HIGHWAY MATERIALS & CARBON FOOTPRINT ASSESSMENT

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- Tier II UTC
- One of 60 authorized in SAFETEA-LU
- Charge
  - Education
  - Work Force Development
  - Tech Transfer
  - Research
- Michigan Tech is also the home of the Michigan LTAP and the Eastern/Midwestern TTAP
Materials in Sustainable Transportation Infrastructure (MiSTI)

- **Education**
  - Course development
  - Undergraduate research opportunities
  - Graduate student support
    - 23% increase in students pursuing M.S
    - 300% increase in Ph. D. program

- **Work Force Development**
  - Construction Career Days
  - National Summer Transportation Institute (FHWA)
UTC-MiSTI and Tech Transfer

- UTC-LTAP-TTAP Collaboration

  - Pooled Fund TPF-5 (042)
    - The Deleterious Chemical Effects of Deicing Solutions on Portland Cement Concrete
      - Fly Ash and Blast Furnace Slag-plus
      - Appropriate use of deicing chemicals
      - Consider sealants in maintenance strategies

  - T2
    - TTAP-Tech Brief
    - LTAP-4 Webinars
      - 859 participants, 29 states, 3 countries
    - UTC-On-site Presentations
      - 8 states and 2 national meetings
UTC-MiSTI and Tech Transfer

- Interdepartmental Working Group
  - MDOT, MDEQ, Michigan Tech
    - Monthly meetings
    - Recycling, use of beneficial materials, opportunities for collaboration, knowledge transfer and greater understanding
    - Discovery calls—barriers and obstacles
      - People
      - Policies
      - Politics
      - Perceptions
      - Price

January 12, 2011
UTC-MiSTI Research

- National Cooperative Highway Research Program (NCHRP)
  - 18-13 Specifications and Protocols for Acceptance Tests of Fly Ash Used in Highway Concrete
    - Sustainability and Fly Ash (FA)
      - Lower “cost” than cement
      - Reduces the end product carbon footprint
      - FA may improve durability
      - Beneficial use - Reduce landfill waste
    - Focus: Air entrainment, hydraulic reactivity, ASR mitigation

January 12, 2011

72 million tons were produced in 2008
42% was beneficially reused
Stay Tuned…

- New EPA rule on fly ash disposal pending
- If Fly Ash is regulated by the EPA as a Hazardous Waste…
  - Costs for use will increase
  - Less will be used
  - More will be land filled
  - Alternative SCMs will be sought
UTC-MiSTI Research

- Wisconsin Highway Research Program
  - Reduction of the Minimum required Weight of Cementitious Materials in WisDOT Concrete Mixes
    - Reducing Cement Content
      - Lowers carbon footprint
      - Reduces “cost” if durability is maintained

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UTC-MiSTI Research

- Michigan Department of Transportation
  - Use of Recycled Concrete in Michigan Pavements
    - Routinely used in soil stabilization, subbase and base courses
    - Research focuses on use as aggregate in HMA and PCC pavements
  - Benefits
    - Reduce amount being land filled
    - Reduce mining for virgin aggregate
    - Reduce the carbon footprint of end product
UTC-MiSTI Research

- Michigan Department of Transportation
  - Carbon Footprint for Hot Mix Asphalt and Portland Cement Concrete Pavements
    - P.I. Amlan Mukherjee, Assistant Professor, Michigan Technological University
- Aims at evaluating alternative Pavement Designs
  - Incorporating secondary materials
- Investigates reconstruction, rehabilitation, and maintenance projects

Transportation accounts for 28% of U.S. GHG Emissions
Materials & Construction account for 10% of Pavement Life Cycle GHG Emissions

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Sustainability Research - Approach

- Use existing tools and reporting procedures
- Estimate GHG Emissions
  - Global Warming Potential
  - Expressed as CO$_2$ Equivalence
- Investigates Context Sensitive Impacts
- Determine Life Cycle Energy and Resource Consumption
Approach

**Interface 1**

Pavement History (Performance & Maintenance)

**Interface 2**

- On-Going Projects
- Previous Projects

Central Database

**Interface 3**

Published Data & Contractor Inputs

**Design Decisions Based on Performance & Construction Operations**

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<th>Aggregate Base</th>
<th>Rubblizing PCC</th>
<th>HMA Base C&amp;S</th>
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**Operation Specifics**
- Material
- Equipment
- Site Info
- Emissions
- Cost

**Methods/Tools**
- LCA
- LCCA
- Emission Calculator

**Final Decision Based on Chosen Design and resulting Total Emission, Total Cost, and Performance Expectations**
Data Collection

Data from Construction Management Software

- Inspectors Daily Reports
- Material Use
  - Manufacturing Impacts
- Equipment Use
  - Operational Impacts
  - Transportation Impacts
- Fuel Use
Data Collection

- Data from Material Testing Orders
  - Site Layout
  - Material Source Locations
  - Estimate Transportation Impacts
A method that:

- Affords more accuracy as it uses actual on-site data
- Maintains actual energy and emissions records for each control section
- Allows a performance based assessment of constructing highway infrastructure
Significance

- This method will enable agencies to support decision-making
  - within their environmental contexts
  - using historical data pertinent to local highway infrastructure
- This will aide in analyzing the behavior of alternative designs
- Such enhanced calculation methods promise to:
  - improve construction operations, processes, and design selection methods
  - reduce long term emissions and environmental impacts
  - Improve cost effectiveness through efficiency
The Devil’s in the Details!

- **Bottom Line:** RECORD EVERYTHING!
  - Develop a long term sustainability plan
  - What are the indicators?
  - What are the performance measures?
  - Analyze trends
  - Recognize leverage points
  - Become more Sustainable!

January 12, 2011
Questions

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