C2SMART
CONNECTED CITIES WITH SMART TRANSPORTATION

Research Brief: Monitoring and Control of Overweight Trucks for Smart Mobility and Safety of Freight Operations

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Introduction

Transportation agencies are tasked with maintaining state of good repair for roads and bridges, which requires understanding the effects of truck loads on the infrastructure. Overweight trucks cause significant deterioration, incurring higher maintenance costs over time. Currently, these vehicles are regulated with permits. However, the fee structure is not based on or intended to reflect the damage costs resulting from the extra wear these vehicles cause on roads and bridges.

For this project, the research team collected and processed data from weigh-in-motion stations in New Jersey and New York. This data was used to calculate bridge deterioration caused by these trucks. This project also included the development of a web-based geographic information system (GIS) application tool to evaluate the damage cost associated with permit vehicles and overweight vehicles. It will help monitor the movement of permit trucks and determine hotspots, as well as help NJDOT engineers plan maintenance and repair operations better.

Methodology

The research team collected and processed data from weigh-in-motion stations and developed a method for determining the impact of overweight trucks on pavement, as well as an analysis of the permit fee system in New Jersey. The researchers developed an equation to calculate the pavement damage cost for a single overweight permit trip based on the equivalent single axle load, unit pavement cost, miles and number of lanes. The unit pavement cost is developed for both interstate highways and local roads. A life cycle cost analysis is performed with the net present value economic index to estimate the unit pavement damage cost. The total pavement damage cost of a single permit trip is obtained by summing the damage cost of each link.

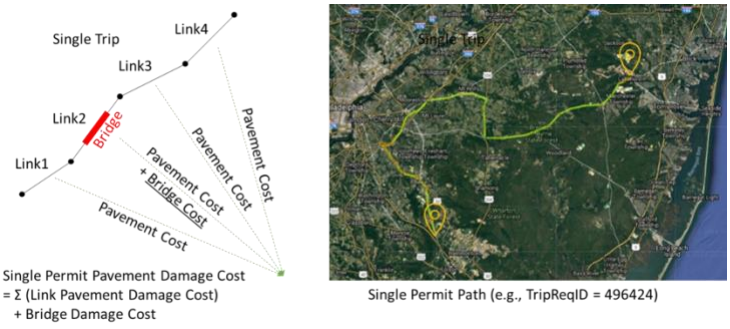

Figure 1: Pavement damage cost calculation procedure of a single overweight permit trip.

Overview

- This project sought to understand and quantify the damage cost to transportation infrastructure in New Jersey and New York City incurred by overweight trucks
- The researchers collected and processed data from weigh-in-motion stations in New Jersey and New York, which was used to calculate bridge deterioration caused by these trucks
- The project also included the development of a web-based GIS application to evaluate and visualize damage costs to New Jersey infrastructure associated with overweight vehicles

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With this cost equation addressed, a web-based GIS application called ASSISTME-WIM was developed to provide a useful tool to monitor the damage to NJ road infrastructure. The methodology used to estimate the pavement damage cost was applied to the entire trip database recorded between 2013 and 2016.

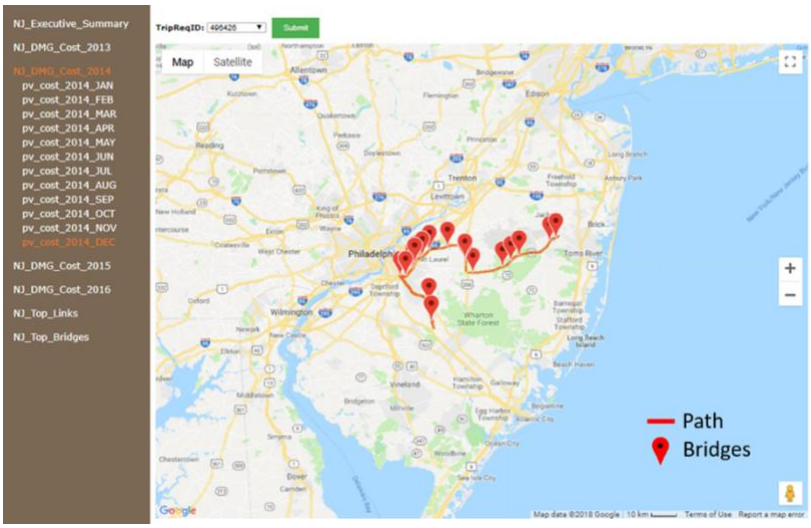

Figure 2: Graphical user interface of developed GIS application for NJ permit data

The above methodology was then extended to New York City. Ideally, the equation for damage cost should be derived using specific NYC pavement characteristics, construction history, cost, and ESAL information from various sources. However, not enough data is available, so the team assumed that: pavement structure is similar between the two states; pavement deterioration and intervention in NYC are similar to NJ; and pavement rehabilitation/maintenance costs are higher in NYC than NJ. Using this approach, the unit pavement damage cost for interstate highways and local roads in NYC was calculated.

Results & Conclusion

The research team found that the unit damage cost is constantly higher for NYC than for most NJ highways. The unit damage cost of overweight trucks on bridges near an NYC local road for reinforced concrete bridge decks, steel multibeam girders, and steel girder-floorbeam girders is 146%, 327%, and 361% of the maximum damage cost found in NJ, respectively. Similarly, the impact on pavements due to overweight vehicles depends on the total number of vehicles and total mileage traveled by overweight vehicles per year. The results from the preliminary analysis on selected corridors in NYC estimate the impact on pavements in the range of $0.0345 and $0.0698 per equivalent single axle load (ESAL)-lane-mile on an interstate highway and between $0.117 and $0.648 per ESAL-lane-mile for local roads, which are approximately 27.6% to 34.2% higher than NJ. However, these estimates are only preliminary since the available data is currently limited. To better understand the effects of overweight trucks on NYC infrastructure, it is necessary to obtain bridge and pavement inspection report data for damage model, and truck traffic data in many more key locations in the city.

For more information and to read the project's full report, visit the C2SMART website.

→ **Project Webpage**

→ **Final Report**

About C2SMART

C2SMART is a USDOT Tier 1 University Transportation Center taking on some of today's most pressing urban mobility challenges. Using cities as living laboratories, the center examines transportation problems and field tests novel solutions that draw on recent advances in communication and smart technologies. Our consortium includes New York University, Rutgers University, University of Texas at El Paso, University of Washington, and City College of New York.

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