FORM 15, PART 18 – JUSTIFICATION
PROPOSAL TO AMEND NIST HANDBOOK 44, SECTION 2.25

1. INTRODUCTION

The Brooklyn-Queens Expressway (BQE) is an aging and deteriorating 6-lane highway that comprises a critical link of I-278 - the sole Interstate highway in Brooklyn, connecting it to Manhattan, Staten Island, and Queens in New York. Constructed in 1954 and comprised of varying and complex structure types, the segment of the BQE between Atlantic Ave. Interchange to the South and Sands St. to the North is nearing the end of its design life. Urgent repairs are underway, while roughly 110 spans may be in need of intervention by 2028, and another 75 spans may be in need of intervention within the next decade. Weigh in Motion (WIM) sensors, installed in October 2019, have revealed overweight vehicles, excessively exceeding FHWA legal load limits, with gross vehicle weights (GVW) that range from just over 80,000 lbs to as high as 200,000. The continued presence of overweight vehicles on the BQE contributes to the continued structural deterioration of this aging piece of infrastructure. The New York State legislature recently authorized the New York City Department of Transportation to conduct automated overweight vehicle enforcement through a WIM demonstration program; however, a universal standard has not yet been established that specifically defines a protocol for calibration and certification by the New York State local Division of Weights and Measures.

In response to this challenge, this proposal seeks an amendment of Section 2.25 of NIST Handbook 44 to allow for Weigh-In-Motion Systems Used for Automated Vehicle Weight Enforcement. The remainder of this proposal lays out the justification for the amendment, using the BQE as an example to establish the urgent need for the amendment, supported by data received from other State programs, including New Jersey, Maryland, and Indiana. The City of New York is not alone in its struggle to maintain the safety and structural integrity of its infrastructure. Guarding against violations of vehicle weight restrictions enacted to protect critical infrastructure is an issue of national concern.

The combined interstate data presented here stresses the national importance of establishing protocols for automated vehicle weight enforcement using WIM, citing:

- the deleterious effects of overweight vehicles and axles on primary structural components and pavements;
- the difficulty associated with the use of screening combined with stationary weighing stations to enforce vehicle weight regulations;
- the percentages of overweight vehicles on major interstates across the nation; and
- the proven accuracy of WIM equipment used in several states across the nation.

2. THE BROOKLYN-QUEENS EXPRESSWAY: THE NEED FOR URGENT INTERVENTION

Constructed in 1954, the BQE is a network of varying and complex structure types, including multi-girder steel bridges, concrete arch bridges, and double and triple concrete cantilever structures. The triple-cantilever section possesses unusual engineering characteristics. Its three levels of cantilevered structure (comprised of two levels of the vehicular roadway and a top-level pedestrian Brooklyn Heights Promenade) are supported by a vertical wall that also serves to hold back the earth, and, in turn, the neighborhood of Brooklyn Heights behind it. Thus, there is a complex system of forces acting to hold up the cantilevered decks and soil, and moving one of its parts affects the others. With major structural components nearly 70 years old, this segment of the BQE is rapidly approaching the end of its design life. Due to its complex nature and its historic integration with the surrounding communities, repair and replacement of this segment of the BQE require careful and strategic planning, exhausting every avenue to maintain the safety of its operations and the integrity of its structural condition.

Its aging characteristics are evidenced by several factors, including:

- Visible signs of deterioration, including scaling, efflorescence, transverse cracking, map cracking, and spalling, with exposed and corroded rebar at the underdeck, walls, and substructure components;
- Poor freeze-thaw results in the concrete cores;
- High chloride levels in the deck, leading to the onset and propagation of steel rebar corrosion in the structural decks and substructure components;
- Deteriorated concrete beneath the surface, as detected by Non-Destructive Test and Evaluations (NDT/E) and verified by probe samples; and
- Projected decreases in structural load ratings to below standard limits, with isolated segments projected to fall below standard limits by 2026, and large segments of this portion of the corridor projected to fall below standard limits by 2028.

