech has led to increased outreach and leadership by faculty and center personnel to ensure that the Center’s activities and programs are addressing the critical needs of the broader transportation industry. In FY 2, Center personnel begin their efforts in providing leadership and outreach in the understanding and development of a more sustainable transportation infrastructure. Here is a listing of outreach activities:

- National Local Technical Assistance Program (NLTAPA) Meeting, Chicago Illinois (July 2007)
- Transportation Engineering Road Research Alliance (TERRA) Meeting, Minneapolis Minnesota (July 2007)
- AASHTO-RAC Meeting, New Hampshire (August 2007)
- Midcontinent Conference (MidCon), Ames Iowa (August 2007)
- Meeting with Great Lakes Cement Promotion Association, Lansing Michigan (September 2007)
- First International Conference on Recent Advances in Concrete, Arlington Virginia (September 2007)
- American Concrete Institute (ACI) Sustainability Conference, San Diego California (September 2007)
- Michigan’s AASHTO TRAC Training Event, Escanaba Michigan (September 2007)
- Workshop on Best Practices for Long-life Concrete Pavements, Xi’an China (September 2007)
- Transportation Engineering Road Research Alliance (TERRA) Meeting, Minneapolis Minnesota (October 2007)
- American Concrete Institute (ACI) Sustainable Development Committee Meeting, St. Louis Missouri (November 2007)

In FY 2, UTC-MiSTI became a member of the Transportation Engineering and Road Research Alliance (TERRA). This unique partnership provides a venue for information exchange with key stakeholders in the transportation community. Through TERRA, industry, state transportation agency and local roads representatives along with academia are working collectively to identify opportunities for partnering to advance the state of road research and research implementation. For more information on TERRA, visit their website at [www.terraroadalliance.org](http://www.terraroadalliance.org)

- Council of University Transportation Centers and University Transportation Center Program Meetings, Washington DC (January 2008)
- Transportation Research Board (TRB), Washington DC (January 2008)
- World of Concrete Conference, Las Vegas Nevada (January 2008)
- Seminar presentation at Western Transportation Institute, Bozeman Montana (March 2008)
- Seminar presentation at the University of Alaska-Fairbanks, Fairbanks Alaska (March 2008)
- Michigan Bridge Conference, Big Rapids Michigan (March 2008)
- National Concrete Consortium (NC) Meeting, Baton Rouge Louisiana (April 2008)
- Michigan’s First Construction Career Days, Mason, Michigan (April 2008)
- International Cement Microscopy Association Meeting, Reno Nevada (April 2008)
- American Society of Testing and Materials meeting, Denver, Colorado (June 2008)
- Council of University Transportation Centers and University Transportation Center Program Meetings, San Jose California (June 2008)
FY2 Baseline Performance

In 2007-08 the Center implemented those activities outlined in the approved strategic plan and secured the Center’s first externally funded research projects including:

- NCHRP 18-13 Specifications and Protocols for Acceptance tests of Fly Ash Used in Highway Concrete (36 month-$749,125.00)
- Reduction of Minimum Required Weight of Cementitious Materials in WisDOT Mixes (27 month-$114,938.00)
- Impact of Hydrated cement Paste Quality and Entrained Air-Void System on the Durability of Concrete (34 month-$304,826.00)
- Efficient use of Recycled Concrete in Transportation Infrastructure (24 month-$180,182.00)

In addition to these 4 sponsored research projects (1c), the Center conducted its second Summer Scholar research program sponsoring eight (1c) internal investigations and engaging 16 students in research activities.

One new graduate course was developed in concrete repair and rehabilitation. Seven technology transfer events reached 231 participants. They included technical presentations at the County Engineers Workshop, the Sustainability in Infrastructure Materials Workshop in China and presentations at Mid-Continent Research Conference, Western transportation Institute, University of Alaska Fairbanks, Montana State University and to the Transportation Engineering Road Research Alliance Board.

*Reported metrics represent change, or increase, from the baseline year. As an example, one new undergraduate course was added in 2006-2007 (5) and one new graduate level course was added to the curriculum in 2007-2008 (5).
**Dr. Tess Ahlborn**, PhD, P.E. 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.

**Dr. 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, P.E., 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.

**Dr. 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.

**Dr. Jacob Hiller**, PhD, is an Assistant Professor in the Department of Civil and Environmental Engineering at Michigan Tech. His areas of research include pavement mechanics and the interaction between materials, analysis and performance.

**Dr. 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.

**Dr. Tom Van Dam**, PhD, P.E. is an Associate Professor in the Department of Civil and Environmental Engineering at Michigan Tech. His areas of research include pavement and airfield design and sustainability.

**Dr. Stanley Vitton**, PhD, P.E., 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.

**Dr. Zhanping You**, PhD, P.E. 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.

**Dr. Pasi Lautala**, PhD, is a Research Assistant Professor within the Michigan Tech Transportation Institute and serves as the Director of the Michigan Tech’s new Rail Transportation Program.