ANNUAL REPORT

![massDOT — Massachusetts Department of Transportation]

Research and Technology Transfer

Massachusetts Department of Transportation
Office of Transportation Planning

FFY2024

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Executive Summary

The MassDOT Research Development and Technology Transfer (RD&T) Section operates within the Office of Transportation Planning (OTP), which supports the entire MassDOT structure, including its highway, transit, aeronautics, and RMV divisions. This office administers research programs that are multi-modal in nature, driven by the needs of various divisions and offices. The section's responsibilities include oversight and administration of research projects, managing contracts, conducting outreach, and ensuring technology transfer and training delivery. The section also manages two MassDOT annual conferences.

In Federal Fiscal Year 2024 (FFY2024), MassDOT continued to provide a high level of research support to the needs across the Department and the Commonwealth.

One overall goal and focus of MassDOT research is to explore how advanced technologies such as AI, machine learning, LiDAR systems, and cloud-based applications, can be integrated into MassDOT practices and procedures to improve efficiency and service delivery. This focus is present across the range of MassDOT research projects including relating to safety, infrastructure, mobility, project planning, sustainability, and efficiency. Current and past research has shown how advanced technology tools can enhance data collection and analysis, assisting with infrastructure inventories and assessments, asset management, safety assessments and more. The knowledge gained through this research can then be used to improve current MassDOT practices and guidelines, though such implementation and establishing new practices and guidelines takes time and can face challenges. The knowledge gained through research can also be disseminated through training and other technology transfer efforts.

During FFY24, MassDOT provided state-wide training opportunities while also focusing on training with partners on the local and regional levels. MassDOT used technology to customize training and conferences by offering options that allowed transportation professionals to participate whether in-person, virtual or blended. On the training side, both Baystate Roads (BSR) and MassDOT Training Services (MTS) completely shifted back to face-to-face (F2F) training. Along with this, online and self-paced training options continued to increase this year, with a dramatic increase in classes available and in participation as compared to last year. In FFY24, the number of class participants increased by 46% and the safety theme was the top priority.

A look back at FFY24 highlights many accomplishments:
- 20 active research projects and the completion of 19 research projects.
- The MassDOT Moving Together Conference and Transportation Innovation Conference had over 3,100 people registered to attend in-person or virtually. Both conferences featured projects and research supported by MassDOT, in coordination with partners from the private sector and academia.
- Delivering 142 Baystate Roads (LTAP) classes to 2,349 participants, and 74 MassDOT Training Services sessions to 1,884 participants.

The work and activities undertaken by MassDOT's RD&T in 2024 have been funded with State Planning and Research Funds (SPR) Part II from the Federal Highway Administration (FHWA), as authorized by Title 23, US Code Section 505, and regulated by Title 23, Code of Federal Regulations (CFR), Part 420.

MassDOT

Overview

MassDOT

Mission & Vision

MassDOT provides research, training, and technology transfer services to a broad audience of municipal, state, and academic partners to support various transportation needs and initiatives. Research activities address key issues in the areas of policy, management, safety, environment, planning, engineering, construction, operations, and maintenance as they relate to the Commonwealth's responsibilities for the state highway, public transportation, and multi-modal transportation systems.

Through an Interdepartmental Service Agreement (ISA) with the University of Massachusetts Amherst, MassDOT contracts with the University of Massachusetts Transportation Center (UMTC) to provide services in four main areas:

- Massachusetts Cooperative Research Program (MCRP)
- Baystate Roads (the Massachusetts Local Technical Assistance Program, LTAP)
- MassDOT Training Services (MTS)
- MassDOT Conferences

# MassDOT Research and Technology Transfer Program

The MassDOT Research Development and Technology Transfer (RD&T) Section operates within the Office of Transportation Planning (OTP), which supports the entire MassDOT structure, including its highway, transit, aeronautics, and RMV divisions. This office administers research programs that are multi-modal in nature, driven by the needs of various divisions and offices. The section's responsibilities include oversight and administration of research projects, managing contracts, conducting outreach, ensuring technology transfer and training delivery, and assisting with MassDOT annual Moving Together and Transportation Innovation conferences.

Research

The MassDOT Research Development and Technology Transfer (RD&T) Section initiates research projects, conducts internal and external outreach activities, and administers associated contracts. Research activities range from literature searches and state-of-practice syntheses to medium-scale (12-15 months) and large-scale multiyear research projects that examine the current and future transportation interests of MassDOT. The Research Section carries out its initiatives by prioritizing MassDOT's research needs in collaboration with MassDOT Divisions and Shared-Service Offices, managing projects and contracts, and tracking implementation efforts and impacts.

The Research Program's process for identifying research needs typically involves a Project Champion (PC), a Principal Investigator(s) (PI/PIs), and a Project Manager (PM). For each project, RD&T will work closely with the PCs and PIs to develop the Scope of Work (SOW), including the research project schedule and budget, and project contract. New projects begin once FHWA approval has been obtained. A PC's involvement throughout the project is critical and helps make sure that the project produces useful results and deliverables for addressing critical agency needs such as tools and methodologies which can be implemented at MassDOT. PCs often play an important role with implementation once the research project has been completed.

MassDOT RD&T additionally prepares and publishes a quarterly newsletter to highlight various completed and ongoing research projects, and news and event announcements. The newsletter also provides additional resources to other databases and AASHTO publications. The newsletter can be found at https://www.mass.gov/lists/documents-and-newsletters.
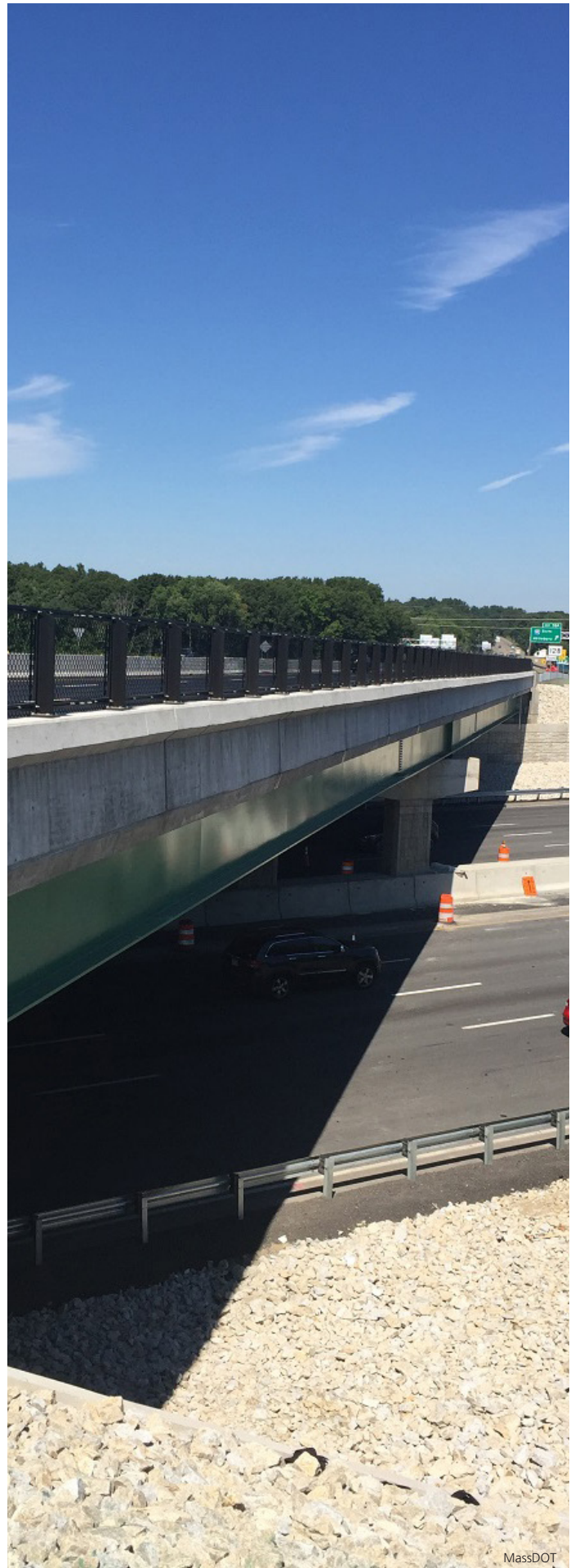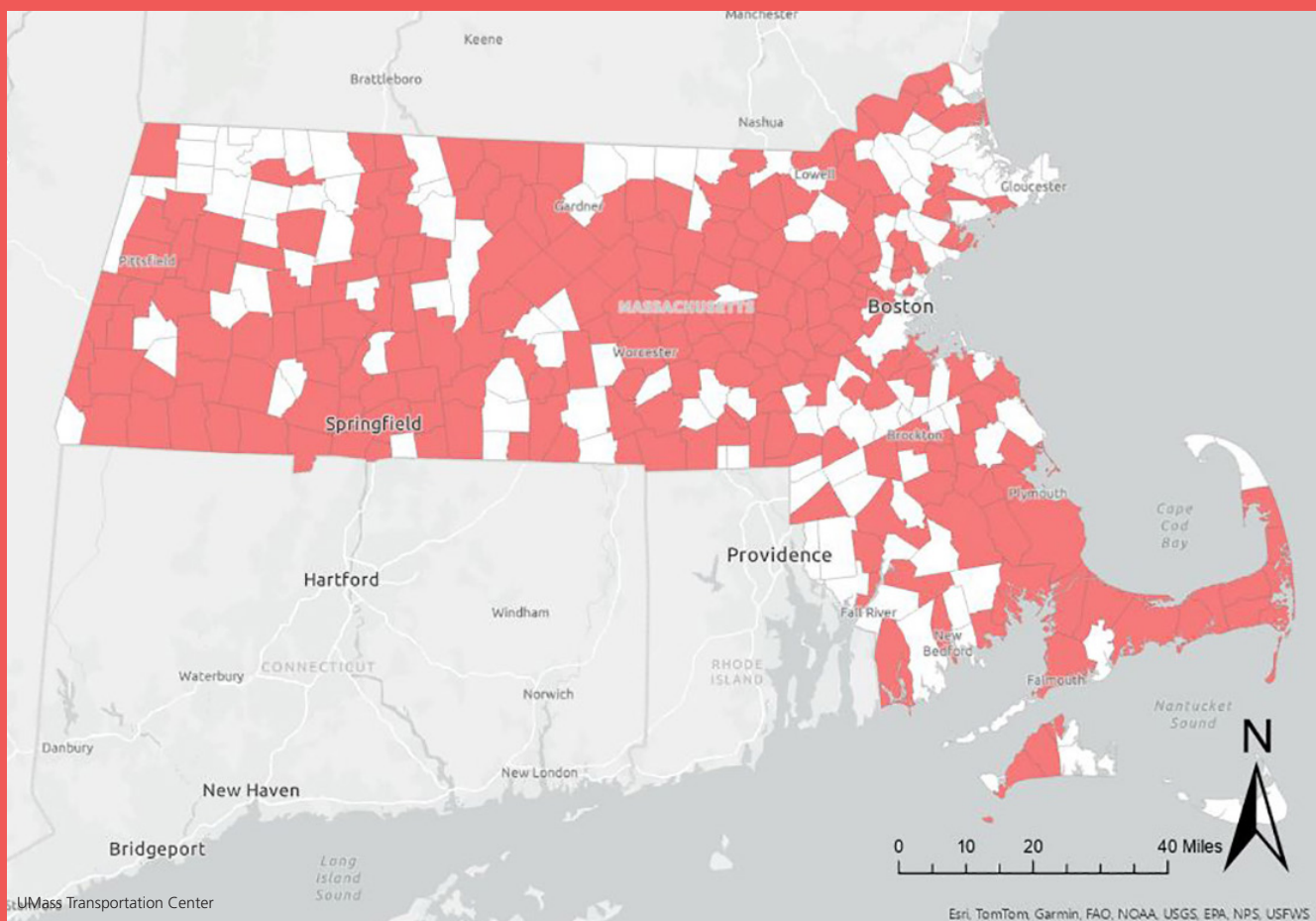
MassDOT

Figure 1: Communities with Baystate Roads Training Participants, FFY24

Training

MassDOT contracts with UMass Transportation Center (UMTC) to provide training services to both MassDOT and municipal audiences, through Baystate Roads (BSR), the Massachusetts LTAP Center, and MassDOT Training Services. These training events serve as conduits for the transfer of new technologies, assist transportation professionals with maintaining mandatory certifications for performing essential work, and share methodologies for operating, maintaining, and managing state and municipal highway departments throughout the Commonwealth. These programs also serve as communication platforms through which MassDOT shares new initiatives and changes related to policies, programs, and engineering directives.

In FFY24, Baystate Roads (LTAP) training participants represented 226 communities: 64 percent of all Massachusetts cities and towns. The following map highlights the communities who participated in LTAP training during the year (Figure 1).

Compared to FFY23, FFY24 saw growth with municipality participation from 208 to 219 municipalities. Outreach efforts were made to engage towns and cities that hadn't participated in BSR training in 3 years. This figure shows in red which communities participated in FFY24.

Collaboration and Engagement

In addition, the Research Section also coordinates and facilitates MassDOT's participation in national and regional research activities, such as with the American Association of State Highway and Transportation Officials (AASHTO), Transportation Research Board (TRB), New England University Transportation Center (NEUTC) and National research development and technology transfer collaboration.

FFY2024 Program Funding

Each year, MassDOT develops its annual SPR Work Program to coordinate planning and research activities funded through the Federal Highway Administration SPR funds as authorized by Title 23, US Code Section 505, and regulated by Title 23, Code of Federal Regulations (CFR) Part 420. SPRII details how MassDOT will allocate funds to conduct research and technology transfer activities in the next federal fiscal year.

Figure 2 below shows the FFY2024 SPRII funding distribution. Research activities—including research projects, the Massachusetts Cooperative Research Program (MCRP), and national RD&T collaborations—accounted for approximately 26% of SPRII funds, while training activities through MassDOT Training Services (MTS) and Local Transportation Assistance Program (LTAP) made up the remaining 69%.
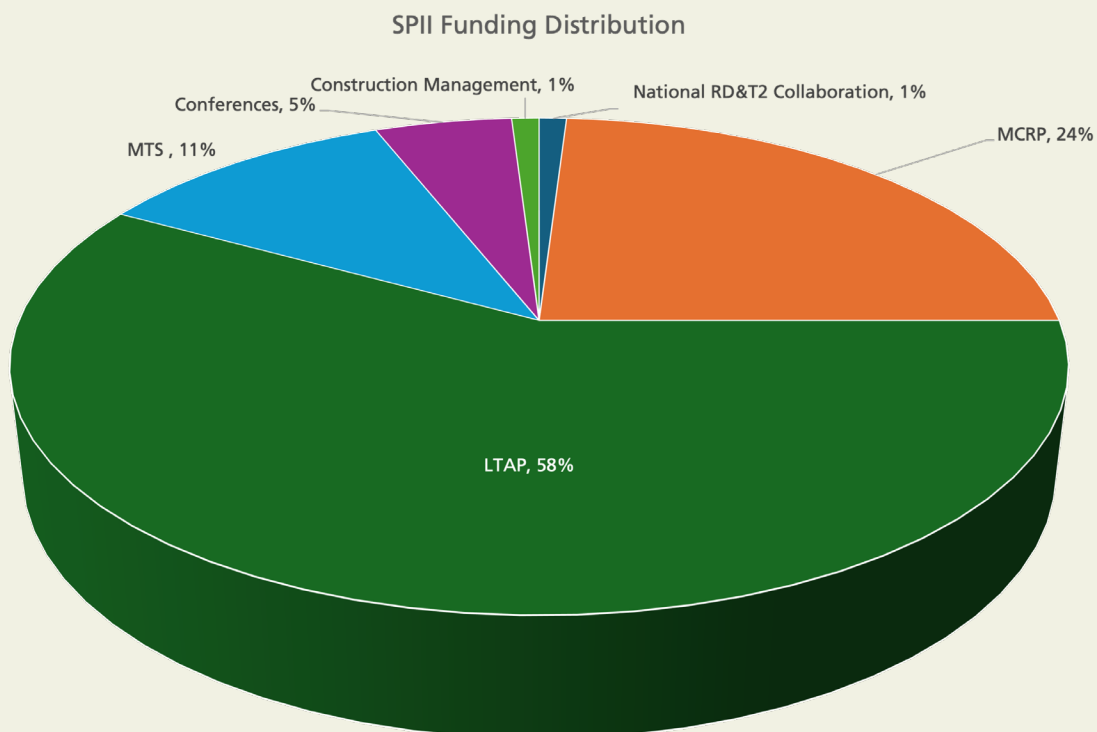
SPII Funding Distribution

