ENVIRONMENTAL RESEARCH

As summer progresses, it’s easier to see the environmental opportunities and challenges on the State’s transportation system. The Department’s research program is playing a greater role in helping staff in all Department programs address environmental challenges that seem to become more complicated with each passing day.

Gary McVoy, Director of the Office of Operations and a member of AASHTO’s national panel developing a transportation vision, said “Throughout the country, people are demanding transportation projects and operations that are sustainable, that is - they protect or enhance communities or natural ecosystems for future generations. Environmental research helps transportation agencies deliver sustainable transportation.”

Mary Ivey, Director of the Environmental Analysis Bureau, said “Many times we find that environmental research does not address specific factors with the transportation system. Using transportation research to address environmental issues makes sure we are well informed about environmental concerns as we advance transportation programs.”

Many existing and new research projects, funded through SPR, Pooled Funds and NCHRP, are helping the Department with environmental stewardship, achieving the goals of our Environmental Priority Result Area and reaching the vision of sustainable transportation. Here is a sample of these projects:

- Deer-Vehicle Accidents (DVA’s) are a major safety and wildlife issue across the State. The Department is participating in a pooled fund effort to identify practices to minimize DVA’s. The Department is also funding an SPR project to develop best practices for deer composting, which may help control the costs of dead deer disposal in a manner that is safe to workers and the environment.
- Living Snow Fence is an umbrella term for vegetation that can eliminate or slow the incidence of blowing or drifting snow across highways. The Department has issued a Request for Proposals to research living snow fence and develop training presentations so this technique can be more widely used Statewide and yield safety, operational and environmental benefits.
- Trucks and automobiles are significant contributors to air pollution. Through a series of SPR and NCHRP projects, the Department is sharpening its analytical capacity to determine the air quality impacts of proposed transportation projects.
The Department is participating in an NCHRP project, initiated by AASHTO, to develop vegetation management guidelines for State DOT's. The project expects to develop a decision model that vegetation managers can use to decide whether to use mechanical controls, herbicides or other methods to control vegetation on given segments of a highway.

See more on the Department’s environmentally motivated research participation and projects on our web site at: https://www.nysdot.gov/portal/page/portal/divisions/engineering/environmental-analysis/research-and-training/environmental-research

CAPITALIZING ON CABLE GUIDE RAIL RESEARCH

New York State has been using and improving upon cable guide rail systems for over 90 years. While the system has generally performed well, the locations where it can be used have been limited by the large lateral distance over which it yields (deflection distance) when struck by an errant vehicle. The UK Department of Transport led a research effort to develop a system with a reduced deflection distance. British Ropes Limited (BRIDON) paid for the costs of the research and development and, as a result, were able to patent the product as BRIFEN cable guide rail. An American subsidiary BrifenUSA, was formed and several states made pilot installations.

The product developed as a result of the UK research has a mildly reduced deflection distance compared to the generic NYSDOT cable used with similar post spacing. However, the research used a high-tension, prestretched cable which typically allows the cable to remain at an effective height after mild impacts. While NYSDOT's experience with its generic cable system has been very favorable, it is a system that is typically rendered ineffective after most hits, requiring prompt repairs. Because the BRIFEN system reduced the urgency of repair, NYSDOT decided to pilot several BRIFEN installations and monitor their in-service performance. The first such installation was made near Sharon on NY 145, which has a low traffic volume. A second installation was recently completed on Route 7 in Schenectady. The product is significantly more expensive than our generic system, so the relative costs and benefits will be closely examined.

In addition to roadside guide rail, cable may also be used as a median barrier, provided it can be placed far enough away from each direction of traffic to ensure a vehicle impacting on one side does not deflect it into opposing traffic. New York developed a cable guide rail system over three decades ago, but has seldom used it. Other states, however, began to use that system or ones similar to it in their medians. Unfortunately, some vehicles managed to slip under the cables and cross the medians. Most of these were vehicles with low, aerodynamically smooth front ends. Research was conducted to determine the cause of the “under-riding”. It was found that vertical changes in the path of the vehicle caused it to bounce, sometimes severely, which would momentarily compress the vehicle’s suspension system, placing the front of the vehicle very close to the ground. If one of those moments coincided with the front end being at the cable median barrier, the lowered front end would wedge under the cables, lifting them up and over the car.

