massDOT
Massachusetts Department of Transportation

Transportation Research Quarterly

Providing highlights of MassDOT's transportation research activities and other helpful information **2024 Q4**

Focus on Research

"Adding salt to the environment does have negative impacts, but for those of us in the Northeast, especially in rural states, where driving is the predominant way of getting around, we need mobility,"

— Jonathan Rubin, Director of the Margaret Chase Smith Policy Center and Professor at University of Maine

INSIDE THIS ISSUE

New Upcoming Projects

Development of a Salt Spreader Controller Program Using Machine-Sensed Roadway Weather Parameters and Climate Data
Budget: $234,921 Duration: 36 months.
The objective of this study is twofold: 1) to develop an improved RSC algorithm by incorporating additional critical road condition categories (e.g., black ice and packed snow) and employing a more complex deep learning architecture; 2) to develop a new SRP model by incorporating the real-time mobile RWIS information from the instrumented truck, the regional stationary RWIS information, and the climate and weather forecasting information.

Environmental Scan of Community Transit Needs Among Older Adults in Massachusetts.
Budget: $150,000 Duration: 18 months.
This project aims to support MassDOT in advancing its community transit programs by systematically identifying and addressing the needs of older adults. Through detailed analysis and stakeholder engagement, the project will provide actionable recommendations for improving transit options and enhancing the quality of life for Massachusetts's aging population.

Cracks of Low-P Rapid Set Concrete in Deck Repairs: Analysis, Prevention, and Alternatives
Budget: $300,00 Duration: 36 months.
The overall objective of this project is to analyze the correlations between cracks in Low-P rapid set concrete and factors including concrete mix design, construction practices, curing conditions, and the service environment/weather conditions of bridge decks. This analysis will guide the understanding of cracking mechanisms and the development of strategies to prevent crack formation in this special concrete.

Annual MassDOT Moving Together Conference 2024

Annual MassDOT Moving Together Conference Report

QUESTION: What you liked most about the Moving Together Conference?

Overall

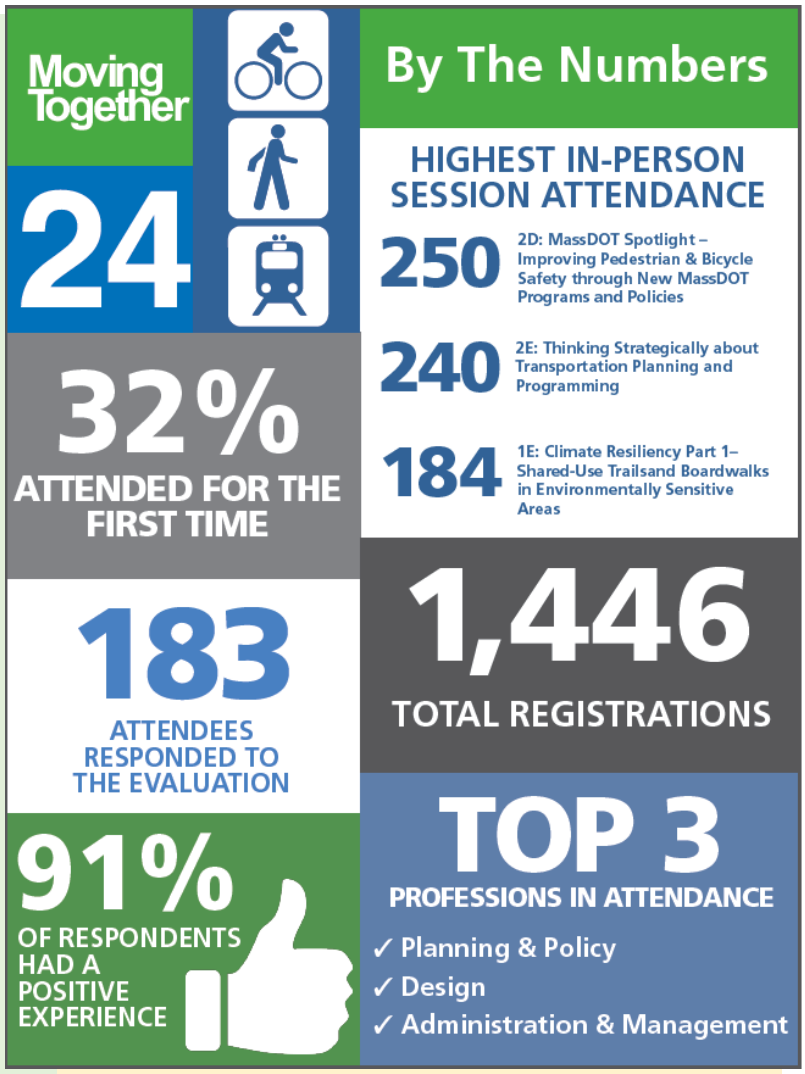
- Vibrant, dynamic, amazing crowd and panels!
- I really liked the overall format of the conference, I thought the timing, pace, location, etc. was really well thought out for the event. My personal favorite was how firms' tables were setup throughout the entire conference, it felt really interactive.
- Municipal planning can get dreary and difficult at times, but this conference always refreshes my idealism for getting good projects done!
- This conference offered a great variety of presentations and opportunities to connect with others.
- The atmosphere was very energizing, and there was a big selection of panels for topics I was interested in.
- Managed to squeeze a lot of sessions and information into one day.

