massDOT
Massachusetts Department of Transportation

Transportation Research Quarterly

Providing highlights of MassDOT's transportation research activities and other helpful information **2024 Q1**

Focus on Research

"The U.S. Department of Transportation defines the future of transportation as one that expands mobility options for the benefit of everyone while maintaining the highest possible standard of safety"

U.S.DOT

INSIDE THIS ISSUE

The annual **MassDOT Transportation Innovation Conference** will take place on April 30th and May 1st. Each year, the conference provides an important opportunity for transportation practitioners to share knowledge, sponsor peer-to-peer learning, and collaborate on issues of mutual interest. This year the Research Section will moderate two panels.

Innovative Solutions for Pedestrian and Cyclist Safety at Crossings - Room B

Explore pioneering approaches and technological advancements aimed at improving safety for pedestrians and cyclists at critical intersections and crossings.

Moderator: Austin Sanders, MassDOT

Presenters:

Chris Stanford, Michael Baker International
Angelina Caggiano, UMass Amherst
Michael Ambrozie, Northeastern University
Nathaniel Pyo, Northeastern University

Bike, Walk, Ride...Accommodating the Vulnerable Road Users in Everyday Life - Main Ballroom (Hybrid)

Presentations will discuss ways to incorporate certain types of floating bus stops and remove obstacles to safe cycling within 500 ft of supermarket entrances with the result of increasing safety and accessibility.

Moderator: Anil Gurcan, MassDOT

Presenters:

Kayla Sousa, MassDOT
Stacey Schwartz, MassDOT
Peter Furth, Northeastern University
Stephanie Upson, MassDOT
Yu-Min (Thomas) Yang, UMass Amherst
Eleni Christofa, UMass Amherst

Full program for the conference can be found **here**.

MassDOT Materials Research

Research and Materials Lab at Hopkinton

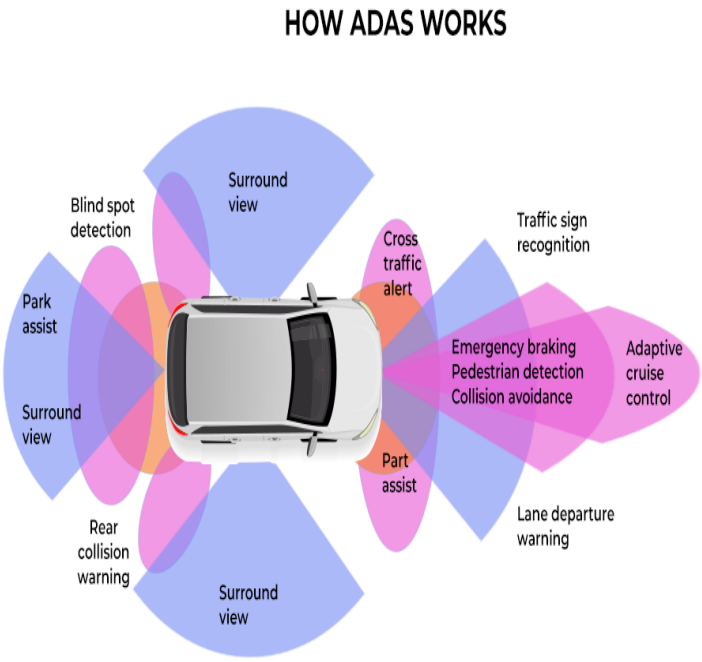
The Research and Materials Laboratories supports MassDOT's mission to provide transportation infrastructure, which is safe, reliable, robust, and resilient through a range of quality assurance and research activities.
Research and Materials Lab's impact is local as well as national with responsibilities that include:

- Serving as MassDOT's central materials laboratory
- Participating in the American Association of State Highway and Transportation Officials (AASHTO) Accreditation Program
- Representing MassDOT on AASHTO Pavement and Materials Committee
- Testing materials for more than 500 ongoing construction projects at any given time
- Evaluating laboratories and sampling/testing procedures throughout the Commonwealth

Highway Sustainability Research Center at UMass Dartmouth

Highway Sustainability Research Center has been supporting MassDOT with the state-of-the-art asphalt material characterization equipment and technology.

Research Project Highlights



Impact of Advanced Driver Assistance Systems (ADAS) on Road Safety and Implications for Education, Licensing, Registration, and Enforcement

Advanced Driver Assistance Systems (ADAS) are rapidly being developed and deployed, with an increasing number of new passenger vehicles equipped with advanced ADAS. These systems promise to improve safety by assisting drivers. However, there exists a critical gap in our understanding of the potential impacts associated with driver over-reliance and disengagement in vehicles equipped with ADAS. This research was undertaken with three broad objectives.

