massDOT
Massachusetts Department of Transportation

Transportation Research Quarterly

Providing highlights of MassDOT's transportation research activities and other helpful information **2023 Q4**

Focus on Research

"The MassDOT Research Program plans, executes and administers innovative research and technology transfer to the increasingly complex transportation challenges in the Commonwealth of Massachusetts"

Dr. Hao Yin, Manager of Research, Office of Transportation Planning

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FFY 2023 Funded MassDOT Research Projects

The FFY 2023 Research Project solicitation received 23 submissions, of which 13 were selected for funding. The selected research projects across MassDOT Divisions and the MBTA comprise a total of $2.97 million. The projects below all launched in 2023 and are currently ongoing. See page 2 for a description of a few of the highlighted 2023 new research projects as well as few of the projects that concluded in 2023.

MassDOT or MBTA Division/Unit/Office	Proposed Project Title	Estimated Cost
MBTA	Cross-Modal Impact Assessment for Sustainable Transportation Networks	$ 100,000
MBTA	Energy-Focused Decision-making Framework for MBTA Operations and Planning	$ 125,000
MBTA	Measuring Fare Payment Compliance on MBTA Buses and Light Rail	$ 150,000
MBTA	Accessible Bus Stop Design in the Presence of Bike Lanes	$ 200,000
MassDOT Highway Research and Materials	LIMMS Development Planning	$ 300,000
MassDOT Highway Research and Materials	Effect of Asphalt Binder Source in Asphalt Mixture Performance	$ 400,000
MassDOT Highway Research and Materials	Recycled Ground-Glass Pozzolan (RGGP) for Use in Cement Concrete	$ 250,000
MassDOT Highway	A Method for Pavement Marking Inventory and Retroreflectivity Condition Assessment Using Mobile LiDAR - Phase 2	$ 200,000
MassDOT Highway	Development of a Visualization, Sharing and Processing Platform for Large-Scale Highway Point Cloud Data	$ 175,000
MassDOT Highway Bridge and Structure	3D Printed Lattice-Based structures for Next Generation Bridge Bearings and Bridge Isolation Bearings	$ 200,000
Secretary's Office	Speed Management and Emergency Personnel	$ 300,000
Office of Transportation Planning	Measuring Accessibility to Improve Public Health: Phase II	$ 200,000
RMV	Evaluating the Effectiveness of Driver's Education Modules on Safety	$ 370,000

MassDOT Research Team

Manager of Research Section – Dr. Hao Yin

Hao Yin holds a B.S., M.S. and Ph.D., all in Civil Engineering, in addition to an M.S. in Statistics. A professional engineer, Hao has worked in the field of transportation (land, air, rail, and transit) across United States. A management professional, Hao has managed projects and programs sponsored by government, academic, industry, and non-profit sectors. An innovative researcher, Hao's scholarly record features over 200 publications. Outside of work, Hao enjoys spending time with family, chasing fish on the fly and off-roading in his Rubicon. You may contact him at Hao.M.Yin@dot.state.ma.us.

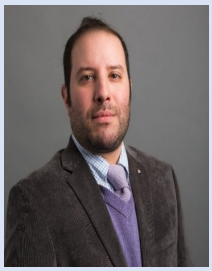
Research Manager – Nicholas Zavolas

Nicholas Zavolas is a transportation planner with the Research Section in the Office of Transportation Planning. Prior to joining MassDOT in 2015, Nicholas worked with the MEPA Office as a staff member for the Secretary of Energy & Environmental Affairs. He holds a Master of Urban Planning & Environmental Design degree from MIT. Nicholas' research interests include electric and autonomous vehicles, and pre-fab and container architecture. He enjoys woodworking, kayaking, hiking and watching his son pitch in the MLB. You may contact Nicholas at Nicholas.Zavolas@dot.state.ma.us.

Research Manager – Michael Flanary

Mike Flanary is a transportation planner with the Research Section at the Office of Transportation Planning. He joined MassDOT in September 2019 after graduating from Tufts University with a Master's in Urban and Environmental Policy and Planning. Prior to working at MassDOT, Mike worked at Tufts University and had internships with Conservation Law Foundation, the Martha's Vineyard Commission, and the City of Cambridge, MA. He is an avid cyclist and greatly enjoys riding his e-bike around Boston. You may contact him at Michael.Flanary@dot.state.ma.us.

