

## **RAC - Highways Program & Project Development**

### Bridges & Structures

1. *Studying Health Monitoring of Bridges:*
  - a. Scour: Research that supports goals and objectives for risk based monitoring, management, and mitigation of scour critical bridges. Scour monitoring using multi-beam echo sounding during and after storm events. Review scour equations based on historical flood events and actual scour depths in various Michigan stream bed stratum. Host a scour technology transfer workshop.
  - b. General Bridge Monitoring and Assessment: Continued research into the development and implementation of bridge monitoring. Incorporation of bridge deck evaluation at near highway speeds into MDOT's bridge inspection and network level bridge management process.
  - c. Load Rating: Reduce the truck types for legal load and permit load evaluations.
2. *Structural Materials:*
  - a. High Performance Materials: Development of specifications for standardization of Carbon Fiber Reinforced Polymer (CFRP) for mild reinforcement and pre-stressing strands. Development of locally produced metal wire or composite fibers and cement for non-proprietary Ultra-high Performance Concrete (UHPC).
  - b. Material Quality Control: Development of plastic state concrete durability test methods. Study the evolving changes in concrete mix components and their impact on material quality.
3. *Structure Asset Management:*
  - a. Incorporate retaining walls, culverts, other highway ancillary structures supportive of enterprise asset management.
  - b. Develop risk assessment techniques for program and project management.
  - c. Study management and prioritization methods for bridge preventive maintenance.
4. *Development of New Technology and Modernization of MDOT's Bridge Program:*
  - a. Advancing Accelerated Bridge Construction: Continued research to specify and standardize the use of structural bridge placement methods. Development of light weight precast pre-stressed pier caps. Investigate means to reduce traffic impacts of bridge preservation activities. Do a performance assessment of practices to date.
  - b. Develop a systematic approach and analysis techniques to determine element stress analysis for Bridge Field Services constructability reviews (staged construction, deck overhangs, construction loadings, etc.).
  - c. Standardization of low cost, secondary route bridges using standard design components and Geosynthetic Reinforced Soil (GRS).
  - d. Development of 3D and 4D (time dependent) bridge models and plans.
  - e. Modernization of MDOT bridge design procedures.

### Environment & Water Resources

1. *Mussels research on habitat enhancement, detection, and mitigation to expedite design phase and partner with Fish and Wildlife.* Techniques and timing of sampling and identification of mussels. Water quality standards for mussel habitat.
2. *Environmental licensing agreements* – benefits, risks, mitigation strategies, impact to MDOT processes / procedures
3. *Turf establishment.*

### Innovative Contracting

1. *Study and determine the cost effectiveness of MDOT's Alternate Pavement Bidding process.* Analyze past alternate bid project data (design costs and bid costs) and document cost savings as compared to traditional non-alternate bid projects.

### Real Estate & Permits

*No priorities.*

### Transportation Safety

1. *Advancement of Strategic Safety Areas* – Urban intersection environment and the relationship to pedestrian and bicycle crashes.
2. *Development of Tools for Safety Design Decisions* – Local agency safety peer exchange.
3. *Validation of Safety Practices* – Establish the relationship between operating, posted and design speeds.
4. *Operations* –
  - a. Evaluating Pavement Delineation Practices in Michigan.
  - b. Evaluate impacts of past speed limit changes on state trunkline since 2000.
  - c. Evaluate the economic, environmental, and social impacts (costs and benefits) of raising speed limits on various roadway types (arterial and freeway).
5. *Evaluating Pavement Markings*: How do we most effectively use pavement markings in Michigan? Can we learn from this research to improve both our highway and airport pavement markings?