The first objective was to understand the current state of commercially available ADAS. The team conducted a literature and market review of the current state of commercially available ADAS technologies, including driver monitoring systems, to document manufacturers' offerings. The second objective was to understand driver knowledge about ADAS technologies and functionalities. Lastly, this research involved the development and evaluation of approaches to improve drivers' understanding of ADAS functionalities and the commensurate role and responsibilities of the driver of vehicles equipped with ADAS.

To understand the information and knowledge drivers have about the ADAS researchers conducted a two-part study. The first part, a survey study gathered information regarding Adaptive Cruise Control (ACC) and Lane Keeping Assist (LKA) use, perceptions, and knowledge. The second part, a simulator study compared understanding of ACC before and after drivers were given different methods of education and measure the change in knowledge.

The outcome of this research includes an understanding of manufacturer offerings of common ADAS technologies in late-model vehicles, an examination of drivers' understanding and perceptions of ADAS technologies, and evidence to support how targeted training may increase drivers' understanding of these systems.

The findings of this research study may support or directly lead to the implementation of new standards or practices for driver training, licensing, and/or vehicle registration and inspection. The findings may also have implications for MassDOT's Highway Division, local/state law enforcement and first responders, and ADAS/ADS technology developers.

This research was cited in a recent U.S. Government Accountability Office (GAO) report to Congress on Driver Assistance Technologies.

Research Project Highlights

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

In recent years there has been a significant increase in interest in additive manufacturing (AM), yet AM is largely unexplored within infrastructure projects, although it can provide unprecedented new design capabilities. The project objectives are, first to explore the feasibility of additive repair technologies for real corroded steel beams ends. Different additive manufacturing solutions and repair technologies will be examined in the lab and on-site. Repaired beams will be tested for their strength, fatigue, and corrosion resistance. Second to research the key factors related to the different repair technologies and equipment investigated that can impact the success of an attempted repair (Example: velocity of material being deposited). Use the research to develop a list of suggested options for equipment and facilities that seem well suited for handling 3D printing applications and the associated qualifications testing of 3D printing repaired steel bridge beams.

The joint research team (UMass Amherst and MIT) has worked on a new solution for repairing corroded steel bridge beams including additive manufacturing. After trying out several different 3D technologies (Laser DED, WAAM and cold-spray), the researchers found that using cold-spray is the most promising methodology to repair steel beams. One of the main goals of this project is to capitalize on previous research laboratory findings and move the technology from the lab to the field. If successful, this project will help MassDOT use 3D printing to repair corroded transportation infrastructure. The team is already in discussions with MassDOT personnel, and they have identified bridges or other components which could benefit from this new technology and serve as initial field demonstration sites.

A Look at Who We are – Team Highlights

Each MassDOT research project team is comprised of a Project Champion(s), a Principal Investigator(s) and a Project Manager. The Project Champion serves as the MassDOT technical representative, the Principal Investigator conducts research investigation and produces deliverables per project scope and schedule, and the Project Manager takes charge of the overall project administrative management and coordination. Highlighted below are the key members of "Feasibility of 3D Printing Applications for Highway Infrastructure Construction and Maintenance Phase II" project team.

Principal Investigator – Simos Gerasimidis Ph.D.

Dr. Gerasimidis is an Associate Professor in the Department of Civil and Environmental Engineering at UMass Amherst. His research interests lie in the areas of bridge engineering, additive manufacturing, structural stability, thin-walled structures, architected metamaterials, infrastructure resilience and energy structures. His research activities have focused on the behavior of structures and new cellular truss-lattice metamaterial architectures to localized damage and defects, as well as identifying novel applications for metamaterials for civil infrastructure. His research spans from experimental techniques for assessing and restoring the residual capacity for steel bridges, computational methods for predicting the failure modes and ultimate capacity of structures as well as new inspection techniques including the use of UAS and LiDar. Dr. Gerasimidis has published more than 90 technical papers.

Principal Investigator – John Hart Ph.D.

John Hart is Professor of Mechanical Engineering and Director of the Laboratory for Manufacturing and Productivity and Center for Additive and Digital Advanced Production Technologies (APT) at MIT. John's research focuses on additive manufacturing, nanostructured materials, and the integration of computation and automation in process discovery. John is co-inventor on over 50 patents, many of which have been licensed commercially. He has also co-founded three advanced manufacturing startup companies, including Desktop Metal. John has been recognized by prestigious awards from NSF, ONR, AFOSR, DARPA, ASME, and SME, by two R&D 100 awards. John has published more than 125 papers in peer-reviewed journals.