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The Federal Outdoor Impact Laboratory conducted crash testing on various cable barriers and median geometries. They determined that the bottom cable needed to be much lower than previously specified. Furthermore, the cables needed to have their vertical separation increased. At about the same time, several states noticed that significant numbers of severe injuries and fatalities were occurring due to vehicles crossing medians that had previously been considered wide enough to minimize that threat. As a result, the warrant for use of median barriers in wide medians was increased, creating a need for barriers to be placed in wide, traversable medians. Cable median barriers were seen as the most cost-effective and reliable means of meeting the need. The Office of Design recognized, however, that the old NYSDOT cable median barrier design did not reflect the results of recent research. The recent design recommendations from the Federal Outdoor Impact Laboratory (FOIL), however, were consistent with changes that the Office of Design wanted to make. Consequently, the Specifications and Standards Section of the Design Quality Assurance Bureau led an effort to produce a new set of specifications and standard sheets for a cable median barrier conforming to the recommendations provided by FOIL. The new design has been through the Department-wide clearance process. FHWA has verbally approved the design and indicates they will soon post it on their website as a nationally approved generic design. The Engineering Instruction with guidance on median barrier use and the Engineering Bulletin with the actual standard sheet will be issued very shortly. Research results indicate the new cable median barrier should be a highly effective and economical means of minimizing cross-median accidents on wide, traversable medians.

If you have any questions please contact Terry Hale @ thale@dot.state.ny.us

DEVELOPMENT OF HYBRID FRP-CONCRETE BRIDGE SUPERSTRUCTURE AND DECK SYSTEM

It is a major challenge to build bridge systems that have long-term durability and low maintenance requirements. One of the possible solutions to this challenge is the use of new materials or to implement new structural systems. Fiber reinforced polymer (FRP) composites have immense potential to play an important role in solving some of the persistent problems in infrastructure applications because of their high specific strength, light weight, and durability.

A study sponsored by the New York State Department of Transportation (NYSDOT), conducted at the University at Buffalo, focused on developing efficient bridge deck and superstructure systems that take into account the combination of FRP and concrete as the main constituent materials forming the structural system. The hybrid FR-Concrete (shown in Figure 1) consists of trapezoidal FRP cell units surrounded by an FRP outer shell forming a bridge system. A thin layer of concrete was placed in the compression zone. Concrete was confined by glass fiber reinforced polymer (GFRP) laminates which provide protection from environmental exposure. Moreover, the concrete layers provide enhancements to the top surface by minimizing the local deformation imparted by truck loading, and the webs of the box section were designed at an incline to reduce shear force between sections.

As part of this research, comprehensive analytical and experimental studies were conducted on two scaled bridge prototypes (shown in Figure 2). The first prototype is a bridge superstructure that was designed as a simply-supported single span one-lane bridge with a span length of 18.3 m, and the second prototype was an FRP-concrete bridge deck supported on steel girders. Results from both experimental
and computational analysis for both scaled prototypes have confirmed that the hybrid bridge superstructure and deck systems possess excellent structural performance. In particular, the hybrid deck represents an efficient system for replacing old and deteriorated concrete decks.

The final phase of this research is underway to evaluate the fatigue behavior and ultimate capacity of the hybrid deck connected to steel girders by shear studs. Upon completion of this final study, the hybrid deck will be in a position for field application to replace the concrete deck.

For more information on the project, contact the Principal Investigator of the project, Dr. Amjad Aref of the University at Buffalo (aaref@eng.buffalo.edu) or the NYSDOT Project Manager, Dr. Sreenivas Alampalli (salampalli@dot.state.ny.us).

VALIDATION OF RAILROAD WHEEL INSPECTION SYSTEM

The Department is working with the New York State Energy Research & Development Authority (NYSERDA) to fund development of an automated railroad wheel inspection system which has the potential to make rail transportation safer and more efficient. The contractor is International Electronic Machines Corp. (IEM) of Albany, and the demonstration of the system is being conducted in cooperation with CSX Transportation at their Selkirk Yard.