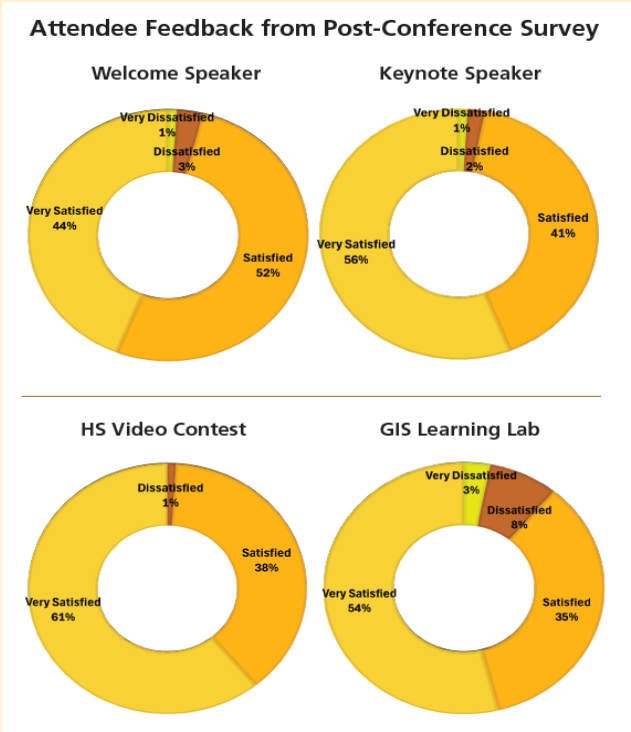
Networking/Attendance

- Great networking (15+)
- Ample opportunity to network despite a packed panel schedule.
- Great to see people from across MA who I've only ever talked to in email chains or video calls.
- Meeting in person with many other colleagues and professionals.
- Many opportunities to network and connect with other organizations.
- Connecting with other engineers and MassDOT staff.
- Meeting the sponsors and consultants.
- Lots of opportunities to connect with people in the industry on the public and private sides, without conference bloat taking it over a single day of programming!

Sessions & Presentations in General

- I enjoyed learning about the innovative projects and planning efforts to advance transportation in the Commonwealth.
- Hearing the overall connection throughout the conference on resilience and sustainability.
- I liked the enthusiasm to provide the public with different modes of transportation and how individuals are working with communities to provide this.
- The variety of topics & presentations, as well as the panel format (a moderator & subject matter experts) was fantastic!
- The workshops/panels were all terrific and the speakers were excellent. There was also a good diversity of topics and speakers.





Ongoing Research Project Highlights

Field Study to Determine Salt Usage Efficiency and Transport to the Surrounding Environment on Two Pavement Types

MassDOT has concerns that certain pavement surface types are being over treated during winter maintenance. This is because one specific type of pavement surface Open Graded Friction Course (OGFC) will appear visually "white" even after treatment. This could lead to a situation where the road is treated again when it is not necessary. OGFC pavement sections typically adjoin dense-graded (DG) pavement sections. Thus, when the OGFC section is treated, the adjoining DG section is also typically treated leading to excessive treatment application. The purpose of this study is to compile data in the field to justify winter maintenance treatment efficiency on OGFC and DG pavement surfaces to ensure that the application is not deficient or excessive. Salt deficiency would result in safety concerns.