Principal Investigator – Wen Chen Ph.D.

Dr. Wen Chen is an Assistant Professor of Mechanical and Industrial Engineering at the University of Massachusetts Amherst. He obtained his PhD in Mechanical Engineering and Materials Science from Yale University. He worked as a postdoctoral research scientist at Lawrence Livermore National Laboratory, where he studied a variety of additive manufacturing techniques including direct ink writing, laser engineered net-shaping, and laser powder bed fusion. Dr. Chen's research is focused on additive manufacturing, alloy development, and materials design. He is the recipient of the National Science Foundation Faculty CAREER award and Society of Manufacturing Engineering Outstanding Young Manufacturing Engineer Award. Dr. Chen has published more than 80 peer-reviewed papers in top journals

Project Champion – Catherine H Chen P.E., MS

Ms. Chen is a Senior Tunnel Engineer in HQ Tunnel Group. She worked on the bridges, structures, and Boston Central Artery tunnels system. Mainly on bridge and tunnel design and reviews of new constructions and rehabilitation projects; document specification, bid contracts, and cost estimate. Bridges and tunnels inspection and rating, structural system monitoring, and monitoring data analysis. Her work involves MassDOT new air right and buildup buildings development, that build on top and around tunnels and covers existing highway that form a new tunnel segment, structural reviews and permits approval.

Graduate Research Assistant – Haden Edward Quinlan

Haden Quinlan is the Senior Program Manager of the MIT Center for Additive and Advanced Production Technologies (APT). Since 2016, Haden has co-led MIT's industry-facing teaching efforts in additive manufacturing. He has helped develop and deliver both in-person workshops and broadly disseminated online courses for working professionals. In total, Haden's work has helped instruct over 10,000 professionals on when, why, and how to use additive manufacturing ("AM") to drive customer or business value. Beyond his teaching efforts, Haden collaborates with researchers within and outside of MIT on cost and value analysis for various AM technologies.

News and Events

The MassDOT Transportation Innovation Conference

The annual MassDOT Transportation Innovation Conference provides a forum for innovative transportation systems, management ideas, and initiatives. Each year, the conference provides an important opportunity for transportation practitioners to share knowledge, sponsor peer-to-peer learning, and collaborate on issues of mutual interest. Conference participants will have the opportunity to discuss the advantages and challenges associated with the innovative methods and technologies being presented. The MassDOT Transportation Innovation Conference is open to all transportation practitioners from federal, state, and local transportation agencies, Metropolitan Planning Organizations, transit agencies, academia, and private industry.

Visit the 2024 Innovation Conference website to view the complete conference program.

Ultra-Thin Bonded Wearing Course Protects Popular Massachusetts Route

In 2018, the City of Newton, MA, searched for a solution to restore ride quality to a roadway section while sealing and protecting the underlying pavement. Ultra-thin bonded wearing course (UTBWC), an overlay composed of a heavy-tack application of polymer-modified emulsion, was selected for the roadway treatment. City officials considered UTBWC an environmentally and economically sustainable pavement solution. UTBWC is also known to effectively treat minor rutting and can help slow fatigue cracking.

In 2020, the city completed a trial project to preserve a section of the deteriorating concrete roadway and in 2022, used UTBWC as an overlay over hot in-place recycling. One of the major benefits of UTBWC is how quickly traffic can resume on high-volume roadways. In some instances, the time to reopen was measured in minutes rather than hours. To learn more about UTBWC or other TOPS applications, please contact TOPS co-team leads Tim Aschenbrener, FHWA Office of Preconstruction, Construction, and Pavements (asphalt) or Robert Conway, FHWA Resource Center (concrete).

American Association of State Highway and Transportation Officials (AASHTO) Annual High Value Research Awards

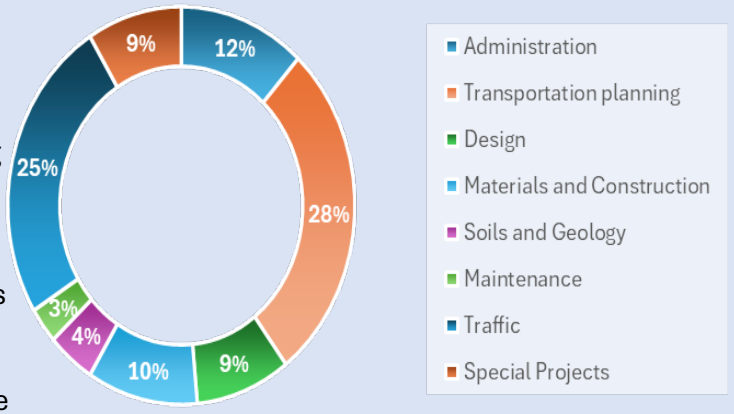
MassDOT is submitting four research projects this year to the High Value Research Awards.