Numerous traffic studies have been completed for this segment of the corridor, revealing average daily traffic (ADT) of approximately 153,000 vehicles, including a substantial average daily truck traffic (ADTT, up to 13 percent of the total ADT). In addition, the installation of WIM sensors in October 2019 has revealed that a considerable number of the vehicles traversing the BQE are classified as overweight, when compared with FHWA legal load limits. WIM data shows Gross Vehicle Weights ranging from just over 80,000 lbs to as high as 200,000 lbs, with roughly 20% of North-bound traffic classified as overweight, and roughly 8% of South-bound traffic classified as overweight.

The New York City Mayoral Executive Order 51, executed in January 2020, mandated the formation of the New York City Police Department (NYPD) BQE Truck Enforcement Task Force, whose purpose is to ensure that all existing weight restrictions on the BQE are strictly enforced. However, the lack of roadway shoulders on this stretch of the BQE means that there is insufficient space for the New York City Department of Transportation (NYCDOT) to introduce stationary weighing stations, or for NYPD enforcement officers to pull over overweight vehicles and use portable scales to screen and enforce legal weight limits.

Urgent repairs are currently underway for two spans within this complex network, while structural assessments show that roughly 110 spans may be in need of intervention by 2028, and roughly 75 spans may be in need of intervention within the next decade.

In response to this challenge, NYCDOT has initiated aggressive efforts to develop and implement a plan that maintains the operational safety of the BQE, as well as protects its structural integrity, including the pursuit of automated weight enforcement using WIM on this segment of the corridor. It has combined its efforts with other local and State agencies in order to demonstrate that this is not an isolated local problem, but a national need.

3. AUTOMATED TRUCK ENFORCEMENT USING WIM: THE NATIONAL NEED

The national roadway infrastructure, including bridges and pavement, has handled substantial daily truck traffic. While trucks have been an integral part of the freight movement network in distributing goods and services to various communities, many trucks are often found to be overweight beyond the FHWA legal load limits. Illegally overweight vehicles have been shown to be one of the primary causes of the deterioration of aging pavement and bridges. Accordingly, the infrastructure suffers from significant deterioration because of the existing environmental conditions exacerbated by the frequently increasing and substantial number of overweight vehicles.

Vehicles on Interstate highways must conform to the Federal Bridge Formula (FBF), designed to protect bridges from vehicle overloads beyond the legal limits. To date, the enforcement regulations have been executed at stationary weighing stations across the nation, especially at the borders between states. However, the stationary stations have limited resources for effective enforcement because: (1) the number of stationary weighing stations is not spatially well distributed across the nation; (2) the operation hours are limited; and (3) the number of enforcement officers is insufficient.

Though each state allows a certain number of permitted vehicles to exceed the FHWA weight limits on Interstate Highways, the number of permit overweight vehicles is typically a small fraction of the total. According to a previous study (Nassif et al., 2016)[1], the number of permit overweight vehicles is only 4% of the total overweight vehicles observed at NJ WIM stations. In New Jersey, it was also noticed that the overweight vehicles cited at the stationary weighing stations were only a small fraction (6.4%) of the *actual* overweight populations recorded by the WIM sensors on the main lanes, and this is, in turn, 0.142% of the total number of vehicles (Nassif et al., 2021)[2]. In New York City, enforcement officers have been able to cite only 14.7% of the *actual* number of overweight vehicles on and near Interstate Highway I-278 between February and December of 2021. Therefore, the overweight enforcement practices at the stationary weighing stations, combined with using mobile enforcement units, are ineffective in substantially reducing the percentage of overweight vehicles.

Figure 1 summarizes the percent of overweight vehicles, relative to the ADTT for each US State. The overall overweight percentage out of ADTT is 13.2%, based on the data in the figure below.