Construction Management, 1%
Conferences, 5%
National RD&T2 Collaboration, 1%
MTS , 11%
MCRP, 24%
LTAP, 58%

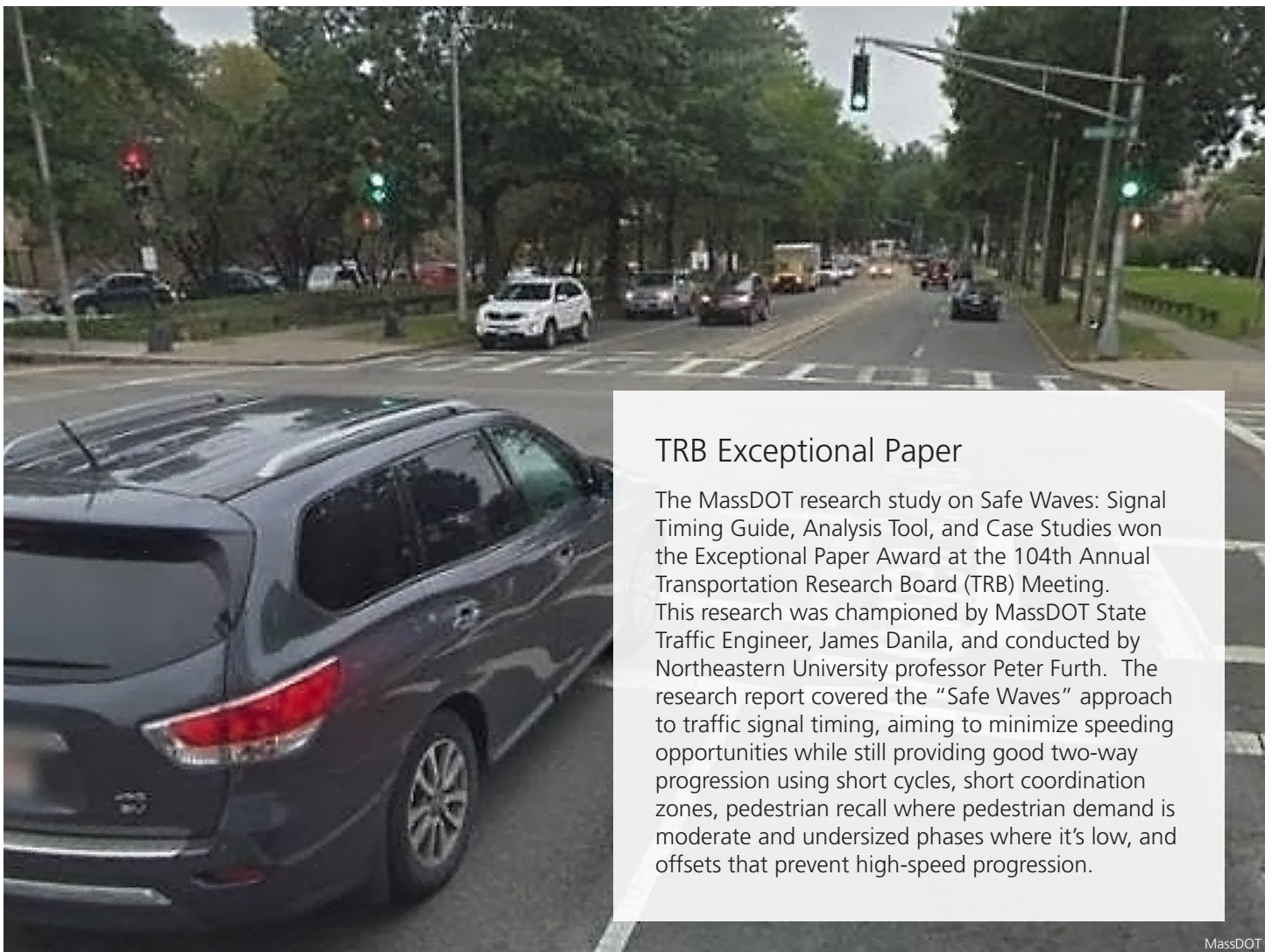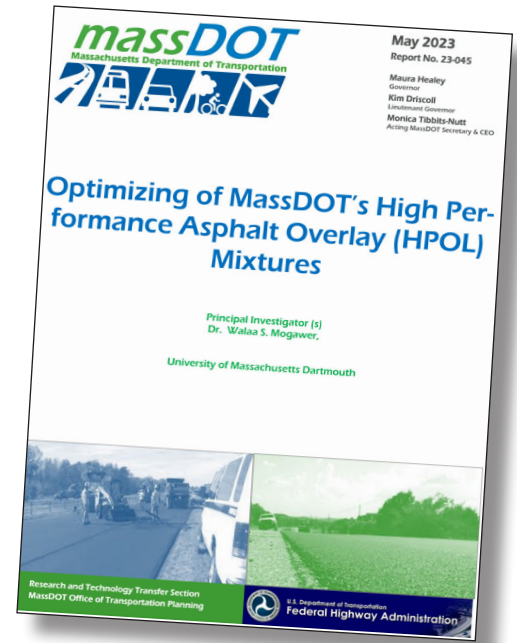*Figure 2: SPRII Funding Distribution*

Research Highlights

AASHTO High-Value Research

Acting on the strategic plan of the AASHTO Special Committee on Research and Innovation (R&I), the AASHTO Research Advisory Committee (RAC) annually asks each of the 50 states to identify and document recently completed "high-value" research (HVR) projects. The RAC Value of Research (VOR) Task Force oversees the submission process and works with the state DOTs and the 4 regions to select the High-Value Research awards--the top 4 from each region, 16 in all (Sweet Sixteen).

Every January, the VOR Task Force Chairs announce the solicitation notice to RAC for HVR projects. The selected projects are then featured in AASHTO events, in the RAC virtual exhibit hall, and are also showcased at a poster session at the Transportation Research Board (TRB) Annual Meeting.

For 2024, there were 22 submissions in Region 1, and a total of 90 submissions nationally. MassDOT Research Program submitted 4 research projects and "Optimizing of MassDOT's High Performance Asphalt Overlay (HPOL) Mixtures" was selected as one of the Sweet Sixteen winners.

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Massachusetts Department of Transportation

May 2023
Report No. 23-045

Maura Healey
Governor

Kim Driscoll
Lieutenant Governor

Monica Tibbits-Nutt
Acting MassDOT Secretary & CEO

Optimizing of MassDOT's High Performance Asphalt Overlay (HPOL) Mixtures

Principal Investigator (s)
Dr. Walaa S. Mogawer,

University of Massachusetts Dartmouth

Research and Technology Transfer Section
MassDOT Office of Transportation Planning

U.S. Department of Transportation
Federal Highway Administration

TRB Exceptional Paper

The MassDOT research study on Safe Waves: Signal Timing Guide, Analysis Tool, and Case Studies won the Exceptional Paper Award at the 104th Annual Transportation Research Board (TRB) Meeting. This research was championed by MassDOT State Traffic Engineer, James Danila, and conducted by Northeastern University professor Peter Furth. The research report covered the "Safe Waves" approach to traffic signal timing, aiming to minimize speeding opportunities while still providing good two-way progression using short cycles, short coordination zones, pedestrian recall where pedestrian demand is moderate and undersized phases where it's low, and offsets that prevent high-speed progression.

MassDOT

Research Projects

In this section, MassDOT-funded research projects are grouped as follows:
• Projects Completed in FFY24
• Projects Initiated in FFY24

As shown in Table 1 and Table 2 below and in the brief project descriptions later in this section, these projects cover a broad range of transportation topics of interest to MassDOT. Each short-term, medium-term, and long-term project is conducted through a separate contractual agreement, while the cooperative research projects are issued as research tasks under a comprehensive Interdepartmental Service Agreement between MassDOT and the University of Massachusetts Amherst.

The budgets and FFY24 spending for active and completed research projects are summarized in a table in an appendix at the back of this report.

Projects Completed in FFY24

Project Title and Duration	Award Amount	Subject Area(s)
1. Implementing the AASHTO Mechanistic-Empirical Pavement Design Guide, Phase III *(Short-Term Project)*	$400,167	*Materials, Construction*
2. Methods to Identify Problematic Carriers and Prevent Infrastructure Damage *(Short-Term Project)*	$126,220	*Safety, Policy & Planning, Freight*
3. Feasibility Study of 3D Printing Applications for Bridge Elements *(Short-Term Project)*	$150,000	*Materials, Maintenance, Construction*
4. Data Driven Approaches for Transit Capital Planning *(Short-Term Project)*	$100,000	*Asset Management, Transit*
5. Using Traffic Signals to Limit Speeding Opportunities on Arterial Roads *(Short-Term Project)*	$140,000	*Safety, Roadway Engineering, Traffic Operations*
6. Artificial Intelligence Framework for Crosswalk Detection Across Massachusetts *(Short-Term Project) (Cooperative Research Program project)*	$99,998	*Asset Management, Active Transportation*
7. Energy-Focused Decision-Making Framework for MBTA Operations and Planning *(Medium-Term Project)*	$124,999	*Policy & Planning, Transit, Sustainability*
8. Accessible Bus Stop Design in the Presence of Bike Lanes *(Medium-Term Project)*	$199,915	*Mobility, Transit Active Transportation*

Project Title and Duration	Award Amount	Subject Area(s)
9. Cross-Modal Impact Assessment for Sustainable Transportation Networks *(Medium-Term Project)*	$99,997	*Policy & Planning, Mobility, Sustainability*
10. Speed Management and Emergency Response—A Synthesis Study	$119,989	*Safety, Roadway Engineering*
11. LIMMS Gap Analysis and Development Plan *(Medium-Term Project)*	$300,000	*Asset Management*
12. Developing a Salt Spreader Control Program Using Machine-Sensed Roadway Weather Parameters *(Medium-Term Project)*	$125,000	*Materials, Maintenance*
13. Smart Work Zone Control and Performance Evaluation Based on Trajectory Data *(Medium-Term Project)*	$150,000	*Safety, Roadway Engineering, Design*
14. Effectiveness of Two-Stage Turn Queue Boxes in Massachusetts: A Comparison with Bike Boxes *(Medium-Term Project)*	$149,778	*Safety, Design, Active Transportation*
15. Revised Load Rating Procedures for Deteriorated Prestressed Concrete Beams *(Medium-Term Project)*	$224,676	*Maintenance, Asset Management*
16. Tree Protection for Street Corridor Development in Massachusetts *(Long-Term Project)*	$89,897	*Policy & Planning, Transit, Sustainability*
17. Development of Improved Inspection Techniques using LiDAR for Deteriorated Steel Beam Ends *(Long-Term Project)*	$199,998	*Maintenance, Asset Management*
18. Ultra-High Performance Concrete Reinforced with Multi-Scale Hybrid Fibers and its Durability-Related Properties *(Long-Term Project)*	$197,402	*Construction, Materials*
19. Evaluation & Mitigation Methods for the Prevention of Cement Concrete Deterioration due to Pyrrhotite Part I *(Short-Term Project). This project was started and completed in FFY24.*	$81,500	*Materials, Construction, Maintenance*

Projects Initiated in FFY24

Project Title and Duration	Award Amount	Subject Area(s)
1. Evaluation & Mitigation Methods for the Prevention of Cement Concrete Deterioration due to Pyrrhotite Part I. *This project was completed in FFY24.*	$81,500	Materials, Construction, Maintenance

Completed
Projects in
FFY24

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Implementing the AASHTO Mechanistic-Empirical Pavement Design Guide, Phase III

MassDOT

Principal Investigator: Dr. Walaa Mogawer, UMass Dartmouth
MassDOT Project Champion: Edmund Naras

❖ Project Overview:

AASHTO's new Mechanistic-Empirical Pavement Design (PMED) method can be a significant improvement in pavement design but the models must be calibrated using local date to accurately predict design performance. This project involves four phases, each building on the last. Phase I included a literature review and assessment of state of the practice, Phase II consisted of the development of an AASHTOWare Pavement M-E User Manual, and local experimental plan and sampling template. This phase, Phase III, involves evaluating the sample size for distress prediction models, and collecting/obtaining the relevant field data that will be needed for the local calibration of the ASSHTO Level 1 PEMD prediction models.

❖ Key Findings:

• Select roadway segments and plant produced mixtures for testing in Phase III, using the local experimental plan and sampling template developed during Phase II. The selected mixtures will represent the spectrum of mixtures produced in Massachusetts.
• Continue laboratory testing of mixtures to obtain data for Level 1 PMED implementation.
• Establish a calibration database in Excel.
• Evaluate the estimated sample size for bias and precision for each of the distress prediction models.

Link to Final Report: https://www.mass.gov/doc/improving-the-long-term-condition-of-pavements-in-massachusetts-and-determining-return-on-investment-implementing-the-aashto-mechanistic-empirical-pavement-design-guide-phase-iii-final-report/download

Link to the Research Cut Sheet: https://www.mass.gov/doc/improving-the-long-term-condition-of-pavements-in-massachusetts-and-determining-return-on-investment-implementing-the-aashto-mechanistic-empirical-pavement-design-guide-phase-iii-research-summary/download

Timeframe: Completed May 2024

2

Methods to Identify Problematic Carriers and Prevent Infrastructure Damage

Principal Investigator: Robin Riessman, UMass Amherst
MassDOT Project Champion: Makaela Niles

❖ Project Overview:

This project aims to establish the current use and availability of datasets, methods of access, and integration nuances related to oversize/overweight trucking operations in Massachusetts, as well as violation types and rates for these vehicles.

❖ Key Findings:

• The data groupings successfully linked multiple datasets, demonstrating that a decoupled analysis approach improves OS-OW vehicle and carrier trend identification.
• The challenges in OS-OW permit processing were noted, including extensive manual steps and a lack of documentation for FMCSA Safety Measurement System verification.
• The stakeholder collaboration was essential for improving data-sharing, enforcement coordination, and infrastructure protection.

Link to Final Report: https://www.mass.gov/doc/methods-to-identify-problematic-carriers-and-prevent-infrastructure-damage-final-report/download

Link to Research Summary: https://www.mass.gov/doc/methods-to-identify-problematic-carriers-and-prevent-infrastructure-damage-research-summary/download

Timeframe: Completed March 2024

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UMass Amherst

Feasibility of 3D Printing Applications for Highway Infrastructure Construction and Maintenance

Principal Investigators: Dr. Simos Gerasimidis and Dr. Wen Chen, UMass Amherst; and Dr. John Hart, Massachusetts Institute of Technology
MassDOT Project Champions: Paul Tykodi and Catherine H. Chen

❖ Project Overview:

A previous MassDOT study explored the feasibility of using AM in the framework of MassDOT and concluded that there AM could play a significant role in improving construction and maintenance of transportation infrastructure. This study builds on that earlier research, exploring more AM innovations and capabilities, and focusing on methods for improving repair techniques of deteriorated transportation infrastructure elements, including deteriorated steel bridge ends, and for using 3D printing technologies to repair them.

❖ Key Findings:

- Additive manufacturing technologies show great potential for future use to repair steel corroded bridge beams. A key finding is the swift and precise deposition possibilities that cold-spray can offer in practice.
- Great results are obtained in compression
- Further research needs to be performed to help improve tensile properties.

Link to Final Report: https://www.mass.gov/doc/feasibility-of-3d-printing-applications-for-highway-infrastructure-construction-and-maintenance-final-report/download

Link to Research Summary: https://www.mass.gov/doc/feasibility-of-3d-printing-applications-for-highway-infrastructure-construction-and-maintenance-summary/download

Timeframe: Completed August 2024

Data-Driven Approach for Transit Capital Planning

4

Principal Investigators: Dr. Eric Gonzales, UMass Amherst, and Price Armstrong, Cambridge Systematics
MBTA Project Champion: Elizabeth McCarthy

❖ Project Overview:

This research aims to develop new approaches and identify best practices for compiling, aggregating, and understanding data that enable better decision-making for transit capital planning. Transparent, repeatable, and uniform processes for data aggregation and analysis will allow MassDOT to make capital planning decisions that are driven by data and consistent with needs and priorities across the Commonwealth. This research will include coordination with the 15 Regional Transit Authorities (RTAs) in Massachusetts.

❖ Key Findings:

Below are a variety of process changes that would make the transit capital planning process more data driven:
• Clear and consistent procedures and timelines
• Establish evaluation criteria or project scoring rubric
• Improve analysis of asset condition and anticipated needs over time
• Consider total investment need for state of good repair
• Use quantitative methods to optimize objectives-- this may be formulated to achieve multiple objectives, including selecting projects to maximize benefits, maximize the rank-order of requests, or ensuring equitable distribution of funds.

