CTDOT Research Highlights Winter 2024

Highway Sign Support Systems: Condition Assessment Deterioration Models and Asset Management

CTDOT and CCSU collaborated on a research project to optimize sign support system management. They built a deterioration model and asset management plan that factors in age, structure type, material, traffic volume, and population. Through surveys and field tests, they discovered that while age is the biggest culprit for sign support failures, factors like traffic volume and material type also play a role.

To address this, they developed a risk assessment model that considers these various factors to predict failure probability and prioritize repairs. This project's findings will not only enhance the safety and reliability of CTDOT's sign support systems but also allow for more efficient maintenance and resource allocation.

Image source: Connecticut Department of Transportation

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Artificial Intelligence (AI) & Markov Process Based Data Mining on Predicting Bridge Operating Conditions

The University of Hartford is using Artificial intelligence (AI) to help the CTDOT predict the bridge deterioration process and enhance its bridge and infrastructure management system. With AI's remarkable ability to acquire knowledge from large data sets, the research develops a machine learning algorithm for training and analyzing 30 years of large and complex bridge inspection data for more than 4,000 bridges in Connecticut.

The developed algorithm uncovers hidden relationships, identifies patterns within this extensive bridge inspection data, and models the intricate connections between various bridge features & bridge performance. A variety of features are considered, including bridge geometry, design, construction, service, cost, weather, & traffic dynamics

Image source: Connecticut Department of Transportation

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Adaption of 3D Scanning Technology for High Precision Bridge Inspection

Current bridge evaluation methods are labor-intensive and subjective, impacting safety assessment and repair prioritization. Our research explored hand-held 3D scanning technology for accurate inspection data, involving trials on Connecticut bridges and creating CTDOT training videos.

The technology assists in quality assurance checks, section loss measurements, and evaluating use cases like corrosion rate determination, crack mapping, and bridge hit documentation.This improved methodology enables better decision-making for load postings, rehabilitation prioritization, and funding allocation.

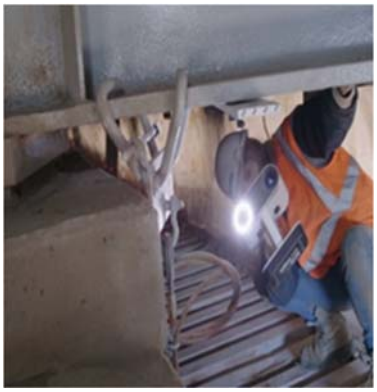

Image source: Connecticut Department of Transportation

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CT Training & Technical Assistance Center (T2 Center)

Image source: Connecticut Transportation Institute, University of Connecticut

For forty years, the T2 Center at UCONN has served the CT Transportation Community with professional learning programs, technical assistance, and comprehensive technical resources. These programs include Public Works Academy, Road Master, Road Scholar, Local Traffic Authority, and Transportation Leadership Program. The center also offers a series of custom training programs to meet the individual needs of CT's cities/towns.

Monthly CT Crossroads and Leadership Lessons newsletters keep the transportation community connected to timely information and tips for their leadership success. The overall focus areas of the center are Safety, Infrastructure Management, Workforce Development and Organization Excellence.

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Connecticut Advanced Pavement Laboratory (CAP Lab)

. Image source: Connecticut Department of Transportation

The CAP Lab is the premier transportation construction materials research laboratory in New England. The lab has been conducting applied research in cooperation with CTDOT since 1995. The CAP Lab has been involved with implementation of advanced pavement technologies including SUPERPAVE, Warm-Mix Additives, Thermal Imaging, and Notched Wedge Longitudinal joints.

On-going research through SPR-2305 includes analysis of long-term field conditions with laboratory performance testing as part of an effort to bring CTDOT to the forefront of Balanced Mix Design. Additional efforts include validation of new performance test methods, implementation of high-performance or specialty pavement mixes

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Repair of Steel Beam/Girder Ends with Ultra High-Strength Concrete – Phase II Part 1: UHPC Push-out Experiments.

Image source: Connecticut Department of Transportation,

An innovative repair technique for severely corroded steel beam ends was assessed for its structural integrity, constructability, and longevity.This method offers design flexibility to enhance the structural performance and load-bearing capacity of aging steel bridges. The repair's effectiveness relies on the load transfer from ultra-high performance concrete (UHPC) cast onto the damaged element.

Push-off tests evaluated the load-bearing capabilities of shear studs embedded in UHPC, leading to design refinements and installation best practices.The successful use of this repair method in a couple of real-world construction projects highlights its practicality and effectiveness. This real-world application underscores the method's potential for broader adoption in similar projects.

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Impacts of CTrail Hartford Line on Real Estate and Urban Economic Development: Phase 1

The Hartford Line, a commuter rail line connecting New Haven, Hartford, CT, and Springfield, MA, is anticipated to impact real estate development. This report focuses on gathering real estate and other urban data for statistical analysis in Phase 2.

The data will be compared to periods before the 2012 funding approval and before the 2018 service initiation. A recommended follow-up study would examine post-2018 data to assess the long-term impact of the Hartford Line on real estate.

Image source: Connecticut Department of Transportation

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Impacts of CTfastrak on Real Estate and Urban Economic Development: Phase 2

Impacts of CTfastrak on Real Estate and Urban Economic Development: Phase 2 CTfastrak, a bus rapid transit line in four Central Connecticut municipalities that opened in March 2015, is expected to affect real estate. A Phase 1 study set the baseline as of the start of service.