### Rest Areas, Utilities & Landscaping

*No priorities.*

### Surveys & Automated Design

1. *3D Visualization*: How extensive should the quality of 3D visualizations be for public/stakeholder engagement on major projects? How much detail is needed? Should signs, trees, fire hydrants, businesses, nighttime lighting, traffic simulation, etc. be displayed to illustrate the completed project? As technology has advanced, so have customer expectations. Higher quality and detail translates into higher cost including additional staff time to develop specialized renderings.
2. *3D - GIS & CAD*: Interoperability between CAD and GIS is still developing. Methods to seamlessly transfer Bentley 3D iModel information into 3D GIS for asset management purposes is still not perfected. Ideally 3 dimensional objects (components) in CAD would export to 3D objects in GIS with attribute information such as size and material included. This technology needs further development.

### Work Force Development

1. *How can workforce development programs be adapted to meet the unique needs of individuals in multigenerational audiences without the need to develop separate training programs for each generation?*
2. *What are the one or two most significant causes for injuries at MDOT resulting in compensable Workers Compensation claims? What steps can the department take to minimize the number of these claims?*

## **RAC – Highways Delivery & Operations**

### Construction

1. *Synthesis on construction scheduling practices and methodologies for project level acceleration cost estimating.*
2. *Synthesis on assessing value added inspection and testing practices.* How others are dealing with resource challenges and targeting limited inspection and testing resources to project oversight and management. As many have moved from method spec contracting to a more shared risk contracting approach, have DOTs adjusted their inspection and testing practices.

### Geotechnical & Foundation Design

1. *Scour Research (Design & Construction)*

Formation of scour holes at bridge abutments on deep foundations. How much undermining actually happens before the granular backfill soils get sucked out? Currently designers are assuming full earth pressure behind abutments, while neglecting pile resistance in a theoretical scour hole. This is deemed very conservative and a small flume study could probably verify. This project would likely complement recommendations that come out of the Foundations Technical Agenda.

Provide a technology transfer workshop that covers methods to design and install rip-rap and filters.

## 2. *Condition assessments*

- a. Identification, monitoring, and management of geo-hazards using Remote Sensing. Remote Sensing Technologies to monitor:
  - i. River meander/Slope stability
  - ii. Bluff and Cliff Erosion
  - iii. Subsidence from Abandoned mines and Sinkholes
- b. *Performance of steel mechanically stabilized earth (MSE) reinforcements at Blue Water Bridge Plaza.* Inspect the reinforcing strips and the connections to the panels to measure actual performance of the MSE wall design.

## Intelligent Transportation Systems

*No Priorities*

## Fleet/Facility Management & Operations

*No Priorities.*

## Maintenance

1. *Measure the operational cost and benefit of fleet vehicle instrumentation.*
2. *Effective approaches to salt pre-wetting.* Pre-wetting salt has long been considered a best practice but; what is the best way to pre-wet salt? Is it best to pre-wet the salt as it leaves the truck, pre-wet a stockpile before each event, pre-wet each truck load using an overhead spray system, etc.
3. *Cost/benefit analysis of Automatic Vehicle Location/Global Positioning System (AVL/GPS) and Maintenance Decision Support System (MDSS) initiatives.*
4. *Synthesis of techniques used to perform winter maintenance for unique interchange configurations (SPUI, DDI).* A state of the practice and operator training materials are needed to assist with developing winter maintenance strategies for new interchange configurations as Single Point Urban Interchanges (SPUI) and Diverging Diamond Interchanges (DDI).
5. *Assessment of available plow blade cutting edge materials.* Carbide and steel blade have been used in the past. Other types of cutting edges made from composites, rubber, and other materials on the market are available and should be evaluated to assist in cost effective purchasing decisions.
6. *State of the practice on culvert rehabilitation.*

## Mobility, Systems & Signal Operations

1. *Effective multi-modal performance measurement techniques for roadway operations.*
2. *Effective performance measurement techniques for highway operations.*
3. *Dynamic Message Signs (DMS) messaging approaches;* i.e. what type of message is effective, how much info is too much, how various messages affect driver decisions and performance.

4. *Further assessment of Quick Clearance strategies.* The Phase I research project, *Implementation of Quick Clearance in Michigan*, provided a mascot, “Captain Clear It” along with suggested public education methods. Phase II research would measure the value-add of the effectiveness of public education to date.