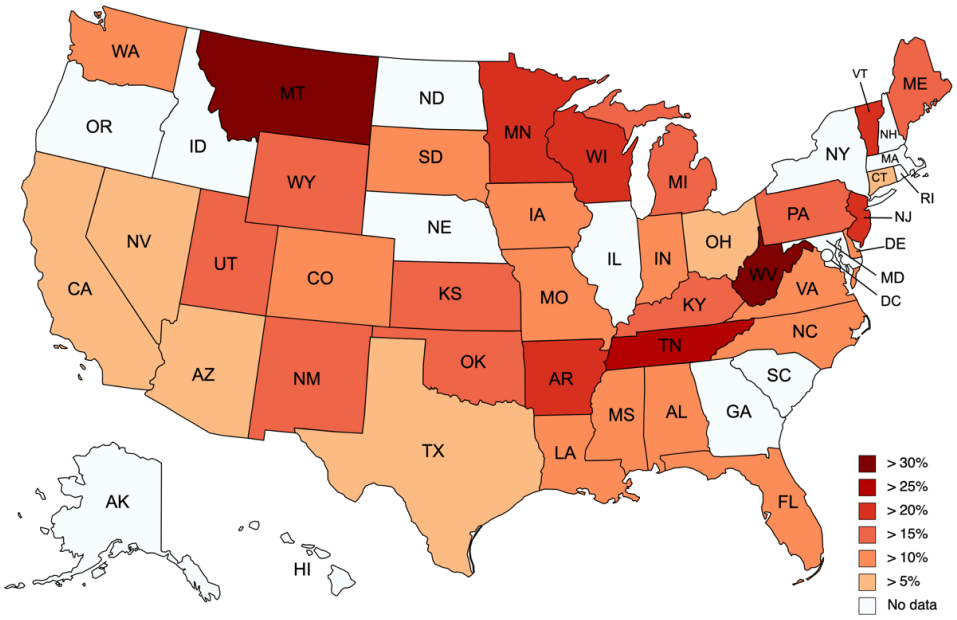

Figure 1. Overweight percentage per State

Going beyond weight enforcement, officers in most States are responsible for checking Commercial Motor Vehicles (CMV's) for safety. This includes different levels of truck inspection, including the driver credentials, hours of service, key systems on the truck, load securement, and many more. The highest level of inspection, Level 1, has 20+ safety criteria that an officer checks on a CMV. There is an opportunity with automated weight enforcement to, not only deter overweight vehicles on the nation's infrastructure, but to automate the inspection tasks of officers, freeing them up so they can do more inspections for other safety issues related to CMV's. Currently, with most sites running with a single officer, as they are focused on weighing, doing an inspection, or interviewing a driver, other unsafe vehicles behind the current one go by without scrutiny until an officer can complete their task.

4. AUTOMATED TRUCK ENFORCEMENT USING WIM: PROVEN ACCURACY OF WIM TECHNOLOGY

[1] Nassif, H., K. Ozbay, H. Wang, R. Noland, P. Lou, S. Demiroluk, D. Su, C.K. Na, J. Zhao, and M. Beltran. Impact of freight on highway infrastructure in New Jersey. Final Report FHWA-2016-004, NJDOT, 2016

[2] Nassif, H., K. Ozbay, C.K. Na, and P. Lou. Feasibility of Autonomous Enforcement using A-WIM system to Reduce Rehabilitation Cost of Infrastructure, C2SMART Tier 1 University Transportation Center, Year 3 Final Report, 2021

ASTM E1318-09 Type III accuracy requirements have been used by many States in their fixed and virtual weigh stations to screen CMV's for over a decade. In New York, three calibration tests were performed using various trucks (Class 9, Class 7, Class 6, and Class 5), and it was found that the WIM system could provide 100% compliance for GVW within 6%, single axle weight within 15%, tandem axle weight within 10%, and even wheel weight within 20%. In Indiana, the Indiana DOT and Purdue University studied the accuracy of the virtual WIM sensors on the main lanes compared to the stationary weighing station. They found that 98% of the virtual WIM weights were within 5% of the static weights.

Attachment A includes data from New York, Indiana, and Maryland, proving the accuracy of their WIM technology. Additionally, Wisconsin, and two other States have expressed interest in sharing data from their sites which meet these accuracy requirements.