This Phase 2 study, for the first 5 years of service, includes a comprehensive set of over 500 before/after maps superimposed on aerial photography (e.g., sales prices; assessed values; property tax revenues; vacancies; vacant parcels; rental units; environmental remediation; number of "assisted units"; travel costs; and planned/ proposed development).

A visualization tool compares maps from both phases. A statistical analysis found after controlling for covariates, proximity to CTfastrak significantly correlated with sales price. A recommended Phase 3 study would cover post-March 2020.

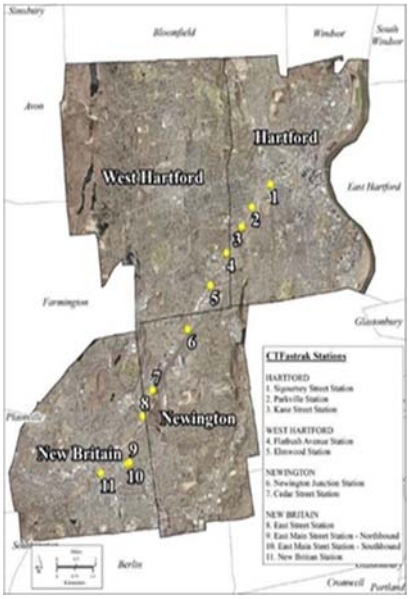

Image source: Connecticut Department of Transportation

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Effectiveness Monitoring of CTDOT Conservation Areas: Pollinator Habitat Survey

CTDOT is protecting pollinator habitat within the right-of-way in designated conservation areas. Pollinator habitat conservation is critical for sustaining pollinators such as native bees and insects facing severe population declines like the monarch butterfly. This project will evaluate how well vegetation management practices in conservation areas are working to provide pollinator habitat resources and food plant resources for the monarch butterfly.

Field surveys will assess nectar plant resources available from spring through late summer & the insect pollinators using these resources. Surveys will quantify the presence of milkweeds and their use by monarch butterflies and caterpillars.

Image source: Connecticut Department of Transportation

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Safety Evaluation of Alternatives for Installing Pedestrian Signals Under Side Street Green

Image source: Connecticut Department of Transportation

This project evaluated the conversion of intersections operating underside street green pedestrian operation, where pedestrians cross the main road during the side street green phase with no additional indications, to concurrent pedestrian operation, where pedestrians cross the main road during the side street phase with "Walk" and "Don't Walk" indications.

Concurrent operation and exclusive pedestrian phasing were found to reduce the probability of pedestrian-vehicle conflicts by almost 50% compared to side street green operations. Concurrent operation with auxiliary informational signage showed almost 50% higher pedestrian compliance compared with concurrent operation without auxiliary signage or exclusive phasing.

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Proof of Concept Study for the Applicability of 3D Imaging for the Inspection of Dry-Stone Masonry Retaining Walls

This project aims to develop a reliable inspection and monitoring method for stone masonry retaining walls using 3D imaging technologies. The project will generate high-resolution 3D models of masonry walls to document in-situ conditions, providing a baseline for future comparisons and revealing vulnerable areas. Objectives include outlining specifications for the data collection process, advancing an image-based monitoring framework, and quantifying minimum achievable errors in measurements.

Screen Shot of 3D Model | Zoomed in View of Model Showing Point Cloud

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Automated Vehicle and Pavement Marking Evaluation in Connecticut

The Connecticut Transportation Institute (CTI) is conducting a study to investigate the effect of pavement marking characteristics on machine vision detection. The study will also examine the performance of advanced driver assistance (ADAS) technologies under different lighting conditions.

The outcomes of this study will help the CTDOT and other infrastructure organizations (IOOs) make informed decisions about the design and maintenance of pavement markings to ensure that they are compatible with ADAS technologies. This will help to improve the safety and efficiency of automated vehicles.

Image source: Connecticut Department of Transportation

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Repair of Steel Beam/Girder Ends with Ultra High-Strength Concrete (Phase III: Implementation &Training)

Image source: Connecticut Department of Transportation

Corrosion damage is a major issue on steel girder bridges, costing billions of dollars annually. A multi-phase research project at the University of Connecticut has investigated a repair method using ultra high-performance concrete (UHPC) encasement as an alternative solution to reduce labor and costs.

Phase III aims to transition the technology from the lab to practice by simplifying designs, conducting field monitoring of select repairs, and transferring knowledge to CTDOT.

The project was featured in the March/April 2022 Issue of the USDOT Innovator Magazine, and the FHWA EDC-6 Initiative.

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Implementation and Evaluation of AirAccess Pilot Run in Connecticut

Image source: aira.io

The Connecticut Transportation Institute (CTI) worked with the CTDOT and

Bureau of Education and Services for the Blind (BESB) to provide free access to Aira's virtual visual assistance services for Blind and Low Vision (BLV) individuals across Connecticut. BLV individuals could use the service for navigation, wayfinding, riding public transportation, and completing essential daily tasks. CTI conducted pre- and post-user surveys to understand travel patterns and barriers faced by BLV individuals and evaluated Aira service usage to identify changes in reported mobility. The goal was to make recommendations on how the state may support these services in the future.

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