These process improvements would be supported by 5 types of changes to the asset management software: documentation and communication; improved data accuracy; and system integrations with existing software tools.

Link to Final Report: https://www.mass.gov/doc/data-driven-approaches-for-transit-capital-planning-final-report/download

Link to Research Summary: https://www.mass.gov/doc/data-driven-approaches-for-transit-capital-planning-research-summary/download

Timeframe: Completed July 2024

UMass Transportation Center

Using Traffic Signals to Limit Speeding Opportunities on Arterial Roads

Principal Investigator: Dr. Peter Furth, Northeastern University
MassDOT Project Champion: James Danila, P.E.

❖ Project Overview:

Preventing speeding on multilane arterials is critical to safety. This project investigates the use of traffic signal timing as a way to reduce speeding on arterials by removing opportunities to drive at high speeds through multiple intersections, while still providing good traffic flow. Preliminary studies suggest that, compared to conventional arterial signal timing, traffic signal timing can reduce "speeding opportunities" - the number of cars arriving at an intersection on a stale green and with no vehicle ahead of them - by up to 50 percent with little to no change in average traffic delay.

❖ Key Findings:

- Conducted field tests to confirm the performance of traffic signal timing in terms of vehicle speeds, speeding opportunities, traffic delays, and stops.
- Developed the web-app Safe Waves Analysis Tool to estimate the number of speeding opportunities that different traffic signal timing plans will produce. This tool will allow traffic engineers to develop and choose timing plans that improve safety without increasing traffic delays.
- Produce a guidebook on timing traffic signals to reduce speeding opportunities.

Link to Research Final Report: https://www.mass.gov/doc/using-traffic-signals-to-reduce-speeding-and-speeding-opportunities-on-arterial-roads-final-report-0/download

Link to Research Summary: https://www.mass.gov/doc/using-traffic-signals-to-reduce-speeding-and-speeding-opportunities-on-arterial-roads-research-summary/download

Timeframe: Completed February 2024

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Artificial Intelligence Framework for Crosswalk Detection Across Massachusetts

Principal Investigators: Dr. Jimi Oke and Dr. Chengbo Ai, UMass Amherst; and
Dr. Yuanchang Xie, UMass Lowell
MassDOT Project Champion: Bonnie Polin

❖ Project Overview:

Knowing the locations of crosswalks is important for prioritizing systematic measures to enhance pedestrian safety. MassDOT had previously developed risk models for pedestrian safety but did not have a complete list of crosswalk locations. This project provided such a list through the use of AI (Artificial Intelligence) algorithms that were able to detect crosswalks from satellite images. Compared to manual identification of crosswalks from satellite images or Google Street Views, an AI tool will be more efficient and more adaptable. An AI tool will allow MassDOT to update the crosswalk inventory frequently when new satellite images are available. Given new satellite images, this tool can be used to conduct change detection over time and identify crosswalks that need maintenance.

❖ Key Findings:

• Based on the study's methodology, 88,440 crosswalks were detected in Massachusetts as of 2021, and there were 83,380 crosswalks in the state in 2019.
• Of these crosswalks, 89% were intersection crosswalks and 8% were midblock crosswalks with the remaining 3% at driveways. These percentages were similar for both 2019 and 2021.
• In terms of crosswalk type by marking, zebra crosswalks accounted for 62-64%, standard/parallel lines accounted for 36-38%, and solid/painted crosswalks comprised the remainder (< 1%).

Link to Final Report: https://www.mass.gov/doc/artificial-intelligence-framework-for-crosswalk-detection-across-massachusetts-final-report/download

Link to Research Summary: https://www.mass.gov/doc/artificial-intelligence-framework-for-crosswalk-detection-across-massachusetts-research-summary/download

Timeframe: Completed February 2024

Energy-Focused Decision-Making Framework for MBTA Operations and Planning

Principal Investigators: Dr. Jimi Oke, Dr. Eleni Christofa, and Dr. Eric Gonzales, UMass Amherst
Project Champion: Sean Donaghy, MBTA

❖ Project Overview:

This project aims to develop an enhanced system-wide energy model for MBTA urban rail transit, and a decision support tool to provide system-wide energy and cost predictions for given input operational strategies, to help meet performance targets. This project builds on earlier MBTA/MassDOT research that created a model to accurately predict system-wide electricity consumption.

❖ Key Findings:

• A high-performance energy forecasting model robust to large disruptions.
• Key planning metrics and a sequence generation approach for modeling specified plans.
• Decision-making framework that generates daily energy forecasts on a quarterly horizon based on specified planning strategies.

Link to Final Report: https://www.mass.gov/doc/robust-decision-making-framework-for-sustainable-operations-and-planning-of-mbta-rapid-transit-vehicles-final-report/download

Link to Research Summary: https://www.mass.gov/doc/robust-decision-making-framework-for-sustainable-operations-and-planning-of-mbta-rapid-transit-vehicles-research-summary/download

Timeframe: Completed September 2024

8

Accessible Bus Stop Design in the Presence of Bike Lanes

Principal Investigators: Dr. Eleni Christofa and Dr. Chengbo Ai, UMass Amherst; and
Dr. Peter Furth, Northeastern University
MassDOT Project Champion: Martha Koch

❖ Project Overview:

This project will investigate how to meet accessibility needs and provide a high-quality experience for transit riders at bus stops, while simultaneously providing space for safe bicycling along bus corridors.

❖ Key Findings:

- Full-width platform bus stops are the preferred design for floating bus stops.
- Horizontal curves and fencing do not impact bicyclist speeds.
- Fencing encourages crosswalk use, limits the duration of pedestrians walking along the bike lane, and restricts potential for bicyclists to veer off to the sidewalk; however they do not prevent riders from walking along the bike lane.

Link to Final Report: https://www.mass.gov/doc/accessible-bus-stops-in-the-presence-of-bike-lanes-final-report/download

Link to Research Summary: https://www.mass.gov/doc/effectiveness-of-two-stage-turn-queue-boxes-in-massachusetts-a-comparison-with-bike-boxes-research-summary/download

Timeframe: Completed August 2024

9

Cross-Modal Impact Assessment for Sustainable Transportation Networks

Principal Investigators: Dr. Jessica Boakye and Dr. Egemen Okte, UMass Amherst
MassDOT Project Champion: Martha Koch

❖ Project Overview:

Large investments into the transportation system should be environmentally friendly, equitable, and cost-effective, the three pillars for sustainable development. When investing in a multi-mode transportation system, the following considerations are crucial for defining the sustainability of the system: what's the best way to quantify complex impacts across multiple domains (social, economic, environmental); how can the impact of taking different transportation modes be quantified; and how can policy decisions about mode choice be evaluated through an equity lens. This research examines such questions and then creates metrics and a decision-making framework to promote sustainable transportation networks.

❖ Key Findings:

The case studies showed that transit and bicycling are the most sustainable modes, especially for shorter trips, due to lower agency costs, reduced emissions, and health benefits. While cars offer faster travel, they carry higher social costs, including safety risks and health impacts. A sensitivity analysis revealed that factors like increased transit ridership significantly influence the cost metric. The key takeaways include promoting active transportation and improving transit reliability.

Link to Final Report: https://www.mass.gov/doc/cross-modal-impact-assessment-for-sustainable-transportation-final-report/download

Link to Research Summary: https://www.mass.gov/doc/cross-modal-impact-assessment-of-sustainable-transportation-research-summary/download

Timeframe: Completed September 2024

MassDOT

Speed Management and Emergency Response – A Synthesis Study

Principal Investigators: Dr. Francis Tainter, Dr. Cole Fitzpatrick. and Dr. Michael Knodler Jr., UMass Amherst; and Dr. Peter Furth and Dr. Daniel Dulaski, Northeastern University
MassDOT Project Champions: Jackie DeWolfe and Chris Falco

❖ Project Overview:

Reducing vehicular speeding is essential for meeting state transportation safety goals. There are numerous known and effective strategies for speed management, but so far, they have not been implemented on a large scale in Massachusetts. This project aims to first enhance the understanding of the impact of speed management strategies on vehicular speeds, and the understanding of municipal emergency and public safety personnels' concerns regarding speed management. The project will then develop recommendations of preferred speed management strategies that reduce speeding, follow design standards, and address municipal personnel concerns.

❖ Key Findings:

• Conducted a survey of current speed management techniques, their effectiveness, and municipal implementation challenges.
• Strategized and hosted regional speed management forums to engage with local stakeholders.
• Created an inventory of regional speed management case studies and municipal partnerships.
• Developed recommendations for strategies and roadway treatments to reduce speeding.

Link to Final Report: https://www.mass.gov/doc/speed-management-and-emergency-response-a-synthesis-study-1/download

Timeline: Completed September 2024

LIMMS Gap Analysis and Development Plan

Principal Investigators: Dr. Russ Tessier, Dr. Jeremy Gummeson, and Dr. Chengbo Ai, UMass Amherst
MassDOT Project Champion: Alana Geary

❖ Project Overview:

The Laboratory Information Materials Management System (LIMSS) 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 include a gap analysis looking at the needs of LIMMS users and an investigation into alternative software that can meet or exceed MassDOT's technical and design requirements. The results will be used to help MassDOT select a next generation material management product.

❖ Key Findings:

- The research determined nearly half of DOTs in the US use AASHTOWare products for LIMMS management.
- For MassDOT, it was determined that an internally developed LIMMS based on existing Microsoft database infrastructure would be the best fit.
- A gap analysis report was created based on feedback from MassDOT users, a literature review, information gathered from other DOTs, and an evaluation of alternative material management products.
- The gap analysis report findings resulted in a detailed and accurate scope of work for a sustainable and efficient LIMMS system.
- Support for non-compliance reports, mobile data entry. flexible interfaces, and customized reporting are desirable features for a next-generation LIMMS. The new LIMMS should integrate seamlessly with existing MassDOT software.

Link to Final Report: https://www.mass.gov/doc/limms-development-planning-final-report/download

Link to Research Summary: https://www.mass.gov/doc/limms-development-planning-research-summary/download

Timeline: Completed July 2024

MassDOT

12

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

Principal Investigators: Dr. Chengbo Ai and Dr. Russell Tessier, UMass Amherst
MassDOT Project Champion: Mark Goldstein

❖ Project Overview:

Massachusetts treats more than 15,000 lane miles during winter. It is critical that the distribution of de-icing and anti-icing materials onto roadways is done efficiently and effectively so that transportation agencies can maintain desirable levels of roadway operations and safety while reducing potential environmental impacts of these materials. Key goals include: instrumenting the entire MassDOT winter operation fleet with a sensor-based system (with real-time in-situ weather conditions and regional weather prediction, and managing winter operations using an integrated coordination portal.

❖ Key Findings:

- 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 Final Report: https://www.mass.gov/doc/development-of-a-salt-spreader-controller-program-using-machine-sensed-roadway-weather-parameters-final-report/download

Link to Research Summary: https://www.mass.gov/doc/development-of-a-salt-spreader-controller-program-using-machine-sensed-roadway-weather-parameters-research-summary/download

Timeframe: Completed July 2024

MassDOT

Smart Work Zone Control and Performance Evaluation Based on Trajectory Data

Principal Investigators: Dr. Yuanchang Xie, Dr. Danjue Chen, and Dr. Benyuan Liu, UMass Lowell
MassDOT Project Champion: Carrie McInerney

❖ Project Overview:

This study seeks to reduce work zone crashes and fatalities by analyzing the trajectories of vehicles approaching work zones, identifying safety hazards, and then developing work zone safety strategies. The study used computer vision technologies to extract vehicle trajectory data.

❖ Key Findings:

• Work zone control strategies, such as taper length and transverse rumble strips, have the potential to significantly impact traffic operations and safety.
• The results do not show consistent and statistically significant impacts of transverse rumble strips and taper length on approaching speed and vehicle merges.
• However, both flashing speed limit signs and portable changeable message signs can significantly encourage early merging and reduce approaching speed.
• Additionally, drivers tend to drive slower and merge later at nighttime than in daytime work zones.

Link to Final Report: https://www.mass.gov/doc/smart-work-zone-control-and-performance-evaluation-based-on-trajectory-data-0/download

Timeframe: Completed May 2024

MassDOT

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Effectiveness of Two-Stage Turn Queue Boxes in Massachusetts: A Comparison with Bike Boxes

Principal Investigators: Dr. Eleni Christofa, Dr. Chengbo Ai, and Dr. Francis Tainter, UMass Amherst
MassDOT Project Champion: Andrew Wilkins

❖ Project Overview:

Previous MassDOT research investigated motorist and bicyclist behavior at single-stage bike boxes and assessed the bike boxes' effectiveness in improving safety. This study will assess the effectiveness of two-stage turn queue boxes (TSTQB) and compare the findings with those from the earlier study to develop design and implementation guidelines for the two treatments.

❖ Key Findings:

• TSTQB utilization by left-turning bicyclists is very low (11.9%)
• The presence of bike boxes, bike lanes (protected or conventional), and size of intersection does not significantly affect TSTQB utilization.
• TSTQBs observe significantly higher utilization in the absence of protected left-turn phasing and dedicated left turns lanes and result in significantly lower crosswalk utilization for bicyclists' left turns.
• Recommendations: Ensure future TSTQB implementations comply with the newly published MUTCD guidelines Implement regulatory or guidance TSTQB signs to increase bicyclist awareness of TSTQB presence. Position TSTQBs near corner curbs of intersections to enhance bicyclist comfort. Position TSTQBs near the through moving path of bicyclists to improve utilization. Implement TSTQBs in the absence of dedicated left-turn lanes, and at locations with high crosswalk use for bicyclists' left-turning maneuvers.

Link to Final Report: https://www.mass.gov/doc/effectiveness-of-two-stage-turn-queue-boxes-in-massachusetts-a-comparison-with-bike-boxes-final-report/download

Link to Research Summary: https://www.mass.gov/doc/effectiveness-of-two-stage-turn-queue-boxes-in-massachusetts-a-comparison-with-bike-boxes-research-summary/download

Timeframe: Completed August 2024.

UMass Amherst

Revised Load Rating Procedures for Deteriorated Prestressed Concrete Beams

Principal Investigators: Dr. Sergio Brena, Dr. Simos Gerasimidis, Dr. Scott Civjan, and
Dr. Jessica Boakye, UMass Amherst
MassDOT Project Champion: Matthew Weidele

❖ Project Overview:

MassDOT has a substantial inventory of deteriorating precast, prestressed concrete structures. This project will develop an approach to realistically and reliably determine a safe working capacity for precast, prestressed concrete bridges that exhibit deterioration to avoid unnecessary bridge closures while also keeping the public safe. This project is being carried out through a combination of computer model simulations and full-scale laboratory testing of actual deteriorated beams. The findings from this study will be used to propose updates to the MassDOT Bridge Manual's load rating procedures.

❖ Key Findings:

• A study of the distribution of deteriorated precast, prestressed concrete bridges in Massachusetts through the NBI database did not reveal parameters that influenced concentration of deteriorated bridges with respect to geographic location, feature crossed, traffic volume, or MassDOT District.
• The majority of corrosion-deteriorated bridges were built in the 1980s. A higher percentage of precast, prestressed adjacent box beams and deck slabs experienced deterioration compared with precast, prestressed beam bridges.
• Physical testing of precast, prestressed box beams resulted in lower load than calculated based on an estimate of strand reduction using current MassDOT Bridge Manual procedures.
• Prestressing strands located above unsound concrete that spalled during testing were determined to have significant corrosion, which led to the lower capacities measured in laboratory testing.

Link to the Research Final Report: https://www.mass.gov/doc/revised-load-rating-procedures-for-deteriorated-prestressed-concrete-beams-final-report/download

Link to Research Summary: https://www.mass.gov/doc/revised-load-rating-procedures-for-deteriorated-prestressed-concrete-beams-research-summary/download

Timeframe: Completed in November 2023

Tree Protection for Street Corridor Development in Massachusetts

Principal Investigator: Dr. Brian Kane and Delia Mahoney, UMass Amherst
MassDOT Project Champions: George Batchelor and Andrew Schlenker

❖ Project Overview:

This research project focuses on the preservation of large trees in high-density areas during infrastructure projects. Trees contribute to the quality of life in communities, as do infrastructure improvement projects to promote walking and cycling. However, infrastructure projects that do not adequately accommodate trees' natural needs can harm trees' health and their value to communities. Preventing harm to trees before and during construction, and restoring habitat conditions as needed post-construction, can be beneficial both to trees and communities.