Research Manager – Anil Gurcan



Anil Gurcan is a transportation planner with the Research Section at the Office of Transportation Planning. He joined MassDOT in January 2023 after graduating from Tufts University with a Master's in Urban and Environmental Policy and Planning. Anil worked at Tufts University Department of Public Health and University of Connecticut School of Public Health as a research assistant. Prior to graduate school Anil used to manage a bicycle store and continues to be a cycling enthusiast . You may contact him at Anil.S.Gurcan@dot.state.ma.us.

Research Manager – Austin Sanders

Austin Sanders is a transportation planner with the Research Section at the Office of Transportation Planning. He joined MassDOT in January 2023. Austin previously worked for the City of Northampton Department of Health and Human Services, and the Westmass Area Development Corporation. He graduated from the University of Buffalo with a Master's in Urban and Regional Planning. Austin enjoys cycling to the office to get some exercise during his commute. You may contact him at Austin.R.Sanders@dot.state.ma.us.

Research Manager – Patrick McMahon

MassDOT Highlights of Research Projects Started in 2023

Cross-Modal Impact Assessment for Sustainable Transportation Networks
Sponsor: MBTA Estimated Cost: $100,000 Estimated Duration: 12 Months
States make large investments into the transportation system, which should be environmentally friendly, equitable and cost-effective. When investing in a multi-mode transportation system, the following are crucial for defining the sustainability of the system: 1) What is the best way to quantify complex impacts across multiple domains (i.e., social, economic, and environmental)? 2) How does an agency quantify the impact of taking different transportation modes? 3) How can policy decisions about mode choice be evaluated through an equity lens? This project has three objectives: 1) introducing normalized metrics that can be used for cross-modal comparisons; 2) quantifying impacts in social, economic, and environmental dimensions; and 3) analyzing investment decisions with respect to equity.

Energy-Focused Decision-making Framework for MBTA Operations and Planning
Sponsor: MBTA Estimated Cost: $125,000 Estimated Duration: 12 Months
The MBTA is the single largest user of electricity in the Commonwealth. This project aims to develop an enhanced system-wide energy model for MBTA urban rail transit, building on prior efforts and harnessing network-specific substation energy data. It will calibrate train-specific energy models for all lines of the MBTA to evaluate high-resolution trajectory and ridership impacts on energy consumption. Eventually, it will build a decision-support tool to provide system-wide energy and cost predictions for different operational strategies to enable robust planning by the MBTA.

Measuring Fare Payment Compliance on MBTA Buses and Light Rail
Sponsor: MBTA Estimated Cost: $150,000 Estimated Duration: 18 Months
Fare collection is a critical revenue stream for transit agencies, and evasion or underpayment reduces these needed revenues. Fare gates in MBTA heavy rail stations provide reliable measures of fare non-payment but it is more difficult to understand who is evading payment and how often on buses and light rail vehicles without direct manual observations. As the MBTA implements new fare and proof of payment policies, it is important to track any changes in fare-evasion over time. This project has two objectives: 1) use existing data from infrequent manual observations and from continuous AFC and APC devices to estimate rates of fare evasion on buses and light rail vehicles and 2) develop a method to identify when and where manual spot checks of fare payment/evasion behaviors are most valuable.

Accessible Bus Stop Design in the Presence of Bike Lanes
Sponsor: MBTA Estimated Cost: $200,000 Estimated Duration: 18 Months
The MBTA continues to upgrade bus stops for better accessibility. While these accessible bus stops are integrated with Complete Street designs and other multi-modal accommodations, the impact of other modes and related infrastructure on transit user safety (e.g., conflicts between bicycles traveling on adjacent bike lanes and transit riders), has not been fully investigated. This project will develop a better understanding of the impacts of bicycle infrastructure on bus stop accessibility and explore mitigation plans, ensuring an accessible, equitable, and safe travel experience for all travelers.

Laboratory Information Materials Management System (LIMMS) Development Planning
Sponsor: MassDOT Estimated Cost: $300,000 Estimated Duration: 18 Months
The Laboratory Information Materials Management System (LIMMS) was designed as a secure platform to streamline and centralize materials data collection and provide tools to analyze patterns and trends statewide. The current design of LIMMS limits the expected benefits of the system. This project will investigate alternative software that can meet or exceed MassDOT's technical and design requirements.