#### Pavements & Materials

1. *Continued research of the relationship between the Mechanistic-Empirical Pavement Design Guide (MEPDG) and pavement performance.* Further research and ongoing calibration of the mechanistic models that support MEPDG are needed.
2. *Establish a forensic investigation methodology to support warranty specifications.*
3. *Pavement performance relationships between cross section layers (bases, subbases and pavement materials).*
4. *Impacts to asphalt concrete (AC) binders/effective AC resulting from new modification processes including Acid modification, high RAP content mixes, and asphalt bond coats.*
5. *Potential long term pavement performance impacts resulting from rumble strip placement. A past research project, Impact of Non-Freeway Rumble Strips, evaluated only the short term (less than 3 years) performance impacts of rumble strips.*
6. *Performance related issues of fine and coarse graded HMA mixtures. - Relationship between fine HMA mixes and Ride Quality issues.*
7. *Rehabilitation of Jointed Plain Concrete Pavements (JPCP) on open graded drainage courses.* Study the various distress mechanisms and causes of JPCP failures and how best to address these from a maintenance and performance stance.
8. *Driver response and the potential safety impacts of roadway lane delineation caused by overband crack seal.*

#### Work/Facility Safety & Security – Emergency Management

1. *Evaluating or developing pre-recovery solutions used or in-place for MDOT staff –* What type of matrix or list of current or new processes or procedures can be used to assist MDOT staff?
2. *Studying worker safety and health programs with worker’s compensation programs -* What improvements can be made to reduce worker compensation costs?

#### **RAC – Multi Modal**

##### Aviation

*No Priorities*

##### Freight and Logistics

*No Priorities*

##### Freight Rail

*No Priorities*

##### Intercity Bus

*No Priorities*

##### Local Transit

1. *Defining Best Practices for Bus Stop Programs:* Define how Michigan transit agencies decide on location and management of bus stops and shelters. Identify best practices (Michigan and other northern states), including partnerships/coordination with the road agency/owner of the right-of-way to improve pedestrian safety; enhance traffic flow and transit ridership and partnerships with private business in adopt-a-shelter programs.

2. *Determining the Effectiveness of “Transit in the Roadway” Decisions:* Analyze the state of practice and the results to-date of Michigan decisions regarding operation of transit within the road right-of-way. Include southeast Michigan in the area bound by Woodward Avenue, Gratiot Road, and M-59; Lansing along Michigan Avenue; Grand Rapids; and other areas. What have been the challenges and successes to-date?
3. *Measuring the Level of Service on the Passenger Transportation System:* Can MDOT define, measure, and track level of service of the passenger transportation system statewide? Can we develop a repeatable method that is Michigan-specific to determine the level of local services statewide and measure the level of public transportation (local and intercity) mobility statewide? Can we develop a transit mobility index?
4. *Evaluation of Transit Bus Technologies and Development of Bus Procurement Standards:* Evaluate pros and cons of MDOT playing a more aggressive role in transit bus technology. Should MDOT drive innovation in testing and bus safety? Review MDOT’s role and other states’ roles (in particular Florida DOT); what are the best practices? Is there an ongoing role for Michigan universities in assisting MDOT in evaluating bus technologies for inclusion in procurement specifications?

Maritime

*No Priorities*

Passenger Rail

*No Priorities*

Private/For Hire Carriers

*No Priorities*

**RAC – Planning & Finance**

Asset Management

*No Priorities*

Contract Administration

*No Priorities*

Finance

1. *Setting the Balance between Cash and Accrual-Based Capital Management Programs:* What are the relative pros and cons of managing a capital program on a cash basis versus an accrual basis? What are the best practices used to effectively manage capital programs on either a cash basis or accrual basis?

Non Motorized Planning & Development

*No Priorities*

Program Development

*No Priorities*

Transportation Policy

*No Priorities*

Travel Demand Forecasting

*No Priorities*