❖ Key Findings:

• Completed the focus group and expert panel, as well as a national survey.
• Considerations of the PDDG Technical Memoranda include:
    - Thoughtful design and planning – accommodate grade changes and consider design alternatives (e.g. sidewalk bridging, structural soil).
    - Tree Protection Zone (TPZ) – protect critical root zone protect critical root zone (CRZ), and
    - Armor trunks and pruning branches.
• Tree physiology and root structure; roots are vital for tree health and structure.
• Benefits of trees increase exponentially overtime, and as canopy cover increases.
• Education and communication are key factors for preserving and protecting trees.

Link to Final Report: https://www.mass.gov/doc/tree-protection-for-street-corridor-development-in-massachusetts/download

Timeframe: Completed June 2024

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Pixabay.com

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Development of Improved Inspection Techniques Using LiDAR for Deteriorated Steel Beam Ends

Principal Investigators: Dr. Simos Gerasimidis, Dr. Chengbo Ai, and Dr. Sergio Breña, UMass Amherst
MassDOT Project Champion: Jean Markowski
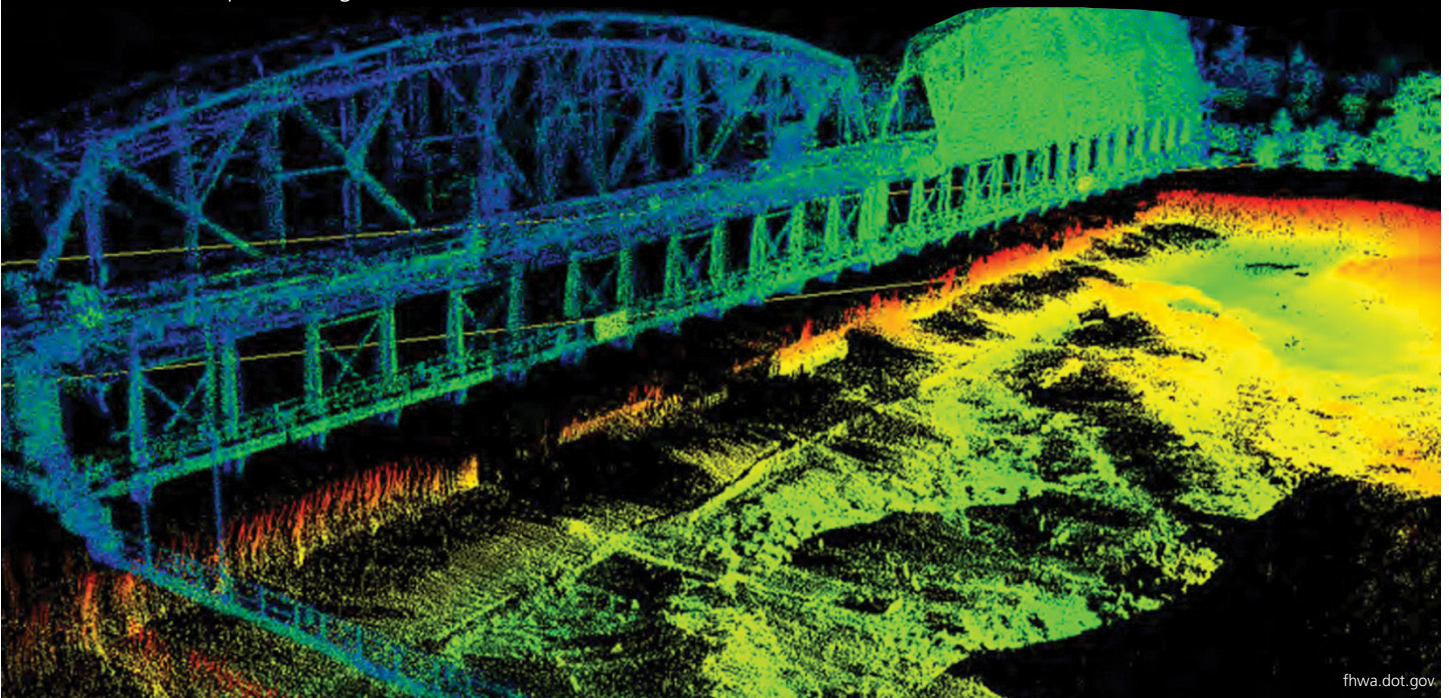
❖ Project Overview:

There is an emerging need for MassDOT to leverage the strength of LiDAR point cloud data and incorporate such a promising technology into their bridge inspection practices if it is deemed feasible.

❖ Key Findings:

- Early phases of this project included conducting a rigorous review of the current methods using 3D scanning techniques for bridge inspection, and laboratory and field scans on corroded beam ends.
- After this, the project focused on developing and validating a semiautomated point cloud data/scanning extraction method.
- A main deliverable for this project was development of a comprehensive and implementable protocol for enhancing bridge inspection with 3D scanning.
- Based on the research results, updates to the MassDOT Bridge Design Manual have been proposed for estimating the remaining capacity of steel beams.

Link to Final Report: https://www.mass.gov/doc/development-of-improved-inspection-techniques-using-lidar-for-deteriorated-steel-beam-ends-0/download

Timeframe: Completed August 2024

fhwa.dot.gov

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Ultra-High Performance Concrete Reinforced with Multi-Scale Hybrid Fibers and its Durability-Related Properties

Principal Investigators: Dr. Jianqiang Wei, UMass Lowell, and Dr. Sergio Breña, UMass Amherst
MassDOT Project Champion: Richard Mulcahy

❖ Project Overview:

Ultra-high-performance concrete (UHPC) is a cementitious composite material composed of an optimized gradation of granular constituents, a low water-to-cementitious materials ratio, and a high percentage of discontinuous internal fiber reinforcement. Due to its excellent mechanical properties, ease of placement, and volume stability, UHPC is often used in transportation infrastructures including roads, underground structures, and bridges. The goal of this study is to develop a novel UHPC reinforced with Multi-Scale Hybrid Fibers (MSHF) and nano-scale additives with enhancements in both early-age properties and long-term performance such as high early-age strength, low volume change, low permeability, and extended service life in the presence of environmental stresses in Massachusetts. The project will also develop a comprehensive understanding of the roles of MSHF, additives, and cement chemistry in improving durability-related properties of UHPC.

❖ Key Findings:

- Seven mix design formulations of UHPC were developed, which reached a 3-day compressive strength of over 20,000 psi, a 28-day flexural strength of over 4,500 psi, a significant decrease in autogenous shrinkage, improved sulfate resistance, and permeability in the "very-low" range.
- Micro-steel fiber yields superior performance to other investigated non-metallic fibers.
- The UHPC connections can provide adequate transfer of forces between the structural components.

Link to Final Report: https://www.mass.gov/doc/ultra-high-performance-concrete-reinforced-with-multi-scale-hybrid-fibers-and-its-durability-related-properties-final-report/download

Link to Research Summary: https://www.mass.gov/doc/ultra-high-performance-concrete-reinforced-with-multi-scale-hybrid-fibers-and-its-durability-related-properties-research-summary/download

Timeline: Completed December 2023

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Evaluation & Mitigation Methods for the Prevention of Cement Concrete Deterioration due to Pyrrhotite Part I

Principal Investigators: Dr. Kay Wille, Dr. Maria Chrysochoou, and James Mahoney, University of Connecticut
MassDOT Project Champions: Richard Mulcahy and Jason Robertson

❖ Project Overview:

Aggregates containing reactive iron-sulfide minerals, such as pyrrhotite, incorporated into Portland cement concrete cause premature deterioration of the concrete. This process can start subtly in the form of interior hairline cracks and may take between 10 to 30 years. There is a need to establish a testing program which can accelerate the deterioration under controlled conditions in the laboratory. This will allow to perform and evaluate potential mitigation methods.
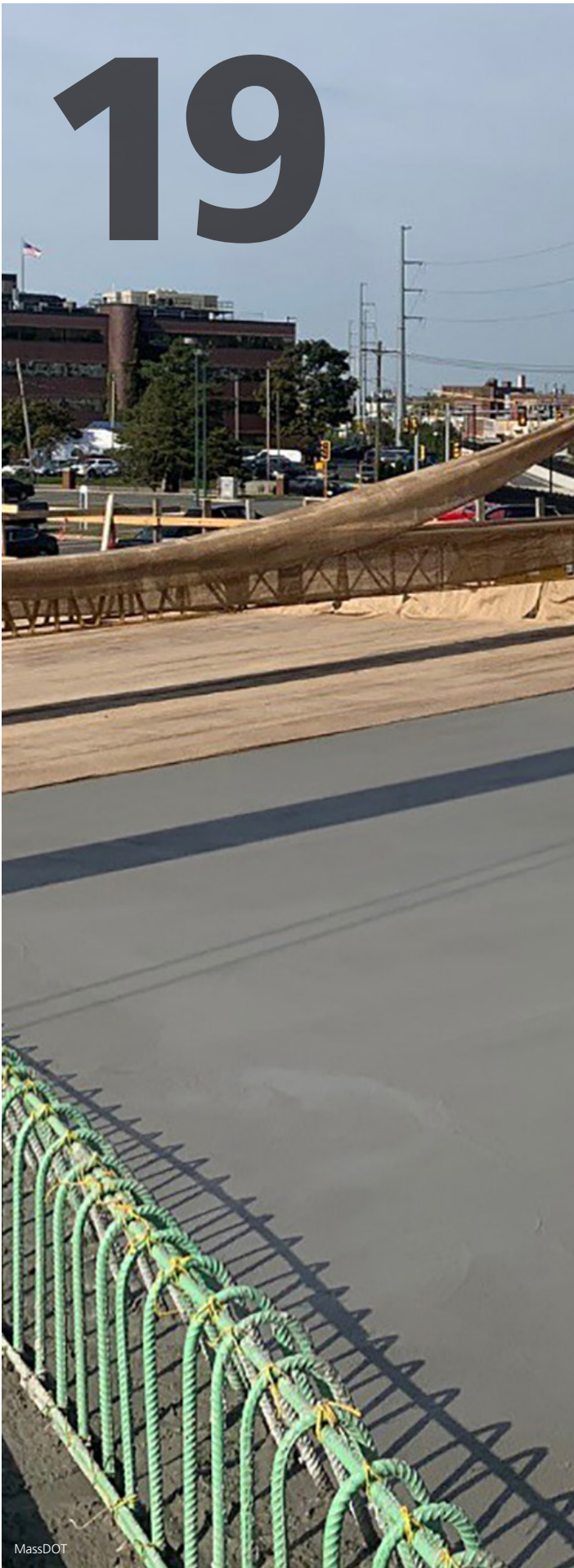
❖ Key Findings:

• Preliminary laboratory tests confirmed that electrochemical accelerated testing (EAT) on pyrrhotite-induce concrete samples effectively replicated deterioration patterns observed in the field, such as discoloration, pop-outs, and map cracking. These findings demonstrate the effectiveness of Electrochemical Accelerated Testing (EAT) in expediting and analyzing pyrrhotite-induced concrete deterioration, providing a reliable tool for early damage detection and risk assessment.
• Concrete with a lower water-cement ratio (0.4) exhibited greater resistance to deterioration, compared to specimens with a higher ratio (0.6).
• The project's results underscore the need for refining testing methodologies to deepen the understanding of deterioration mechanisms and assess viable mitigation strategies.

Link to Final Report: https://www.mass.gov/doc/evaluation-mitigation-methods-for-the-prevention-of-cement-concrete-deterioration-due-to-pyrrhotite-final-report/download

Link to Research Summary: https://www.mass.gov/doc/evaluation-mitigation-methods-for-the-prevention-of-cement-concrete-deterioration-due-to-pyrrhotite-part-1-research-summary/download

Timeline: Completed September 2024

MassDOT

Research Impacts and Outcomes

Using Research Findings at MassDOT (Project Champion Survey Results)

Recommendations will hopefully guide future project planning and design. Results have been presented at the MassDOT Moving Together Conference, 2024, the TRB Annual Meeting in 2025, and will be presented in the upcoming MassDOT Innovation webinar series and at the MassDOT Transportation Innovation Conference, 2025. MassDOT is committed to tracking the implementation and impacts of research. To help with this goal, the MassDOT Research Section and UMTC staff sent a Project Completion Survey to the MassDOT Project Champions (PCs) and Principal Investigators (PI), and Project Managers (PM) for research projects completed during FFY24.

These surveys collect important information on how research study findings are implemented by MassDOT and help to inform revisions of agency procedures and policies to improve efficiency and existing practices, guidelines and standards. The survey results also show how these research findings are disseminated through journal publications, conferences, etc... aiding knowledge transfer and future workforce development by sharing the state of research and results. In FFY24, many of the MassDOT research projects were featured in the Innovation Webinar Series. There were also a number of projects published in peer-reviewed journals. An example of MassDOT research presented on the national stage was at the 17th IFAC Symposium on Control in Transportation (July 2024, Cyprus) and the research report was Assessing the Impacts of Merge and Speed Control Strategies on Highway Work Zone Safety and Operations Using Artificial Intelligence and Advanced Sensors.

A few examples of MassDOT research reports being published include the influence of bike boxes on motorist and bicyclists' behavior: the Bicyclist and Motorist Behavior at Bike Boxes, Eleni Christofa, Chengbo Ai, and Efthymia Kostopoulou, Transportation Research Record: Journal of the Transportation Research Board, Volume 2678, Issue 3, pp 235-251, 2024-03 https://doi.org/10.1177/03611981231179473

Another example addresses the energy consumption of the MBTA: Line-Specific Energy Modeling Framework for Urban Rail Transit Systems: A Case Study of Boston, Zhuo Han, Eric Gonzales, Eleni Christofa, and Jimi Oke, Transportation Research Record: Journal of the Transportation Research Board, Volume 2678, Issue 1, pp 150-164, 2024-01, https://doi.org/10.1177/03611981231170181

Survey responses from MassDOT Project Champions (PCs) demonstrate a range of potential implementation efforts. In the most successful cases, research findings and results are being evaluated and potentially be incorporated into current procedures, or have already been, incorporated into the agency's Standard Operating Procedures (SOPs) and technical specifications, and/or have facilitated a phased approach to long-term implementation. For example, the Using Traffic Signals to Limit Speeding Opportunities on Arterial Roads research project focused on one corridor (Rt 114 in Danvers) and the results have been implemented based on the designs and software developed during the project. MassDOT is monitoring this corridor with an eye on applying the new software in other corridors.

Another MassDOT research project that incorporated research results into their standards was Artificial Intelligence Framework for Crosswalk Detection Across Massachusetts. The research data collected on each crosswalk has been very helpful and practical as this data is being used on a regular basis by departments and incorporated into road file layers. In the Speed Management and Emergency Response research report, MassDOT has taken the cut-sheets and case studies developed during this project and included them on their Safe Speeds repository page. While this material will likely not translate in a publication per se, the data and marketable materials will be useful in presentations to local municipalities in managing their speed management implementation strategies. One common theme in PC responses to the survey questions on technology transfer and implementation was that the research results had been shared with other MassDOT personnel who may play a crucial role in MassDOT using the findings and implementing recommendations. Another common theme in the PC responses was that further study was needed before implementation. Of the 20 research projects that were active in FFY24, MassDOT is now funding additional phases for two of them.

Disseminating Research Results

All final MassDOT research reports are publicly accessible online along with their compliance with accessibility requirements. MassDOT, Federal Highway (FHWA), and UMTC work together to finalize each report, including making the report Section 508-compliant for accessibility. Once a report is 508-compliant, the report is posted on the MassDOT Research and Technology Transfer webpage alongside the Project Summary cut sheet. Final Reports are also published on the following web pages: the FHWA Research Library (Link: https://highways.dot.gov/research/resources/research-library/federal-highway-administration-research-library); the FHWA Office of Corporate Research, Technology, and Innovation Management (Link: https://highways.dot.gov/research/turner-fairbank-highway-research-center/offices/office-corporate-research-technology-innovation-management); the National Transportation Library (Link: https://ntl.bts.gov/ntl); and the Transportation Research Board Library (Link: https://www.trb.org/InformationServices/TRBLibrary1.aspx) for their records and collection.

Sharing Research Internationally, Nationally, and In-State

During FFY24, MassDOT research projects and findings were shared at international, national, and in-state conference settings. Studies and their key findings were presented at the 2024 Transportation Board Annual Meeting, the 2024 MassDOT Transportation Innovation Conference, and the MassDOT 2023 Moving Together Conference.