- Multisource Data Fusion for Real-Time and Accurate Traffic Incident Detection via Predictive Analytics
- Massachusetts Depth to Bedrock Project
- Optimizing of MassDOT's High Performance Asphalt Overlay (HPOL) Mixtures
- Artificial Intelligence Framework for Crosswalk Detection Across Massachusetts

HIGH VALUE RESEARCH

NCHRP NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

The National Cooperative Highway Research Program (NCHRP) is supported on a continuing basis by funds from participating member states of the American Association of State Highway and Transportation Officials (AASHTO). Each year, AASHTO refers a research program to the TRB consisting of high-priority problems for which solutions are required by the states. This year, MassDOT's Office of Transportation Planning managed to complete 130 evaluations & scores provided by 72 MassDOT subject matter experts. These scores that were compiled and submitted to NCHRP on behalf of MassDOT. The Following chart shows the percentage of projects in each subject matter category receiving a high score from MassDOT reviewers



Research Resources

In Progress MassDOT Research

	Start Date
Using Traffic Signals to Reduce Speeding Opportunities	July 2021
Development of Improved Inspection Techniques Using LIDAR for Deteriorated Steel Beam Ends	March 2022
Smart Work Zone Safety Control and Performance Evaluation	April 2022
Tree Preservation and Planting for Complete Streets Development	April 2022
Development of a Salt Spreader Controller Program	April 2022
Post-Fire Inspection of Concrete Structure Phase III- In-Situ Experiments	April 2022
Methods to Identify Problematic Carriers and Prevent Infrastructure Damage	June 2022
3D Printing Applications for Bridge Element Repair	June 2022
Evaluating Safety Impacts of Two-stage Bike Boxes	August 2022
Field Study to Determine Salt Usage Efficiency on Two Pavement Types	August 2022
Implementing AASHTO Mechanistic-Empirical Pavement Design Guide Phase III	November 2022
Effect of Asphalt Binder Source on Asphalt Mixture Performance	February 2023
LIMMS Development Planning	March 2023
Accessible Bus Stop Design in the Presence of Bike Lanes	March 2023
Cross-Modal Assessment of Sustainable Transportation Networks	March 2023
A Pavement marking Inventory and Retroreflectivity Condition Assessment Method Phase II	March 2023
Speed Management and Emergency Response – A Synthesis Study	April 2023
Evaluating the Effectiveness of Drivers' Education Modules on Safety	April 2023
Fare Payment Compliance on MBTA Buses and Light Rail	May 2023
Measuring Food Access to Improve Public Health Phase II	September 2023
Data-Driven Approaches for Transit Planning	September 2023

Recently Completed MassDOT Research

	Completion Date
Uncovering the Root Causes for Truck Rollover at Highway Ramps	March 2023
Safety Impacts of Yellow Flashing Permissive Left-Turn Indications – Approach Analysis	March 2023
Using Mycofiltration Treatment for Stormwater Management	March 2023
Construction and Material Best Practices for Concrete Sidewalk Phase II – Hot Placement	March 2023
Optimizing MassDOT's High Performance Asphalt Overlay Mixtures	May 2023
Massachusetts Depth to Bedrock	May 2023
Multisource Data Fusion for Traffic Incident Detection	May 2023
Measuring Food Access To Improve Public Health Phase I	July 2023
Post-Fire Damage Inspection of Concrete Structures (Phase II) – Experimental Phase	February 2023
Building Information Model for Transit Infrastructure: Feasibility and Gap Analysis	August 2023
Implementing AASHTO Mechanist-Empirical Pavement Design Guide Phase II	September2023
Developing Massachusetts-Specific Trip Generation Models for Land Use Projects	September 2023
Revised Load Rating Procedures for Prestressed Concrete Beams	November 2023
Ultra High-Performance Concrete Reenforced with Multi-scale Hybrid Fibers	December 2023
Artificial Intelligence Framework for Midblock Crosswalk Detection Across Massachusetts	February 2024

Additional Resources

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

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

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

Contact Us

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* Project documents are being edited for accessibility and will be posted shortly.