The project objectives are:

- Compare OGFC and DG pavement response to identical winter maintenance (salt) applications in terms of reflected physical parameters.
- Investigate the safety implications related to winter maintenance activities for both OGFC and DG pavement types.
- Evaluate whether either pavement type requires a greater or lower application rate to achieve desired results.

The proposed project is a field study that will occur during winter weather events. Both pavement types are located successively on I-95 (Rt 128) Southbound in Needham, MA. Data will be collected with respect to each pavement type from: 1.) existing weather stations, 2.) invasive sensors (to be installed), 3.) winter maintenance activities, 4.) friction and surface condition testing, 5.) crash data, and 6.) photographs.

With these data, and the known treatment application rate and frequency, the research team will attempt to develop a methodology that MassDOT can use to determine if the treatment applications and frequency are correct, deficient, or excessive.

This project is conducted by UMass Dartmouth as a part of MassDOT Research Program.

Completed Research Project Highlights

Development of a Salt Spreader Controller Program Using Machine-Sensed Roadway Weather Parameters.

This study of Development of a Salt Spreader Controller Program Using Machine-Sensed Roadway Weather Parameters was undertaken as part of the Massachusetts Department of Transportation (MassDOT) Research Program. Public agencies are actively searching for an optimized “formula” to minimize the utilization of the deicing material without compromising its effectiveness. The study proposed to address this need by leveraging mobile road weather information sensor (RWIS) technologies and automated mechanical controls.

The research team developed a new salt application system in this study by leveraging the instrumented mobile RWIS, computer vision, and a new salt application model. The research team focused on developing four key aspects of the intelligent salt application system, including hardware, software, algorithm, and model, so that an optimized salt application decision can be provided to the actuator to treat the road surfaces. Through this study, a complete hardware/software system with automated RSC and SRP algorithms has been developed, pilot-tested, and validated with promising performance.

Experimental tests during winter weather events facilitated an analysis of the salt rate prediction model and an evaluation of the efficiency of auto-grip mode, manual mode, and a salt treatment mode, which uses rates recommended by the salt rate prediction model. Further analysis was performed using simulation under fixed weather conditions. A comparative analysis of the results derived from all experiments was performed based on grip improvement and salt usage.

The salt rate prediction model simulation revealed an approximately 18% decrease in salt usage compared to auto-grip mode. The salt rate prediction model demonstrated efficient performance through cumulative results analysis, particularly during use under moderate to heavy weather conditions and sleet mixed snow weather conditions.

Link to the complete final report can be find here

A Look at Who We are – Team Highlights

Each MassDOT research project team is comprised of a Project Champion(s), a Principal Investigator(s) and a Project Manager. The Project Champion serves as the MassDOT technical representative, the Principal Investigator conducts research investigation and produces deliverables per project scope and schedule, and the Project Manager takes charge of the overall project administrative management and coordination. Highlighted below are the key members of "Development of a Salt Spreader Controller Program Using Machine-Sensed Roadway Weather Parameters" project team. This project was managed by project manager Micheal Flanary from our research team.

Principal Investigator – Chengbo Ai Ph.D.

Dr. Chengbo Ai is an assistant professor at the Department of Civil and Environmental Engineering at UMass Amherst. He received his Ph.D. from Georgia Tech in Transportation Systems Engineering and his BS from Peking University in Electrical and Computing Engineering. His inter disciplinary research focuses on developing computational models, AI algorithms, and remote sensing hardware systems as they are applied in transportation asset management, geometry design, roadway safety, pavement preservation and maintenance, and many other critical transportation applications.

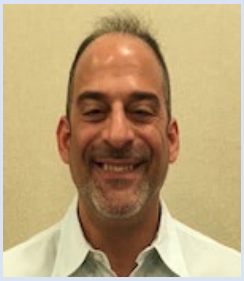
Principal Investigator – Russell Tessier Ph.D.