2024 TRB Annual Meeting

At the 2024 Transportation Research Board (TRB) Annual Meeting, MassDOT was well represented at lectern and poster sessions. Presented MassDOT-funded research covered a wide range of projects, including but not limited to:

- Timing Traffic signals to Reduce Speeding: New Metrics and Tools,
- Identification of Risk Factors for Severe Younger and Older Driver Crashes in Massachusetts,
- Bicyclist Behavior in the Presence of Two-Stage Turn Queue Boxes,
- State of Practice for Pavement Management Systems Currently Being Used in Massachusetts,
- Determining a Relationship between Real Section Loss and Surface Delamination of Corroded Beam Ends,
- Construction and Materials Best Practices for Concrete Sidewalks,
- Massachusetts Route 3, A SHRP2 Product R26 Case Study in Preservation Approaches for High Traffic Volume Roadways along with High-Speed Shoulder Preservation Treatments, and
- Energy Forecasting and Scenario Planning for Sustainable Decision-Making in Urban Rail Transit Systems.

At TRB, MassDOT staff also:
- Presided over workshops on Shaping the Future: ChatGPT and Other Artificial Intelligence Technologies in the Transportation Industry, and on Designing and Role Playing a Planning Process for More Equitable Decision Making.
- Presented in lectern sessions on: the Evolving Role of Transportation Agencies; Information Classification at MassDOT: Motivations and Future Directions; Innovative Artificial Intelligence/Machine Learning Strategies in State DOTs; and Embedding Social Science in Transportation Engineering and Planning.

massDOT
Innovation Webinar Series

The Innovation Webinar Series started in 2020 as a way to share information on important innovative transportation initiatives, technologies, and projects with state and national audiences. Starting in FFY22, the Innovation Webinar series has focused primarily on presenting and sharing MassDOT-funded research projects and findings. Ten webinars on different projects were held during FFY24 with the research Principal Investigator(s) from academia and the MassDOT Project Champion or their designee presenting at each:

• Massachusetts Depth to Bedrock Project
• Use of UAS for Surface Transportation Emergency Response
• Construction and Materials Best Practices for Concrete Sidewalks: Long-Term Performance and Hot-Weather and Cold-Weather Placement Effects
• Using Traffic Signals to Reduce Speeding Opportunities
• Artificial Intelligence Framework for Crosswalk Detection across Massachusetts
• Development of a Salt-Spreader Control Program using Machine-Sensed Roadway Weather Parameters
• Data-Driven Approaches for Transit Capital Planning
• Effectiveness of Two-Stage Turn Queue Boxes in Massachusetts: Comparison with Bike Boxes
• Speed Management and Emergency Response – A Synthesis Study
• Development of Improved Inspection Techniques using LiDAR for Deteriorated Steel Beam Ends

These ten webinars combined had a total attendance of 1,462, with 37 percent of attendees being from MassDOT, and 27 percent from the private sector. Attendees also came from USDOT, FHWA, municipalities, regional agencies, academia, and at least 23 other state DOTs.

At the end of each webinar, attendees were invited to provide feedback through a short online survey. The feedback they gave was generally very favorable and included comments such as these:

> *"This webinar did a great job of explaining the multitude of data sources that went into developing the raster images and "model" for depth to bedrock as well as the limitations." (Massachusetts Depth to Bedrock)*

> *"The presenters were very knowledgeable in the subject matter and the topic is very applicable to the construction industry and engineering." (Construction Best Practices for Concrete Sidewalks)*

> *"The info presented is highly relevant to our day-to-day work and will be shared and considered internally in our projects." (Using Traffic Signals to Reduce Speeding Opportunities)*

> *"I'm impressed with the work presented today on crosswalks. It was reassuring to see research used for pedestrian and motorist safety." (Using AI for Crosswalk Detection)*

> *"This information is helpful, and examples given will be front and center as our community looks at future projects." (Speed Management and Emergency Response)*

> *"Excellent presentation on a very interesting and useful technology." (Development of Improved Bridge Inspection Techniques using LiDAR)*

The webinar recordings are publicly available through the UMTC's Innovation Webinar Series web page (Link: https://www.umasstransportationcenter.org/umtc/MassDOT-Innovation-Series.asp)

MassDOT RD&T Quarterly Newsletter

MassDOT RD&T publishes a quarterly newsletter highlighting ongoing and completed research projects as well as other research related news.

Technology Transfer and Training Services

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The MassDOT Research Development and Technology Transfer (RD&T) Section delivers training activities through both the Massachusetts Local Technical Assistance Program (LTAP, branded as Baystate Roads) and MassDOT Training Services (MTS).

The Training Unit delivers training and professional development activities and programs through both the Massachusetts Local Technical Assistance Program (LTAP) (Baystate Roads (BSR)) and MassDOT Training Services (MTS). To help guide our efforts, Baystate Roads Vision and Mission statements were developed this year:

BSR Vision:
To be recognized by the Commonwealth's municipal public works teams as their premier resource and partner in professional development of roadway and transportation infrastructure and technologies by meeting their ever-evolving educational and training needs.

BSR Mission:
To foster a safe, efficient, and environmentally sound surface transportation system for the Commonwealth of Massachusetts by improving the skills and increasing the knowledge of the municipal transportation workforce and decision-makers, through training and technical support and assistance.

The Training (BSR and MTS) team continued to provide a variety of training formats, including in-person workshops, virtual classrooms, online training, blended learning, and webinars. The remote training formats can be defined as:
• Virtual classroom: Live instructor via an online platform (e.g., Zoom). Classes may be condensed or broken into several presentation dates to complete.
• Online: Self-paced modules completed independently online.
• Webinar: A one-hour presentation conducted on a virtual platform (e.g., Zoom)
• Blended learning: A combination of approaches such as completion of online modules followed by a classroom or virtual class.

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Overview

In FFY24, Baystate Roads responded to or facilitated over 166 requests for information. Requests are made via email, phone and the Baystate Roads listserv. As the primary communication method, the Baystate Roads listserv allows quick feedback from administrators, team members and peers. FFY24 listserv posts covered a wide range of topics, including employment postings, grant opportunities, human resources, and contracting questions, material specs and applications, learning opportunities and resources, and job opportunities.

FFY24 welcomed, for the first time in many years, MassDOT attendees to a handful of selected BSR workshop topics, embracing a new layer of networking and insight at those classes. In total, 24 MassDOT employees participated in one or more of the 11 BSR classes delivered, 7 of which were MassDOT initiatives. Those classes covered the following 5 topics: Confined Space Hazard Awareness Training, Drainage Roadway Maintenance & Reconstruction, Stormwater Retrofits for Meeting MS4 Treatment Requirements, *MaPIT 5.0, and *Rivers & Roads Tier 2A & 2B Workshop. (*indicates MassDOT Initiative topic).

Lessons Learned

Since the pandemic began, many of our processes and methods had to suddenly shift to accommodate virtual training. Over time, some of those changes proved to be valuable and continued to be utilized. Others did not work quite so well. With more time being spent at in-person workshops, and the need for connection and hands-on learning, blended learning became too time intensive to manage and deliver. Those topics will return to an in-person format for FFY25.

While "Stump the Instructor" webinars quickly became an extremely popular and much needed source of information and connection during the pandemic, they now hold a more judicious spot in the schedule. When quick delivery of a hot topic to a wide audience is needed, Stump the Instructor will fill that need going forward.

A handful of virtual classes have stood the test of longevity and necessity. Those topics remain virtual to capture as wide an audience as possible due to their high demand or the infrequency in which they are offered. One such topic is Flagger/First Aid Certification. The demand is constant and high, and with the American Red Cross controlling the small class capacity, it is imperative that anyone from any part of the state who wishes to get certified has access to any class that is offered.

The backbone of our technology transfer and training efforts is via in-person training. The significance of being face to face with participants and instructors cannot be measured with data. It is measured in the depth of one-on-one conversations, the light water cooler chatter during breaks, the shared conversations held about each other's workplaces, history, colleagues, other trainings, and so much more. Building a level of comfort and trust among participants and instructors is the foundation of a more conducive learning environment.

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Baystate Roads

The Massachusetts Local Technical Assistance Program (LTAP) provides training and technical resources to the 351 municipalities across the Commonwealth. Through the development and implementation of annual and quarterly training plans, classes are offered to municipal personnel and contractors based on local needs and MassDOT priorities. Statewide training and specific training for individual municipal groups is provided by a technical training specialist and a variety of additional professional instructors.

FFY24 was an exceedingly productive year. Figure 3 illustrates the outcome of a full year of training. While a whopping 96% of the approved plan was scheduled, an even more impressive 91% of the approved plan was fulfilled and delivered, losing just five classes to cancelations due to weather, the instructor or too low registration counts. The number of classes delivered from FFY23 to FFY24 increased by 448%.
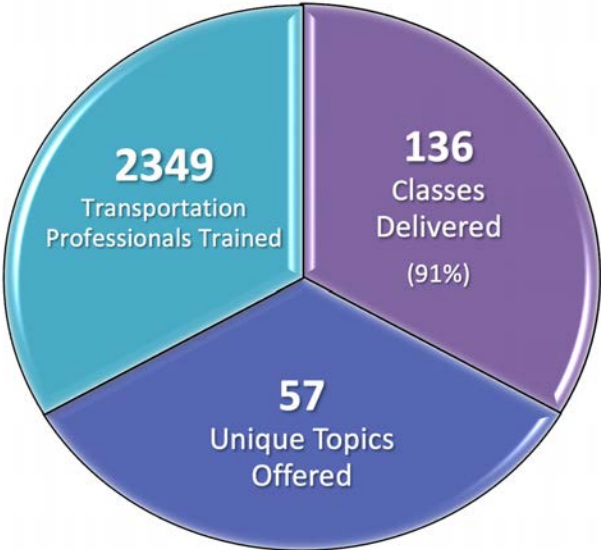
Figure 3: FFY24 Training by the numbers

The average number of participants of a Face-to-Face (F2F) class jumped from 12.6 participants in FFY22, and 17.5 in FFY23, to 18.4 in FFY24, a 46% increase from FFY22 and 5% increase from FFY23.

	FFY22	FFY23	FFY24
Blended	30	20	39
Online	95	45	82
Virtual	1603	680	609
F2F	542	1631	1619
Total	2270	2376	2349

Table 3: Number of participants by training format, FFY22 to FFY24

Continued participation in National Local Technical Assistance Program Association (NLTAPA) and industry training events allow sharing of products, services, processes, and new instructor identification. NLTAPA events attended during FFY24 included the in-person regional meeting in Storrs, CT and annual conference in Albuquerque, NM. The NLTAPA's advantageous partnership with the American Association of State Highway and Transportation Officials (AASHTO) and the National Highway Institute (NHI) increased the number of their available free web-based trainings to NLTAPA (LTAP) centers, enabling BSR to offer requested topics at no cost that are not provided in person. In Table 3, the increased participation of the Online training from FFY23 is due in large part to the expansion of the NLTAPA/AASHTO/NHI partnership.

Of the fifty-seven unique topics on the FFY24 plan, nine were new to the training schedule, which is an increase of 1% from FFY23. 100% of the new topics were delivered via F2F, OnDemand/Online or virtual training formats. This is up 33% from FFY23 and 28% from FFY22.

These new topics include:

| AASHTO TC3 Math Basics for Construction Inspectors |
| AASHTO TC3 Math Basics for Maintenance Technicians |
| AASHTO TC3 Math Basics for Materials Technicians |
| AASHTO TC3 Math Basics Series: Introductory Math Concepts |
| FHWA-NHI-133126A National Traffic Incident Management Responder Training |
| ADA Municipal Transition Plan Development & Tracking |
| Creating Accessible Communities |
| Truck Maintenance Essentials |
| MUTCD Update - What You Need to Know |

Figure 4: F2F Creating Accessible Communities

Class evaluation comment from Creating Accessible Communities:
"[The instructor] did a nice job presenting the information with great real-world details. Overall, the training was very helpful."

Class evaluation comment from Truck Maintenance Essentials:
"The class instructor [was] very knowledgeable, and I love this opportunity."

"Very hands on, great learning experience!"

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Figure 5: Truck Maintenance Essentials class

The topics that had the most sessions (excluding MassDOT Initiative classes) and reached the most people are listed in Table 4.

Table 4: Top topics delivered by number of attendees

Topic	# of sessions	# of attendees
Flagger/First Aid Certification	12	133
Snow & Ice Operations (Frontline Workers and Supervisors)	5	124
Work Zone Safety	5	102

Woodchipper Operations & Safety (F2F) ratio of attendance rate to registration rate holds the FFY record at 98%. Work Zone Safety was a close runner-up with 94%.

Illicit Discharge Detection & Elimination (IDDE) Training for MS4 Permitting (Virtual) had just one session and claims the highest number of attendees at 121.

Table 5 lists the MassDOT Initiatives workshops in FFY24. These initiatives accounted for fifteen of the 136 classes delivered. Rivers & Roads Tier 2A & 2B was presented for the first time since before the pandemic began and was very well received. Overall, this topic produced an 85% turn-out rate (number of registrants attended). It also had the highest average attendance per class among the initiatives at 27.

Table 5: MassDOT Initiatives courses and attendance, FFY24

Topic	# of sessions	# of attendees
Rivers and Roads Tier 2A&2B Workshop	3	80
MaPIT 5.0	7	124
Complete Streets 201, 301, 304, 306	5	111

Class evaluation comments for Rivers & Roads:

"The flume table was extremely illustrative and was really fun and cool to see how rivers function in real life."

"This training was invaluable. I feel all community planners and state regulators should take this!"

While this endeavor was successful in attracting several new communities to BSR trainings, a handful of regularly participating communities were absent from FFY24 workshops. FFY23 seems to be an anomaly as FFY22 also counted 219 participating municipalities. See Figure 6.
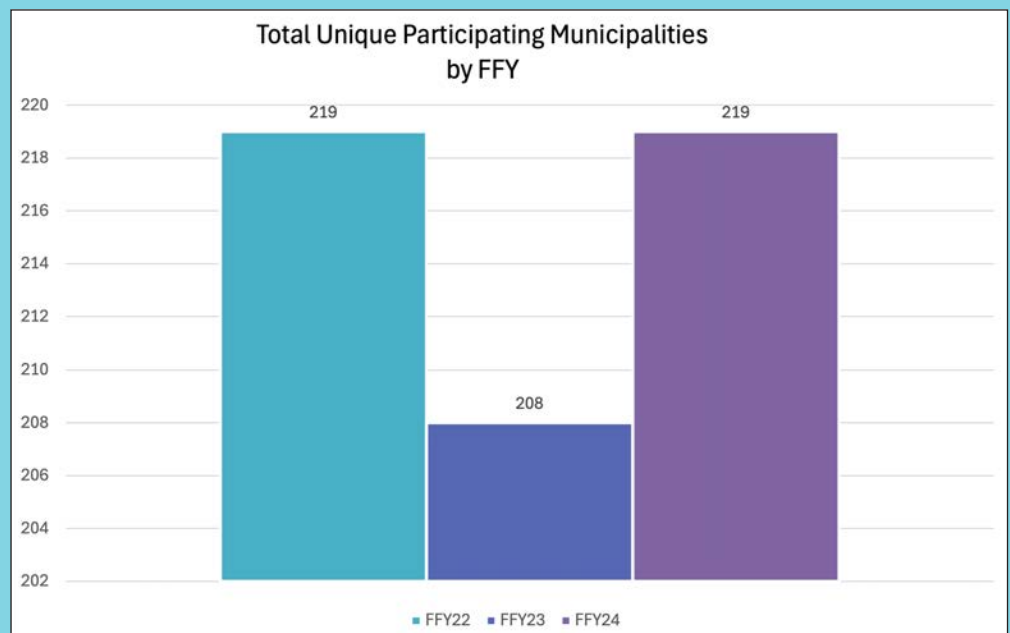

Figure 6: Number of participating communities, FFY22-FFY24

Trends

Safety topics continue to be a top priority for Public Works teams. Of the 136 classes delivered, 60% included safety as a central focus. Furthermore, seven additional safety classes were added to the approved plan midway through the program year to accommodate some of the demand. This prompted a review of which topics are considered evergreen, also known as always in need, and an evaluation of the number of people who need the training. The FFY25 training plan reflects these outcomes, with an increase in the number of safety classes being offered.

To emphasize our understanding of the importance of safety to our audience, a course track, or collection of course topics, called Public Works Principles, was developed in late FFY23. Finally launching in FFY24, its intent is to help identify and lay the foundational knowledge and skills for entry level public works employees in MA. The goal of this program is to provide employers and personnel with a framework of important entry level training and a method to easily track and manage training for new employees.

Figure 7: LTAP number of class topics delivered FFY22-FFY24, by training format

Figure 7 shows that over the course of the last three FFYs, the number of topics delivered virtually declined significantly, a clear indicator of the end of the pandemic and the shift back to F2F trainings. The dip for Self-paced topics in FFY23 is attributed to the SafetySkills Videos contract coming to an end, removing 13 mini video trainings from the self-paced line-up. Eight new online topics were added in FFY24.