MassDOT Highlights of Research Projects Concluded in 2023

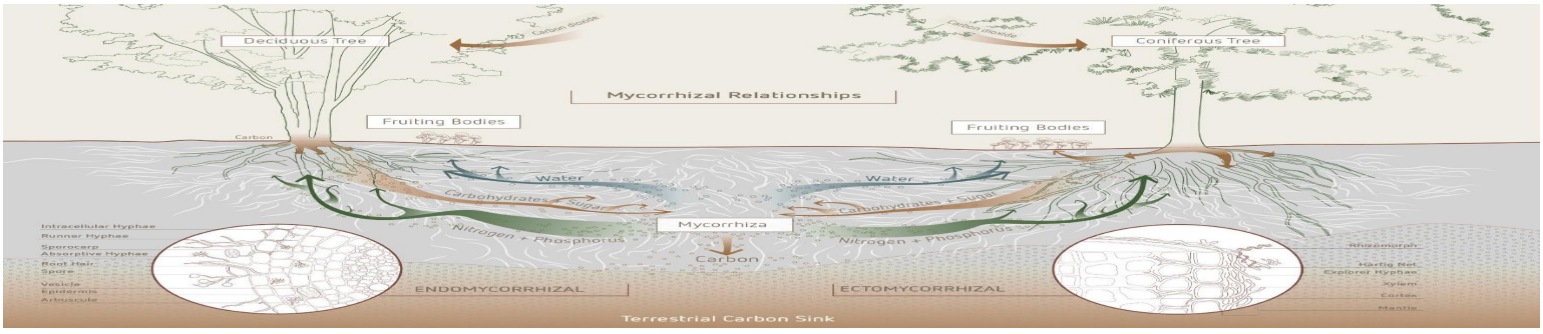
Massachusetts Depth to Bedrock Project
Sponsor: MassDOT Cost: $114,675 Duration: 20 Months
This project is an attempt to reduce the uncertainty in highway project planning by providing interpolated statewide data layers of the depth to bedrock and bedrock altitude at 100-meter resolution based on currently available subsurface data. In addition, maps depicting the level of confidence in the estimate of the bedrock altitude and depth are also provided. Meticulous effort was employed to create the "best" model of the bedrock altitude and depth to bedrock based on the currently available data. The most effective way to use the bedrock altitude or depth to bedrock maps is to use them in conjunction with the error maps, well data, and bedrock outcrops and shallow to bedrock data points.

Uncovering the Root Causes for Truck Rollover at Highway Ramps
Sponsor: MassDOT Cost: $120,000 Duration: 12 Months
This research utilizes drones to collect ramp traffic videos at seven high-risk ramps and develops an Oriented Mask-RCNN model for vehicle detection and several other algorithms for tracking vehicles, extracting vehicle trajectories, and identifying high-risk events such as unsafe and last-minute lane changes. It is found that over 95% of ramp truck rollovers are single-vehicle crashes and speeding is the predominant cause. The proposed trajectory-based safety analysis approach provides important inputs for understanding driver behavior at/near highway ramps, and it can be used as an effective tool for road safety audits.

Measuring Food Access to Improve Public Health Phase I
Sponsor: MassDOT Cost: $149,999 Duration: 28 Months
In this research spatial analysis is conducted for the centroids of each census tract within a study area. An equity analysis using Lorenz curves shows that food access is most equitable by driving, and there are significant inequities for people that do not have access to a car. A regression analysis using the gradient boosted model, a machine learning method, shows gaps in food access for each transportation mode while controlling for community characteristics. This research provides a quantitative method to identify gaps in food access and insights for where policy interventions would be valuable for improving food access.

Using Mycofiltration Treatment for Stromwater Management
Sponsor: MassDOT Cost: $40,000 Duration: 15 Months
This project analyzed existing literature and case studies on mycofiltration, documented interviews with subject matter experts, identified MassDOT BMPs most suited for mycofiltration. Mycofiltration is a nascent stormwater management technology that utilize mycelium, or fungal webs, as biological filters to mitigate water contaminants passing through woodchips, straw, or soil. Conceptual details for mycofiltration Best Management Practices (BMP) are provided, as are lists of potential local fungal inoculant vendors and academic research partners for future studies. The research indicates that there is not enough scientific peer-reviewed literature to support deploying mycofiltration as an addition to MassDOT stormwater BMPs currently. However, with further testing and verification, there may be benefits of including fungi to BMPs in the future.