Dr. Tessier is a Professor and Department Head of Electrical and Computer Engineering at University of Massachusetts Amherst. He holds a Ph.D., SM in Electrical Engineering and Computer Science from MIT and received his BS in Computing and Systems Engineering from Rensselaer Polytechnic Institute. His research interests are in reconfigurable computing, field-programmable gate array architecture, CAD Algorithms for FPGAs, and FPGA-based logic emulation. He received Stamatis Vassiliadis best paper award from International Conference on Field Programmable Logic and Applications in 2019. He was a founder of Virtual Machine Works, a logic emulation company, now owned by Siemens.

Research Assistant – Vaishnavi Avhad

Ms. Avhad recently completed her graduate studies at UMass Amherst. She has industry experience of 3 years in system validation of Edrive and powertrain project with exclusive experience on system integration testing on HiL, secured ECU Diagnostics (CeBID), ECU diagnostics and flashing, CAN communication and ISO 14229. She has worked on Heating ventilation and air conditioning (HVAC), suspension level control, tire pressure monitoring and cooling systems of vehicles. She is proficient in validation and diagnostics tool like CANoe , CANape, ProveTech, and MONACO. During Bachelors education, she ranked as a finalist in Technochamp 2k17 all India Innovation contest organized by John Deere.

Project Champion – Mark Goldstein



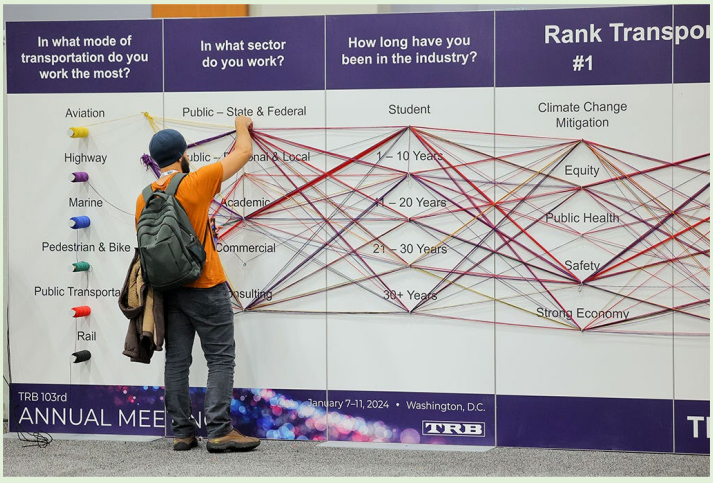
Mark Goldstein received his Bachelor of Arts degree from Brown University in the area of Business Economics and his Master of Science degree in Environmental Science and Engineering from the Colorado School of Mines. He has been with MassDOT for over a decade and worked in Highway Division Environmental Services before joining Operations and Maintenance as the Snow & Ice Program Coordinator. He now serves as the Statewide Snow & Ice Engineer and enjoys utilizing the latest strategies and technologies to increase operational efficiency, while reducing normalized salt usage in MassDOT's Snow & Ice Program. Mark is the project champion for both projects highlighted in this issue.

News and Events

Transportation Review Board Annual Meeting 2025

About the Program

The meeting program covers all transportation modes, with sessions and workshops addressing topics of interest to policy makers, administrators, practitioners, researchers, and representatives of government, industry, and academic institutions.
Workshops Announced: Details regarding specialty workshops are available online. These workshops take place on the first and last day of the meeting.
The full 2025 program, including details on sessions and workshops, is available now via the **Online Program**. Workshops take place on the first and last day of the meeting.