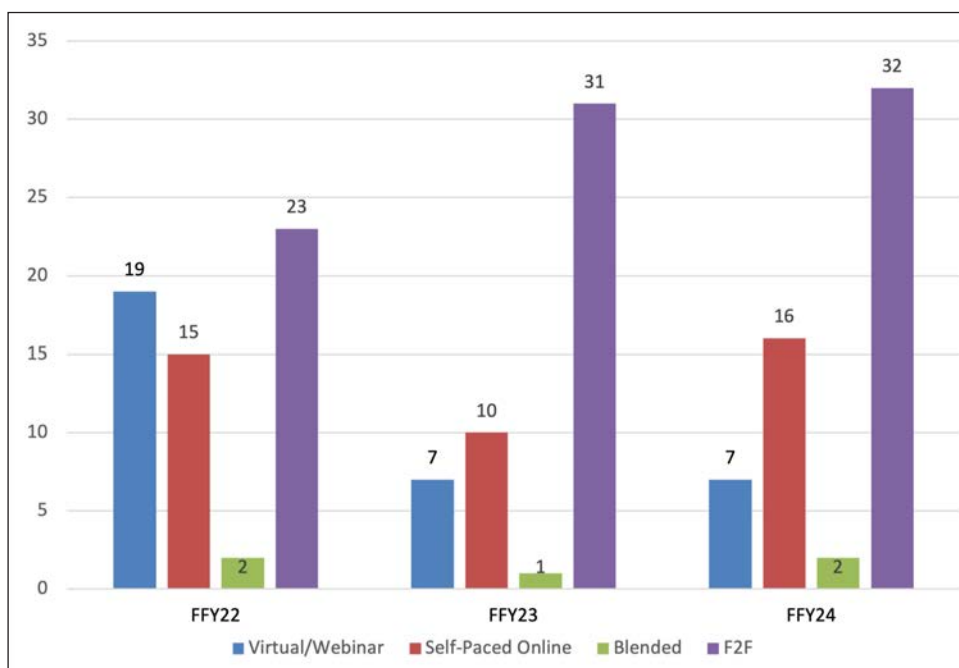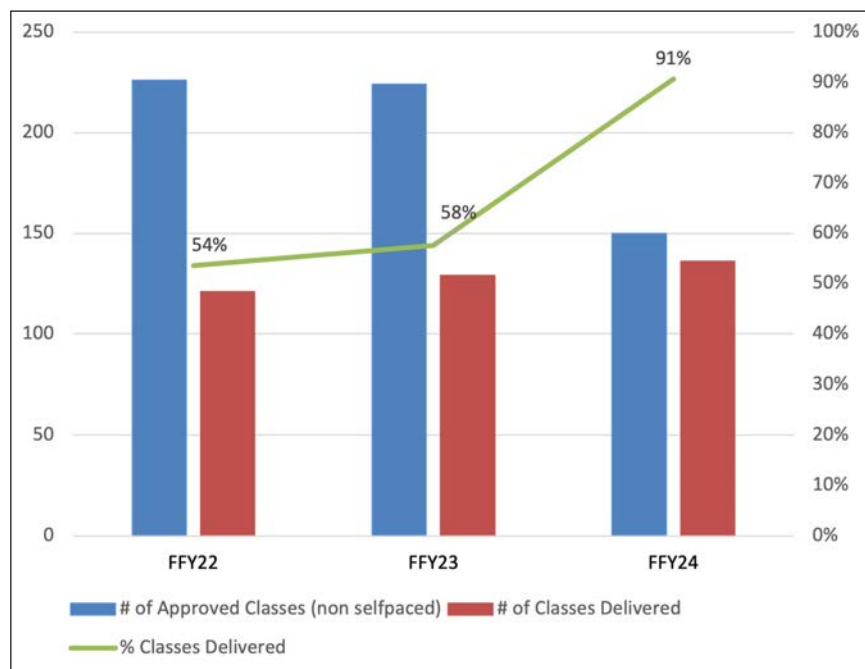*Figure 8: LTAP # of classes approved and delivered FFY22-FFY24*

Figure 8 indicates that the number of classes delivered during the same 3-year time frame was relatively the same. While an 11% difference separates FFY22 from FFY24, the trend shows continued growth. This graph also reveals that the number of approved classes in FFY24 reflects more accurately the number of classes that can be actualized during the year.

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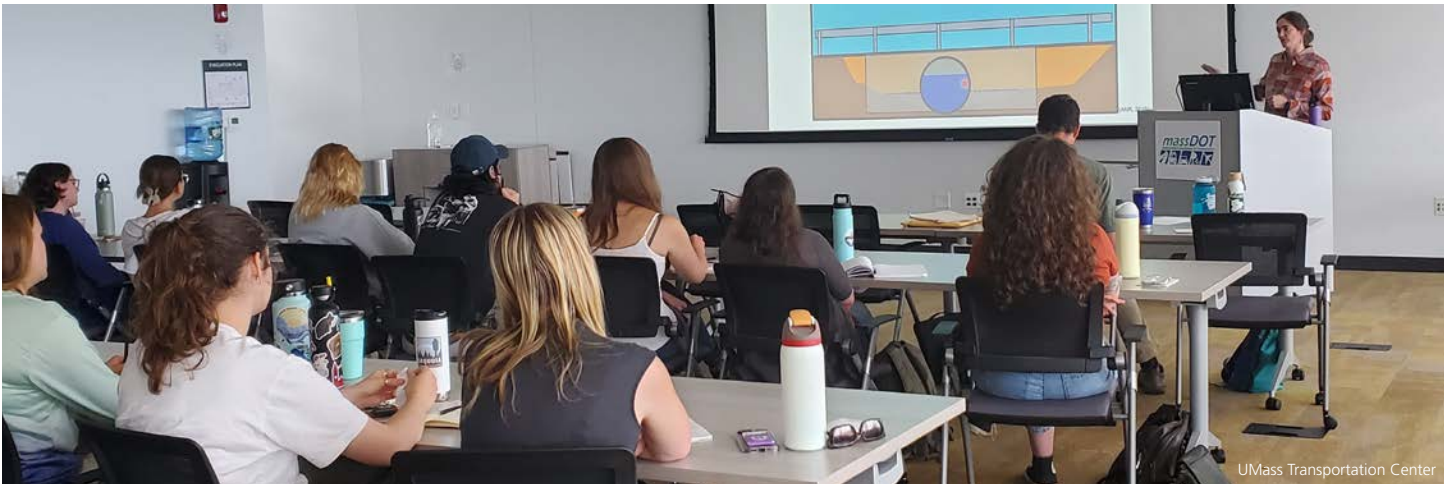
MassDOT Training Services (MTS)

MassDOT Highway Division personnel training needs are addressed by the MassDOT Training Services (MTS). MTS is comprised of two types of training programs.

- Coordinated trainings are those that require UMTC program coordinator efforts to book dates and schedule classes. These efforts are invoiced and paid per class.

- Managed contracts involve administrative oversight of contract management and AP processes for several Special Contracts certification and safety training efforts, scheduled and conducted independently by MassDOT District Coordinators.

Coordinated Training Efforts

MTS returned training to nearly 100% in-person, leaving just one virtual class on the schedule. On the other hand, self-paced online class topics more than tripled from FFY23.

The FFY began with 87 workshops on the coordinated approved plan. As the FFY counted down, two additional coordinated classes were added to the plan and 12 were changed from Annual Safety Refresher to Fall Protection & Ladders.

Added/modified coordinated classes:
- 12 Fall Protection & Ladders
- 1 OSHA 10 for Construction
- 1 Work Zone Safety for Construction Field Personnel

At the end of the FFY, 94 workshops were approved and 93 were delivered, a remarkable 99% of the total approved classes were delivered. Compared with FFY23 this represents a 72% increase over FFY23, and a 25% increase over FFY22. While the actual number of approved classes decreased by more than 79% from FFY23, the delivery rate was 71% higher. See Table 6.

Table 6: Coordinated number of classes, approved and delivered

MTS Coordinated Classes	# of Approved Classes	# of Delivered Classes	% Delivered
FFY22	194	145	75%
FFY23	355	100	28%
FFY24	74	73	99%

The delivered class topics this year focused on worker safety above all else. 10 of the 18 topics presented were safety focused, representing 61% of the total classes conducted. 82% of the total attendees for FFY24 participated in safety classes.

Fall Protection & Ladders (+Slips, Trips, & Lifting Ergonomics) was offered more than any other topic at 22. Of the 838 MassDOT employees registered, 673 attended, or 80%. An average of 31 employees attended each class.

Table 7: Comparisons of coordinated class topics, approved and delivered (does not include self-paced)

Year	# of Approved Topics	# of Delivered Topics	% Delivered
FFY22	55	64	116%
FFY23	55	40	73%
FFY24	26	18	69%

Figure 9: MTS Number of Class Topics Held by Training Format, FFY22-FFY24
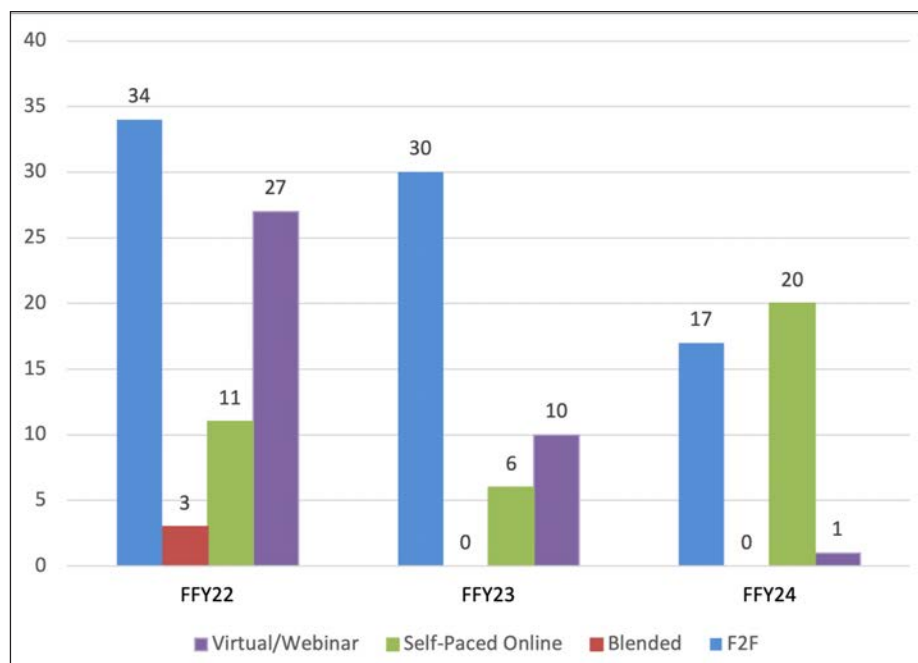
Table 8: Number of class topics held, by training format, FFY22-FFY24

	Virtual/Webinar	Self-Paced Online	Blended	F2F	Totals
FFY22	0	0	3	34	75
FFY23	20	6	11	30	46
FFY24	1	10	27	17	38

MTS Highlights

Table 9 lists the highest attended classes based on the number of classes provided. Four of the six top workshops are safety focused and account for 79% (1,185 of the 1,496) of attendees in these workshops.

Table 9: Top classes by the number of MassDOT employees trained

Topic (F2F)	# of Classes Held	# Employees Trained
ATC Cabinet Training	5	103
Fall Protection and Ladders	22	675
FHWA-NHI Sessions	4	104
Work Zone Safety	11	246
Chainsaw Training	10	148
Trenching and Excavation Safety: Competent Person	6	116

Table 10 shows that combined the in-person and virtual participant counts in FFY24 decreased 1% from FFY23. However, when the self-paced online participants are included, FFY24 class participation is actually up by 6% over FFY23.

Table 10: Participant counts for different class formats, FFY22-FFY24

	Blended	Online	Virtual	F2F	Total
FFY22	82	251	1321	1251	2896
FFY23	0	108	262	1444	1814
FFY24	0	234	13	1676	1923
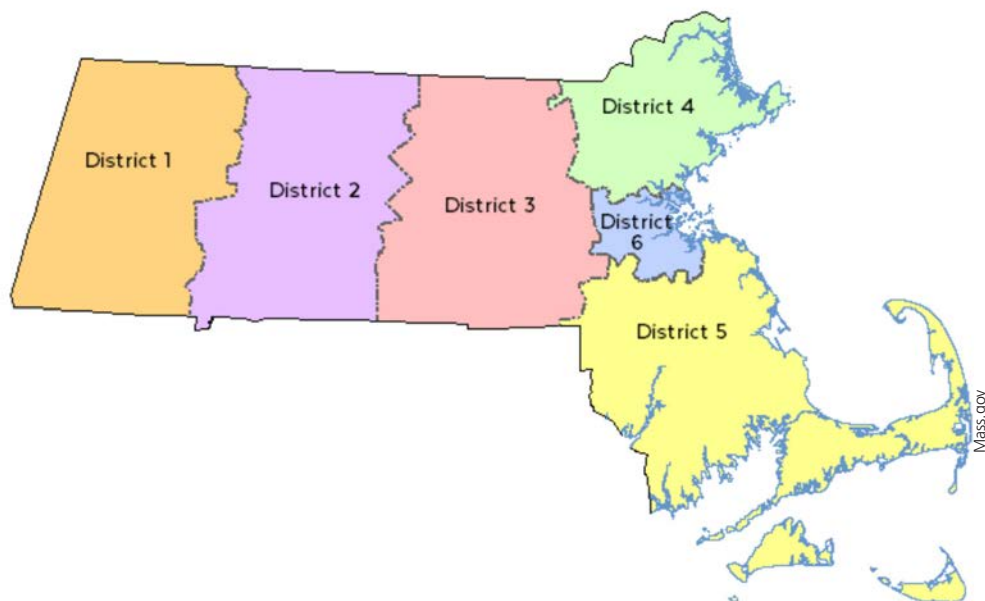
Figure 10: MTS number of trainings scheduled by MassDOT district host
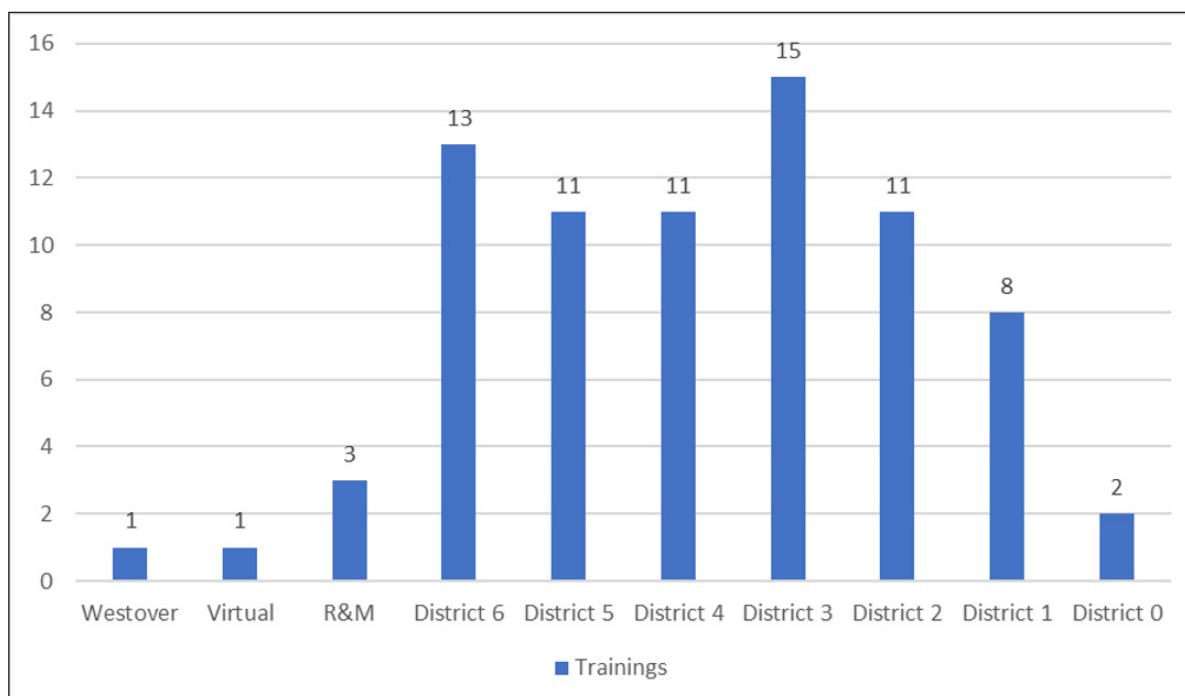
With Figure 10, it's important to note the following:
- District 1 and District 2 hosted one class together
- 1 of Boston Headquarters' classes was canceled, and
- 4 of the workshops held at District 3 Worcester were for all 8 districts (6 districts, Research & Materials, and Boston Head quarters) and one training was primarily for Boston HQ attendees, leaving 10 workshops held specifically for District 3.

