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UTC Spotlight

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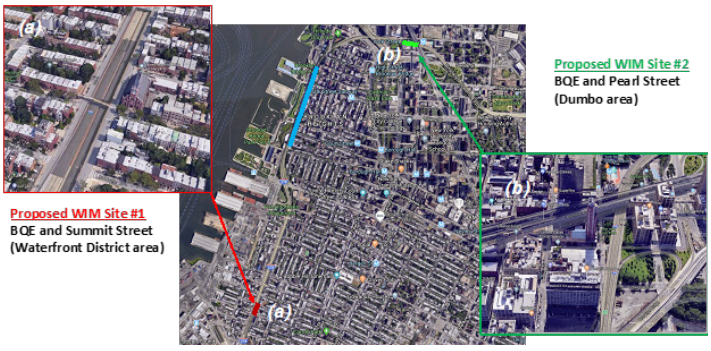
Installation of a Smart Roadway Testbed in Brooklyn, NY to Measure the Impact of Overweight Trucks

Our January 2020 newsletter highlights the work of one of our USDOT Tier 1 University Transportation Centers, Connected Cities with Smart Transportation (C2SMART). C2SMART has been researching the damage caused by illegal overweight trucks on bridges and pavements in urban areas. Associate Director and Professor Hani Nassif from the Rutgers Infrastructure Monitoring and Evaluation (RIME) Group leads this multi-year effort along with researchers from the New York University (NYU) Tandon School of Engineering, and the New York City Department of Transportation (NYCDOT).

The goal is to establish and implement a new ***smart roadway testbed*** along a cantilevered section of the Brooklyn-Queens Expressway (Interstate 278) in Brooklyn, New York. This new testbed will allow the research team to collect real-time data on truck loads using embedded weigh-in-motion (WIM) sensors to measure their impact on bridges and pavements in an urban transportation infrastructure network.



Satellite Imagery Courtesy of Google Maps (https://google.com/maps)

Project Study Site in Downtown Brooklyn, NY

New York City's overweight truck population is higher than the national average and requires extra effort and resources to maintain infrastructure compared with other urban metropolitan areas. While many efforts have been made to reduce the number of overweight trucks on the road—such as variable message signs (VMS) and load posting—these measures remain ineffective. Data from neighboring New Jersey highlights the scale of the challenge: the C2SMART team found that citations issued at established weigh stations there accounted for only 8.6% of the total number of overweight trucks estimated to be traveling in the state, based on measurements from over 90 New Jersey WIM stations. This low enforcement rate means that a comprehensive and advanced plan will help the region effectively reduce the damage to roadways and structures caused by overweight trucks.

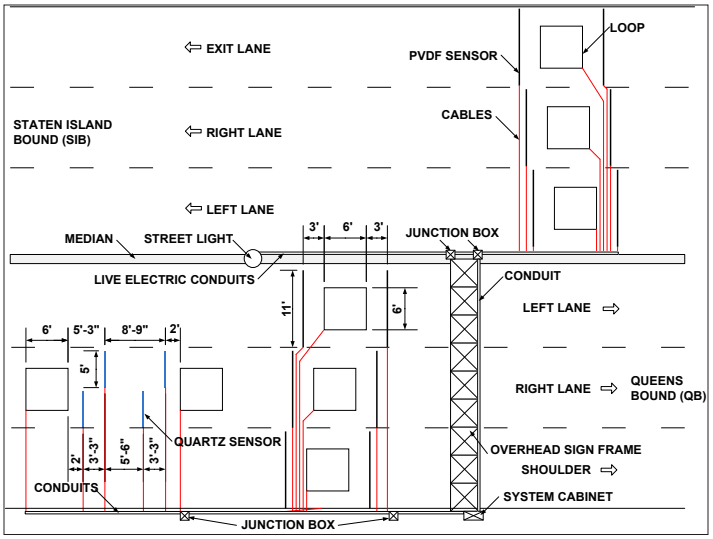


Diagram Source: Chaekuk Na, Rutgers University

Smart Roadway Testbed Implementation Plan (Brooklyn-Queens Expressway)

There is a separate C2SMART project, to develop an algorithm for autonomous tracking of (and active enforcement against) illegal overweight trucks. This project may help enable a comprehensive plan to reduce the damage to roadways and structures which these trucks cause. In the Fall of 2019, the research team installed various types of WIM sensors and an Advanced-WIM (A-WIM) system along the roadbed to capture truck weights as they drive at highway speeds. Two types of WIM

Image Source: Chaekuk Na, Rutgers University

Installation of WIM System on Brooklyn-Queens Expressway

sensors were installed: two piezo-polymer (PVDF) sensors with one inductive loop were installed in each lane of the three-lane roadway in both directions (six lanes in total), while four piezo-quartz (Quartz) sensors with two inductive loops were installed on the right lane of the Queens-bound roadway where the majority of trucks travel. During installation, NYCDOT contractors provided needed lane closures for four nights to accommodate the installation effort, as well as a truck of known axle weights to calibrate the WIM sensors and system. Technical support was provided by C2SMART industry partner Kistler Instrument Corp., the manufacturer of the Quartz WIM sensors. With two types of WIM sensors with different accuracy levels in the same lane, the team is able to develop algorithms to calibrate for their differences while collecting and processing the WIM data.

Initial results have shown notable differences in data collected depending on the WIM sensor type: the PVDF sensors, which are cheaper but less accurate than others, are very sensitive to the pavement temperature, roughness, and rutting. In contrast, Quartz sensors provide a high level of accuracy that could potentially be used to support future autonomous enforcement. Non-permitted overweight trucks are observed from the WIM data, indicating that enforcement is needed. The team is currently working on the integration of a license plate camera, security camera, radio frequency identification (RFID) system, and more to provide a package of information about illegal overweight trucks. This process can help researchers develop autonomous or direct enforcement algorithms and serve as a prelude for potential future legislation and wide-scale implementation.

Principal Investigator Hani Nassif and co-Principal Investigator and C2SMART Center Director Kaan Ozbay, are both members of the Brooklyn-Queens Expressway Expert Panel convened by the Mayor of New York City to produce planning and design recommendations for this section of roadway. On January 30, 2020, the BQE Expert Panel released its Final Report, and New York City Mayor Bill De Blasio signed Executive Order 51 the following day, taking immediate action against illegal trucks and establishing an aggressive BQE enforcement task force. In its press release, the Office of the Mayor cited the role of data supplied by C2SMART's state-of-the-art sensors in assessing the expressway and revealing the extent of serious weight restriction violations. Based on the success of this effort, the research team plans to work with NYCDOT and other agencies to bring this technology and monitoring system to other roadways and to extend the life of critical infrastructure through better monitoring and enforcement of overweight trucks on structures and pavements.

Image Source: Chaekuk Na, Rutgers University

Research and Installation Teams Following Successful Installation of WIM System

About This Project

This ***smart roadway testbed*** was created as a result of a multi-year research effort by C2SMART Center researchers led by Professor Hani Nassif of Rutgers University, Professor Kaan Ozbay of New York University, and Dr. Chaekuk Na of Rutgers University. Special thanks are given to all of the student and staff researchers engaged in this project, partners from Kistler Instrument Corp., New York City Department of Transportation, Daidone Electric Inc., and Conway Marine Construction, Inc. in the installation of these sensors, as well as the New Jersey Department of Transportation in support of current and prior research efforts.