Given the consistent accuracy of WIM measurements, compared with measurements obtained from the stationary scales, the amendment of Handbook 44 to expand its provisions for screening to include automated vehicle weight enforcement using WIM is both prudent and justified.

5. CONCLUSIONS

Across the nation, the deterioration of aging infrastructure is exacerbated by the presence of overweight vehicles in excess of the Federal Bridge Formula (FBF). Though several states have implemented vehicle weight enforcement measures using a screening protocol that includes the use of mobile enforcement officers and stationary scales, these measures have been insufficient in significantly reducing the volumes of overweight vehicles on the nation's infrastructure. The use of WIM for the purposes of automated vehicle weight enforcement would both alleviate this problem and free up local and state resources to address other safety concerns. However, to date, no unified national standard specifically paves the way for the certification of WIM technology to be used for the purposes of automated vehicle weight enforcement. The amendment of Section 2.25 of NIST Handbook 44 will provide such a standard. With several states evidencing the proven accuracy of current WIM technology, the amendment of Section 2.25 to expand its screening provisions to include automated vehicle weight enforcement using WIM is both prudent and justified.

This request is not to introduce new regulations to the trucking industries but to guide the trucking industries to comply with the applicable laws to protect our infrastructure, provide safe corridors to the nation's taxpayers, and improve the resilience of our built environment. Moreover, this request would allow the United States to catch up with other countries globally that have successfully implemented and proved automated weight enforcement as summarized in Figure 2, including China (2004), the Czech Republic (2010), Russia (2013), Hungary (2016), France (in process) and Brazil (in process).

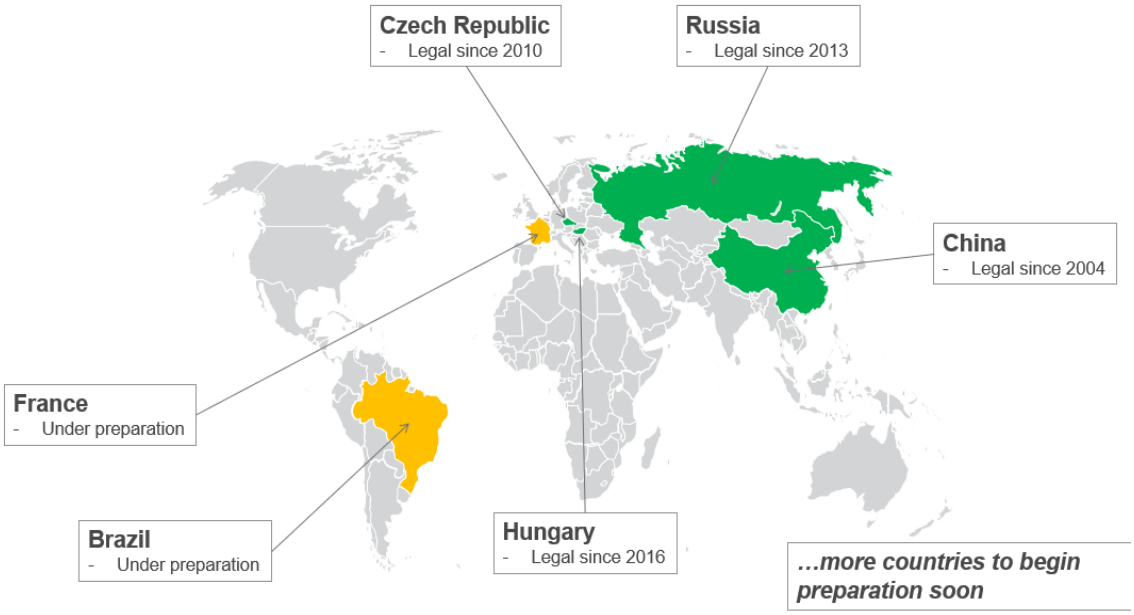

Figure 2. Automated enforcement around the world