Figure 11: MTS Number of completed workshops and attendees by District

In-Person/Virtual Sessions & Attendees by District

District	total sessions	total registrants	total attendees
D1	6	44	38
D2	11	124	91
D3	11	127	88
D4	10	99	71
D5	13	182	104
D6	11	147	108
Statewide	7	159	143
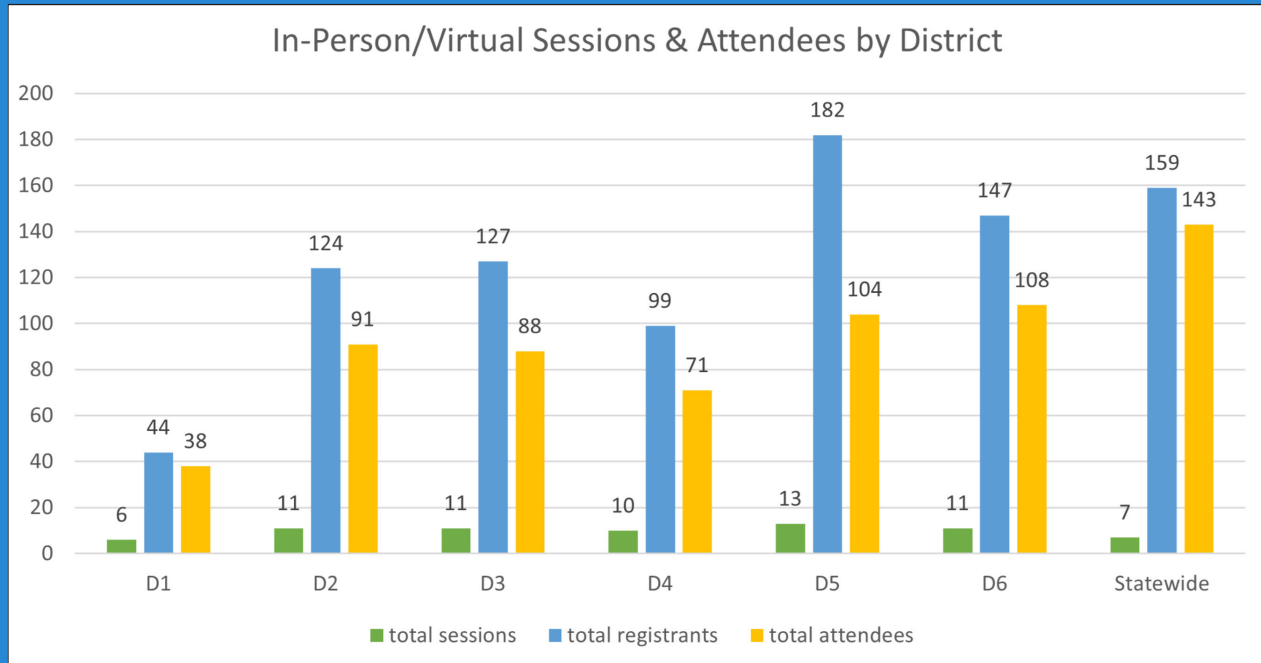
The percentage of registrants who attended training sessions in FFY24 was 82%, which is down 2% from FFY23 and down 3% from FFY22. The average number of attendees per class for FFY24 was 23, 26% higher than FFY23 and 21% higher than FFY22.

Figure 12: Number of MTS self-paced online training registrants by course, FFY24. (The new course offerings for FFY24 are indicated in red).

FFY24 saw a 46% increase from FFY23 in self-paced courses offered.

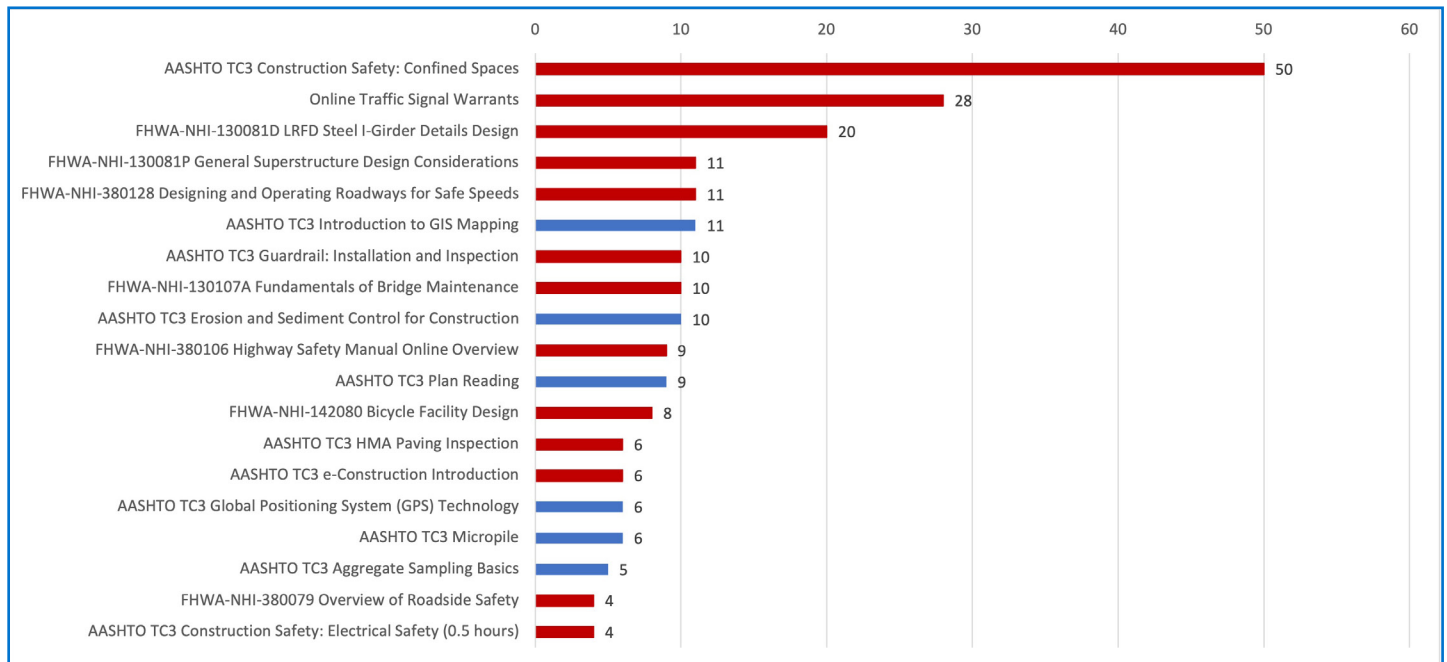| Course	Registrants
AASHTO TC3 Construction Safety: Confined Spaces	50
Online Traffic Signal Warrants	28
FHWA-NHI-130081D LRFD Steel I-Girder Details Design	20
FHWA-NHI-130081P General Superstructure Design Considerations	11
FHWA-NHI-380128 Designing and Operating Roadways for Safe Speeds	11
AASHTO TC3 Introduction to GIS Mapping	11
AASHTO TC3 Guardrail: Installation and Inspection	10
FHWA-NHI-130107A Fundamentals of Bridge Maintenance	10
AASHTO TC3 Erosion and Sediment Control for Construction	10
FHWA-NHI-380106 Highway Safety Manual Online Overview	9
AASHTO TC3 Plan Reading	9
FHWA-NHI-142080 Bicycle Facility Design	8
AASHTO TC3 HMA Paving Inspection	6
AASHTO TC3 e-Construction Introduction	6
AASHTO TC3 Global Positioning System (GPS) Technology	6
AASHTO TC3 Micropile	6
AASHTO TC3 Aggregate Sampling Basics	5
FHWA-NHI-380079 Overview of Roadside Safety	4
AASHTO TC3 Construction Safety: Electrical Safety (0.5 hours)	4

Two NHI Bridge Inspection classes (NHI-130053 and NHI-130078) were hosted so that Bridge Program Managers & Team Leaders could maintain their credentials per the 2022 NBIS Final Rule. Delivering these trainings before FHWA's mandatory completion date of June 6, 2024 was an enormous undertaking and accomplishment.

As a new topic, ATC (Advanced Transportation Controller) Cabinet Training made the list of top classes by the numbers (see Table 9). Comments from the evaluations indicate how well it was received. Today's ATC's technology is likely to remain stable for the next 10 – 15 years; one in-person class was recorded and is now offered as Online/Self-Paced training for new employees and/or refresher for existing employees. Class evaluation comments:

"[The 2 instructors] represent the gold standard of expertise in the subject matter covered in this class. Their presentation styles kept the material interesting and were highly effective."

"Very informative and it was great that they had the "real life" equipment with them to show participants."

"Great training and very informative for even entry level folks. Presenters did a tremendous job explaining the information"

Managed Contracts

FFY24 Managed Contracts began with five contracts that were either a continuation of or were renewed from the previous FFY. Two (2) certifications were added per MassDOT request.
Original five contracts:
- ACI Certifications
- NETTCP
- Amtrak
- Keolis
- Mass Coastal

Added certifications:
- Radiation Safety Officer
- ACI Self-Consolidating Concrete Testing Technician

MassDOT

MassDOT Conferences

In FFY24, MassDOT hosted its two annual transportation conferences, Moving Together and the Transportation Innovation Conference. Both conferences are funded by SPRII through the MassDOT RD&T program.

Both conferences were held in person with a virtual (remote) attendee option. The remote attendee option, started during the Covid-19 pandemic, was continued during FFY24 to promote equity and inclusion by making the conference accessible to people for whom attending in-person would be a challenge for logistical or health reasons. After each conference, the recordings of the keynote and the hybrid (in-person/virtual) presentation sessions, and the slide decks from presentation sessions, were shared initially with conference attendees, and then later were made publicly available.

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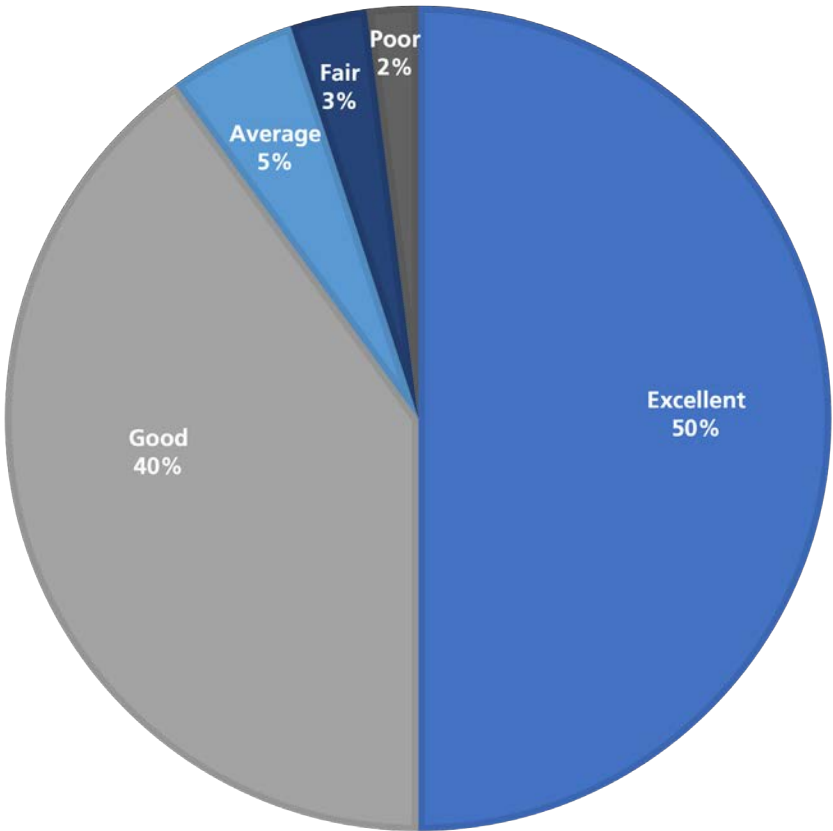
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Moving Together (MT23), October 4, 2023

The 23rd Annual Moving Together Conference was held in Boston, on October 4, 2023. Moving Together highlights current walking, bicycling, public transportation, and related safety, healthy, and accessibility topics and projects.

A total of 1,358 people registered for the conference, and 164 attended virtually. The conference included two site visit sessions to nearby bicycle and pedestrian infrastructure projects, and 59 in-person sponsors/ exhibitors.

The morning keynote speaker was Lieutenant Governor Kim Driscoll. Additionally, as has been the tradition at past Moving Together Conferences, the Massachusetts Secretary of Transportation (acting Secretary at the time), Monica Tibbits-Nutt, provided the main keynote address at lunchtime and then presented the awards for the best entries in the annual Safe Streets Smart Trips High School Video Contest. In the post-conference survey, 90 percent of respondents indicated that their overall conference experience was either "Excellent" (50%) or "Good" (40%).

Overall Conference Experience

Poor 2%
Fair 3%
Average 5%
Good 40%
Excellent 50%

155 attendees responded to the conference evaluation

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# Transportation Innovation Conference (IC24), April 30 and May 1, 2024

The Transportation Innovation Conference took place on April 30-May 1, 2024, at the DCU Center, in Worcester. This Conference provides a forum for sharing knowledge and ideas on innovative transportation initiatives, technologies, and systems.

There were 1,765 people who registered for the conference, and 173 registered to attend virtually. The conference had 30 sessions, a poster session, a hands-on GIS learning lab, and 91 sponsors/exhibitors. In the exhibit hall, there were a few experiential exhibits, including one called "Empathy at the Intersection" with hands-on activities that enabled participants to consider intersection and crosswalk safety from three different road user perspectives.

The conference keynotes included talks by Victoria Sheehan, Executive Director of the Transportation Research Board of the National Academies of Sciences, Engineering, and Medicine, and by Monica Tibbits-Nutt, Secretary and CEO of MassDOT, and a keynote panel discussion moderated by Meghan Haggerty, Chief Operating Officer, MassDOT, on Building the Community Centered DOT with panelists from MassDOT, Connecticut DOT, Washington State DOT, and Slalom. Following the lunchtime keynotes, awards were given out to the winners of the MassDOT's Municipal Innovation Award and of MassDOT's Digital Billboard Design Contest for college students to promote work zone safety.

In the post-conference survey, 75 percent of respondents indicated that they attended both days, and 90 percent said that overall, they had a favorable—either "Good" or "Excellent"—experience at the conference. From the survey comments, it was clear both that many attendees were happy that the conference was offered in-person, and that other attendees were grateful that a limited virtual attendance option was offered as well.

Overall Conference Experience

217 attendees responded to the conference evaluation

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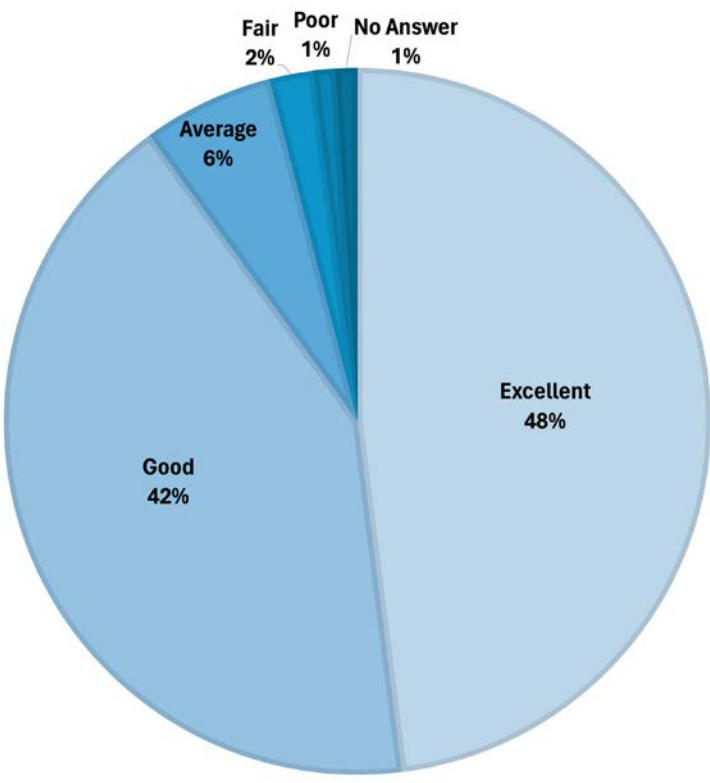
Moving Together and Innovation Registrations by Organization Type

Table 11: Conference registrations by organization type

	MT 23	IC24
Private Sector	34.7%	43.6%
MassDOT/MBTA	35.5%	33.2%
Local /Regional Govt (inc. MPOs)	14.4%	7.9%
Other State DOT	2.3%	2.3%
Regional Transit Agencies	1.1%	2.0%
Other Public	3.5%	3.0%
Non-Profit	3.9%	0.3%
Academia	0.9%	6.5%
HS Students	1.8%	0.0%
Conference Staff (inc. UMTC)	3.0%	1.1%

As indicated in Table 11, for both the 2023 Moving Together Conference (MT23) and 2024 Innovation Conference (IC23), approximately one-third of the conference registrations were for MassDOT or MBTA employees. At Moving Together compared to the Innovation Conference, there was greater representation from local and regional governments (14% compared to 8%). At the Innovation Conference there were higher percentages of participants from the private sector (44%) and academia (7%).