TRB

(TRB) Annual Meeting ***on January 5–9, 2025 Washington D.C.***

massDOT Innovation Webinar Series

Smart Work Zone Control and Performance Evaluation Based on Trajectory Data – December 12, 2024
This research utilizes ultrahigh-definition radar and thermal camera sensors to capture detailed driver behavior data. Specifically, the radar sensors provide individual vehicle speed profiles along the segment prior to a work zone, allowing us to study how drivers adjust speeds in response to various control strategies.
Click here for the webinar recording

Cross-Modal Impact Assessment for Sustainable Transportation Networks – November 14, 2024
This study aims to develop a Holistic Impact Measurement (HIM) methodology incorporating economic, environmental, and social factors of sustainability for different transportation modes. The focus of the project compares the overall sustainability of a travel choice from point A to point B with a current snapshot of Massachusetts transportation infrastructure.
Click here for the webinar recording

What You Can't See: The Commonwealth of Massachusetts Direct Vision Study Findings – October 9, 2024
This webinar will walk attendees through the co-creation of the vehicle vision rating system called Direct vision. Webinar will share the findings from the 60 vehicles measured, including common medium- and heavy-duty trucks, as well as some new market entrants.
Click here for the webinar recording

Research Resources

In Progress MassDOT Research

	Start Date
Development of Improved Inspection Techniques Using LIDAR for Deteriorated Steel Beam Ends	March 2022
Smart Work Zone Safety Control and Performance Evaluation	April 2022
Tree Preservation and Planting for Complete Streets Development	April 2022
Post-Fire Inspection of Concrete Structure Phase III- In-Situ Experiments	April 2022
Methods to Identify Problematic Carriers and Prevent Infrastructure Damage	June 2022
Field Study to Determine Salt Usage Efficiency on Two Pavement Types	August 2022
Implementing AASHTO Mechanistic-Empirical Pavement Design Guide Phase III	November 2022
Effect of Asphalt Binder Source on Asphalt Mixture Performance	February 2023
Accessible Bus Stop Design in the Presence of Bike Lanes	March 2023
A Pavement marking Inventory and Retroreflectivity Condition Assessment Method Phase II	March 2023
Speed Management and Emergency Response – A Synthesis Study	April 2023
Evaluating the Effectiveness of Drivers' Education Modules on Safety	April 2023
Fare Payment Compliance on MBTA Buses and Light Rail	May 2023
Measuring Food Access to Improve Public Health Phase II	September 2023

Recently Completed MassDOT Research

	Completion Date
Uncovering the Root Causes for Truck Rollover at Highway Ramps	March 2023
Safety Impacts of Yellow Flashing Permissive Left-Turn Indications – Approach Analysis	March 2023
Using Mycofiltration Treatment for Stormwater Management	March 2023
Construction and Material Best Practices for Concrete Sidewalk Phase II – Hot Placement	March 2023
Optimizing MassDOT's High Performance Asphalt Overlay Mixtures	May 2023
Massachusetts Depth to Bedrock	May 2023
Multisource Data Fusion for Traffic Incident Detection	May 2023
Measuring Food Access To Improve Public Health Phase I	July 2023
Post-Fire Damage Inspection of Concrete Structures (Phase II) – Experimental Phase	February 2023
Building Information Model for Transit Infrastructure: Feasibility and Gap Analysis	August 2023
Implementing AASHTO Mechanist-Empirical Pavement Design Guide Phase II	September2023
Developing Massachusetts-Specific Trip Generation Models for Land Use Projects	September 2023
Revised Load Rating Procedures for Prestressed Concrete Beams	November 2023
Ultra-High-Performance Concrete Reinforced with Multi-scale Hybrid Fibers	December 2023
Artificial Intelligence Framework for Midblock Crosswalk Detection Across Massachusetts	February 2024
Using Traffic Signals to Reduce Speeding Opportunities	February 2024
LIMMS Development Planning	July 2024
Development of a Salt Spreader Controller Program	July 2024
3D Printing Applications for Bridge Element Repair	August 2024
Data-Driven Approaches for Transit Capital Planning	August 2024
Cross-Modal Assessment of Sustainable Transportation Networks	August 2024
Evaluating Safety Impacts of Two-stage Bike Boxes	August 2024
Evaluation & Mitigation Methods for the Prevention of Cement Concrete Deterioration due to Pyrrhotite	September 2024
Accessible Bus Stop Design in the Presence of Bike Lanes	September 2024

Additional Resources

Transportation Research and Information Database (TRID) is a comprehensive bibliographic database containing more than 1.2 million records of transportation research.

Research in Progress (RiP) Database contains information on more than 13,000 current or recently completed federally-funded transportation research projects.

AASHTO Publications include the most accepted technical guides, specifications, and manuals of the industry.

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