Post-Fire Damage Inspection of Concrete Structures (Phase II) – Experimental Phase
Sponsor: MassDOT Cost: $99,998 Duration: 14 Months
This project investigates the deleterious effects of fire on concrete tunnel structures and how the extent and degree of fire damage can be assessed, with the goal of developing a rapid inspection protocol/checklist for inspectors to assess the relative safety of a tunnel structure after fire. Topics include residual mechanical properties of concrete, steel, and concrete/steel bond after fire; residual strength and stiffness of structural members after fire; existing inspection tools and methods for assessing concrete structures after fire; and repair methods for fire-damaged concrete structures. Preliminary experimental testing outcomes are presented, including setup of a new heat system; procurement of sample specimens for testing; thermal and physical testing of specimens; and evaluation of results.



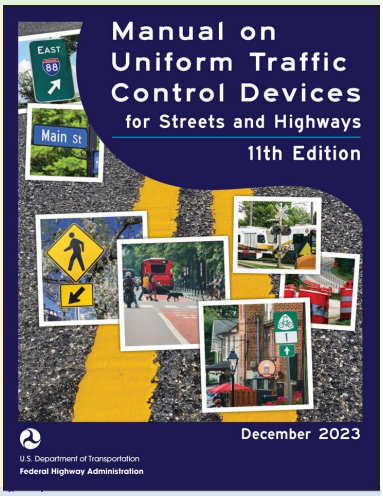
News and Events

TRB's Annual Meeting attracts thousands of transportation professionals from around the world. The 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.

TRB's volunteer technical committees organize the sessions and workshops at the Annual Meeting. They also hold over 430 committee meetings throughout the week of the meeting, and most of them are open to the public. With more than 170 committees, almost every transportation mode and topic is represented

The ***Manual on Uniform Traffic Control Devices for Streets and Highways***—the **MUTCD—** defines the standards used by road managers nationwide to install and maintain traffic control devices on all streets, highways, pedestrian and bicycle facilities, and site roadways open to public travel. The MUTCD is published by the Federal Highway Administration (FHWA) under 23 Code of Federal Regulations (CFR), Part 655, Subpart F.

The MUTCD, which has been administered by the FHWA since 1971, is a compilation of national standards for all traffic control devices, including road markings, highway signs, and traffic signals. It is updated periodically to accommodate the nation's changing transportation needs and address new safety technologies, traffic control tools, and traffic management techniques.



TRB TRANSPORTATION RESEARCH BOARD

No time to conduct a literature search yourself?
TRB Library Snap Searches can help

Snap Searches are designed for the busy researchers or professionals who would like to quickly get up to speed on complex research topics. They provide a succinct summary of current activities at TRB on a given topic including:

- A list of recent reports from TRB and the National Academies
- Current and upcoming projects related to the topic
- Names of Committees working on relevant issues
- Upcoming events such as conferences and webinars

massDOT Massachusetts Department of Transportation
U.S. Department of Transportation Federal Highway Administration
AASHTO
TRB TRANSPORTATION RESEARCH BOARD OF THE NATIONAL ACADEMIES
NCHRP NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Research Resources

In Progress MassDOT Research

	Start Date
Revised Load Rating Procedures for Prestressed Concrete Beams	May 2021
Using Traffic Signals to Reduce Speeding Opportunities	July 2021
Ultra High-Performance Concrete Reenforced with Multi-scale Hybrid Fibers	August 2021
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
Development of a Salt Spreader Controller Program	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
3D Printing Applications for Bridge Element Repair	June 2022
Evaluating Safety Impacts of Two-stage Bike Boxes	August 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
LIMMS Development Planning	March 2023
Accessible Bus Stop Design in the Presence of Bike Lanes	March 2023
Cross-Modal Assessment of Sustainable Transportation Networks	March 2023
A Pavement marking Inventory and Retroreflectivity Condition Assessment Method Phase II	March 2023
Artificial Intelligence Framework for Midblock Crosswalk Detection Across Massachusetts	May 2023
Fare Payment Compliance on MBTA Buses and Light Rail	May 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

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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