Total funds collected and expenditures made for each event are shown below

4-Oct-23			1-May-24		
Moving Together 2023			**Innovation 2024**		
Revenue			**Revenue**		
Sponsorships	$	95,250	Sponsorships	$	167,900
Attendees	$	83,000	Attendees	$	80,450
	$	178,250		$	248,350
Expenses			**Expenses**		
Non-personnel costs - grant	$	180,946	Non-personnel costs - grant	$	147,427
Non-personnel costs - revenue account	$	133,527	Non-personnel costs - revenue account	$	262,314
Total Non-Personnel Expenses: Grant + Revenue		**$314,473.00**	**Total Non-Personnel Expenses: Grant + Revenue**		**$409,741.13**

National and Regional Research Collaboration

TRB.org

MASSACHUSETTS DEPARTMENT OF TRANSPORTATION

UMass Transportation Center

Transportation Research Board Annual Meeting and TRB Committees

The partnership between the Transportation Research Board (TRB) and the state departments of transportation (DOTs) has been in place since 1920, with states providing direct financial support beginning in the 1940s. This TRB/state partnership promotes the development and implementation of innovations that save lives, improve mobility and access, and increase the cost-effectiveness of materials, designs, construction practices, and operations. Massachusetts's contribution to the Core Program was $160,446 in 2024, which means we leverage approximately $104 for every $1 we invest.

The National Cooperative Highway Research Program (NCHRP) was established in 1962 to administer research of common interest to state DOTs. By pooling their contributions through NCHRP, states leverage their funding, avoid duplication, and benefit from the input of their colleagues across the country. Individual states, AASHTO committees, and the Federal Highway Administration (FHWA) may submit problem statements. The state DOTs then review and vote on the submissions. The AASHTO Special Committee on Research and Innovation, assisted by the AASHTO Research Advisory Committee and based on input from the states, selects the projects and approves the annual program of research. Panels of state DOT staff and other experts oversee individual research projects to ensure that they meet the objectives laid out by the states. Funds are set aside to facilitate implementation of research results. TRB manages this process and administers the research contracts.

State contributions to NCHRP in 2024 totaled $56.3 million. MassDOT's contribution to that total was $860,425, which means we leverage approximately $65 in research-related activity for every $1 we invest in TRB's NCHRP activities.

Massachusetts's DOT participates in NCHRP by:
• Submitting problem statements
• Rating problem statements
• Participating on and chairing NCHRP panels. TRB reimburses state employees for travel and lodging expenses related to participation in panel meetings.

The ongoing availability of thousands of expert volunteers allows TRB to produce several "tangible" benefits for its sponsors. MassDOT's use of these benefits in FFY24 included the following:
• Complimentary registration to the TRB Annual Meeting. MassDOT sent 49 employees to the TRB 2024 Annual Meeting, a value of $68,355 for Massachusetts.
• Complimentary, unlimited participation in TRB Webinars. Approximately 96 MassDOT employees attended 51 different TRB webinars.
• Reduced fees to selected TRB-sponsored convened conferences. This discount is usually about 25% below the general registration fee for more than a dozen conferences TRB conducts each year outside of the Annual Meeting. In FFY24, 51 MassDOT employees attended 3 convened conferences, saving $5,100 in registration fees.

MassDOT staff members participate on several Transportation Research Board (TRB) committees to share knowledge of best practices across many transportation platforms. MassDOT employees also serve on TRB-administered research project technical panels, such as for National Cooperative Highway Research Program (NCHRP) projects. These panels are made up of experienced transportation practitioners and research specialists from across the country, providing technical guidance on transportation research projects selected annually by the American Association State Highway and Transportation Officials (AASHTO) Research & Innovation (R&I) committee. The following two tables summarize the TRB committees (Table 12) and NCHRP project panels (Table 13) on which MassDOT employees currently participate as members. In FFY24, there were 19 MassDOT employees serving on TRB standing committees and 17 serving on NCHRP project panels.

Table 12: TRB standing committees with MassDOT members

Standing Committee on Data for Decision Making
Standing Committee on Economic Development and Land Use
Standing Committee on Landscape and Environmental Design
Standing Committee on Performance Effects of Geometric Design
Standing Committee on Performance Management
Standing Committee on Safety Performance and Analysis
Standing Committee on Seismic Design and Performance of Bridges
Standing Committee on Strategic Management
Standing Committee on Transportation and Public Health
Standing Committee on Transportation Safety Management Systems
Standing Committee on Workforce Development and Organizational Excellence

Table 13: NCHRP project panels with MassDOT representation

Development of Guidance for Non-Standard Roadside Hardware Installations
Roadside Vegetation Management Guidelines for Prevention and Management of Wildfire
Practitioner's Application Guide to the Highway Safety Manual
Sensitivity Evaluation of Balanced Mix Design Performance Tests to Binder Properties and Mix Design Variables
Development of MASH Test Procedures for Motorcycles
Guidelines for Crash Testing Roadside Safety Hardware for Motorcycles
Load Rating and Posting of Long-Span Bridges
Incorporating the Safe System Approach into Road Safety Audits
Practical Approaches to Quantifying Safe System Concepts
Conflict-Based Crash Prediction Method for Intersections
Incorporation of the Human Factors Guide into Transportation Agency Practices
Performance Measures for Community-Centered Transportation Outcomes: A Guide
Research Implementation Barriers and Guidance for Overcoming Barriers
Guide for Effectively Linking Performance Measures, Risk Management, and Process Improvement

The New England Transportation Consortium (NETC)

The New England Transportation Consortium (NETC) is comprised of DOT representatives from the New England states including Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. NETC identifies, funds and manages a cooperative regional cooperative research effort leading to the dissemination of shared transportation research initiatives and findings.

The NETC Advisory Committee includes representatives from the state DOTs, FHWA, and New England state universities. Representatives from the MassDOT RD&T actively participate as members of the NETC Advisory Committee to determine annual financial contributions for regionally significant transportation research projects, and participation on NETC project technical committees and monthly meetings and annual events.

Active NETC research projects in FFY2024 included:
(click on the project titles to access the project descriptions on the NETC web site)
* 19-3 Improved Load Rating Procedures for Deteriorated Unstiffened Steel Beam Ends
* 21-3 Initiating Seed Production for Effective Establishment of Native Plants on Roadsides in New England

newenglandtransportationconsortium.org

New England University Transportation Center (NEUTC)

The New England Regional UTC (NEUTC) is a varied, multidisciplinary consortium committed to addressing the pressing issues of traffic safety:
* Developing Smart Infrastructure and Connected Systems
* Improving Safety for all Modes and Populations
* Promoting Automated Vehicle Safety
* Embedding Community Engagement within Transportation Safety

This consortium includes the University of Massachusetts Amherst, University of Connecticut, Massachusetts Institute of Technology (MIT), Bunker Hill Community College, Holyoke Community College, University of New Hampshire, University of Maine, and Norwich University. In addition to the funding support from the USDOT, MassDOT RD&T provides matching funds using SPRII funding.

The USDOT grant not only recognizes UMass's leadership in transportation research but also strengthens MassDOT's capacity to implement cutting-edge solutions through enhanced access to research, technology transfer, and workforce development opportunities. This partnership is poised to deliver transformative outcomes for the transportation sector, setting new benchmarks for innovation and excellence in the New England region and on a national stage. A total of 34 NEUTC projects began in FFY24, ranging from How Do Mode-Specific Network Metrics Impact Safety Outcomes? to Leveraging Vehicle Sensors for Pavement Condition Evaluation and Tracking to Ride-Sourcing Demand and Supply Estimation Based on Coarse Public Data.

Below are the NEUTC projects with direct MassDOT involvement that began in FFY24:

MassDOT

Community-Centered Traffic Safety

Principal Investigators: Dr. Cole Fitzpatrick, Dr. Francis Tainter, Krista Reichert, and Gordon Snyder, UMass Amherst
Approximate Budget: $400,000

❖ Project Overview:

This project aims to develop a locally informed approach to traffic safety, integrating multiple research areas to create tailored solutions that address the specific traffic safety needs of different communities.

❖ Main Research Objective:

"Community-Centered Traffic Safety" is a research project focused on addressing the complex issue of traffic safety through a multifaceted, locally informed approach. Recognizing the limitations of uniform strategies, the project explores traffic safety challenges by considering varied cultural, financial, and infrastructural factors that influence different communities. The project includes four research thrusts: evaluating the effectiveness of current citation fine structures across different population groups, developing tailored safety messaging, creating a crowdsourced app to identify local safety concerns, and analyzing pedestrian crashes near transit stops to identify contributing factors.

This comprehensive effort involves collaboration with the Massachusetts Department of Transportation (MassDOT) and interdisciplinary student participation from Engineering, Planning, and Public Policy departments. The project will engage with local communities through surveys, focus groups, and observational studies, and will use the UMassSafe Crash Data Warehouse for analysis. Expected outcomes include a proposed revision to the fine structure, targeted traffic safety campaigns, and a prototype of a community-informed app. The project also emphasizes student involvement in data analysis, stakeholder collaboration, and app testing, contributing to the broader goal of improving traffic safety and strengthening community engagement.

Timeline: Completed August 2025

Truck Permits: Managing Increasing Loads and Mitigating Infrastructure Damage to Balance Freight Mobility and Safety Needs Assessment. A Case Study of Northfield, VT

Principal Investigators: Dr. Gerasimidis Simos, Dr. Chengbo Ai and Dr. Egemen Okte - UMass Amherst
Approximate Budget: $282,000

❖ Project Overview:

This research examines the impact of non-reducible truck permit loads on transportation infrastructure and explores strategies for balancing freight mobility with infrastructure preservation. By analyzing the extent of permit usage and its effects, the project aims to recommend practical policies to reduce infrastructure damage while supporting safety and economic productivity.

❖ Main Research Objective:

Non-reducible truck permits, essential for freight mobility, pose significant challenges to infrastructure integrity, contributing to accelerated fatigue, increased maintenance costs, and safety hazards. This study quantifies the scope and distribution of permit loads across Massachusetts, evaluates their impact on bridges and highways, and verifies their alignment with current regulations and industry standards. The research will integrate data on truck permits, freight volumes, and infrastructure conditions to develop data-informed recommendations for mitigating adverse effects. Outcomes include optimized permit management strategies, improved infrastructure durability, and expanded access to reliable transportation, aligning with US DOT priorities in safety and system performance.

Timeline: Estimated Completion August 2026

Appendix

FFY 2024 SPR Annual Spending Report (10/1/2023–09/30/2024)

Office of Transportation Planning Research Activities / SPR II

Project Title	Contract Number	Total Amount	FFY24 Spending
A. Research Program Administration	N/A		
B. Massachusetts Cooperative Research Program (MCRP)	109600	$2,888,403	$843,459
1. Artificial Intelligence Framework for Crosswalk Detection Across Massachusetts	109600	$91,900	$45,617
2. Speed Management and Emergency Response-A Synthesis Study	109600	$119,989	$77,021
C. Local Technical Assistance Program (LTAP)	109600	$3,761,085	$1,019,203
D. MassDOT Training Services	109600	$5,094,152	$1,444,695
Short-Term Research Projects			
1. Implementing the AASHTO Mechanistic-Empirical Pavement Design Guide, Phase III (Continuing Project)	120714 Dartmouth	$400,167	$40,216
2. Methods to Identify Problematic Carriers and Prevent Infrastructure Damage (Continuing Project)	117649	$126,220	$79,219
3. Feasibility Study of 3D Printing Applications for Bridge Elements (Continuing Project)	117646	$150,000	$55,807
4. Data Driven Approaches for Transit Capital Planning (Continuing Project)	119829	$100,000	$42,516
5. Using Traffic Signals to Limit Speeding Opportunities on Arterial Roads (Continuing Project)	114372 Northeastern	$140,000	$4,105
Medium-Term Research Projects			
1. Energy-Focused Decision-Making Framework for MBTA Operations and Planning (Continuing Project)	121534	$124,999	$82,304
2. Accessible Bus Stop Design in the Presence of Bike Lanes (Continuing Project)	121272	$199,915	$83,706
3. Developing a Salt Spreader Control Program based on Grip Sensor (Continuing Project)	117740	$125,000	$45,449
4. Cross-Modal Impact Assessment for Sustainable Transportation Networks (Continuing Project)	121271	$99,997	$77,216

Project Title	Contract Number	Total Amount	FFY24 Spending
5. LIMMS Gap Analysis and Development Plan (Continuing Project)	121179	$300,000	$183,379
6. Smart Work Zone Control and Performance Evaluation Based on Trajectory Data (Continuing Project)	117478 Lowell	$150,000	$53,626
7. Post-Fire Damage Inspection of Concrete Structures in Tunnels, Phase III (Continuing Project)	117741	180,000	$35,273
8. Measuring Fare Payment Compliance on MBTA Buses and Light Rail (Continuing Project)	121858	$150,000	$105,918
9. Effectiveness of Two-Stage Turn Queue Boxes in Massachusetts: A Comparison with Bike Boxes (Continuing Project)	118671	$149,778	$40,609
10. Developing a Visualization, Sharing, and Processing Platforms for Large-Scale Highway Asset Point Cloud Data (Continuing Project)	121410	$174,999	$97,522
Long-Term Research Projects			
1. Ultra-High-Performance Concrete Reinforced with Multi-Scale Hybrid Fibers and its Durability-Related Properties (Continuing Project)	115287 Lowell	$197,402	$60,726
2. Complete Street and Urban Trees (also called: Tree Protection for Street Corridor Development)(Continuing Project)	117524 UMAMH not UMTC	$89,897	$29,402
3. Recycled Ground-Glass Pozzolan (RGGP) for Use in Cement Concrete (Continuing Project)	122821 Lowell	$250,000	$75,133
4. Revised Load Rating Procedures for Deteriorated Prestressed Concrete Beams (Continuing Project)	114071	$224,676	$ 1,364
5. Field Study to Determine Salt Usage Efficiency on Two Pavement Types (Continuing Project)	119609 Dartmouth	$450,000	$146,324
6. Evaluating the Effectiveness of Driver Education Modules on Safety	121727	$369,999	$156,300
7. Development of Improved Inspection Techniques using LiDAR for Deteriorated Steel Beam Ends (Continuing Project)	117416	$199,998	$75,074
8. Measuring Accessibility to Improve Public Health Phase II (Continuing Project)	123632	$200,000	$90,165
9. 3D-Printed Lattice-Based Structures for Next Generation Bridge Bearings (Continuing Project)	121135	$225,599	$81,578

Project Title	Contract Number	Total Amount	FFY24 Spending
10. A Method for Pavement Marking Inventory and Retroreflectivity Condition Assessment Using Mobile LiDAR (Continuing Project)	121137	$200,000	$ 101,728
11. Effect of Asphalt Binder Source in Asphalt Mixture Performance (Continuing Project)	121136 Dartmouth	$400,000	$45,226

UMTC Grant ST 172845 FFY 2024 Budgets and Actual Spending		
LTAP		
FFY 2024 Estimated Budget	900,000	
FFY 2024 Spending	1,019,203	
MTS		
FFY 2024 Estimated Budget	1,700,000	
FFY 2024 Spending	1,444,695	
MCRP		
FFY 2024 Estimated Budget	650,000	
FFY 2024 Spending	843,459	includes tasks $215,674
Conferences		
FFY 2024 Estimated Budget	850,000	
FFY 2024 Spending	978,963	
Total FFY 2024 Estimated Budget	4,100,000	
Total FFY 2024 Spending	4,286,320	