Modern railroad wheels are large steel forgings which are critical to the performance of the railroad as a transportation system with superior safety and energy efficiency. Wheels concentrate a load of over 15 tons onto an area less than that of a quarter and withstand this cyclical beating over hundreds of thousands of miles and thousands of thermal cycles due to braking. The detail profile of the tread and flange changes with wear and is important to tracking stability, and defects in the steel can eventually grow and result in catastrophic failure.

Maintaining the nationwide fleet of wheels requires geographically widespread, regular inspection to pick out those which have been worn or damaged outside of accepted tolerances. The traditional inspection technique has been by manual inspection using standards gauges, but recently this has been supplemented by newly-developed technologies. Among these new technologies, IEM has been supplying hand-held electronic wheel-profile measuring devices for several years, and has been developing a fixed wayside version using the same laser measurement principles.
The Selkirk Yard is one of the largest focal points of rail freight traffic flows in the northeastern US, which makes it an ideal location for an automated wheel inspection site. Most individual freight cars are sorted in the “hump yard” and, as such, all these cars are moved over the hump lead track, so this is the optimum single location for the system. The IEM system was put into full operation in April and is being integrated into the CSX car-routing data system so that all cars are properly identified and prioritized. When the system detects a defective wheel, the yard switching system automatically routes the car to the repair facility within the yard and, if necessary, can notify the car owner and/or the shipper of the potential delay. Additionally, while the NYSDOT/NYSERDA project is funding the basic installation with laser profile measurement, CSX and IEM are also piggybacking on the installation to develop wheel tread crack detection, brake shoe wear measurement and other emerging technologies.

The current project is to operate the system to demonstrate its functionality in the broader freight car management data system operating across North America. Eventually, with similar systems installed in multiple locations and continued integration of data systems between different operating companies, individual freight cars will be monitored for their continuing mechanical health, and trends in deterioration of performance can be identified before they cause uneconomic operation (including excess energy consumption) or an unsafe condition.

As IEM gathers operating experience, adjustments and design improvements are being made. A system testing thousands of wheels a day without direct human oversight must be set up with a robust decision tree built into its logic systems to select which cars to flag as bad-ordered. The cost of false-positives to the yard is significant — an hour and a half of time in the shop, at least, as any bad-ordered car must be fully inspected before it can be sent on. Thus, the “at the exact limit” approach would not be cost effective, as there would be a very large flow of cars entering the shop, a large number (close to 50%) of which would be false-positives. The ideal configuration would be one in which the margin of error just barely reaches the FRA limit. In the words of one engineer, “we want to just ‘tickle’ that limit — get maybe one false-positive a week or two, which tells us we are just on the limit.” At that point, we know that we are not letting any cars go by which have truly significant defects, but are not wasting many hours of shop time with false positives.

Please contact Jeff English if you have any questions, jenglish@dot.state.ny.us

NEW YORK STATE’S WASTE TIRE BENEFICIAL USE INITIATIVE

There are approximately 35 million tires in both legal and illegal waste sites throughout New York State. As a responsible state agency, NYSDOT is taking steps to assist the Department of Environmental Conservation (DEC) with the cleanup of waste tires by providing a market for their use. This market consists primarily of using these tires, in shredded form, as a replacement for conventional embankment fill. DOT’s first step was to demonstrate that it could safely construct such an embankment. In 1999, DOT initiated a pilot project in Broome County that used 267,000 tires in the construction of

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an off ramp from Route 17. To date, the ramp is performing very well.

In 2003, the DOT embarked on an ambitious program that identified projects where tire shreds could be beneficially used. A new process was developed that addressed material quality issues. Through the development of strong ties with other state agencies the DOT is now in position to beneficially use tire shreds on a production basis. NYSDOT’s efforts under the tire shred initiative include training and certifying tire shred inspectors, performing quality assurance sampling and testing, providing construction specifications, and performing design functions. Guidance for sampling and testing, as well as for selecting appropriate projects, is shown in GCP-19; Procedure for the Sampling and Testing of Tire Shreds, and GEM-20; Guidelines for Project Selection, Design and Construction of Tire Shreds in Embankments.

In 2005, over 1.4 million tires were used. In 2006 another 1.3 million tires were placed. Starting in May 2007, tire shred placement began for the Route 219 project in Springville. About 10,000 tons (equivalent to 900,000 tires) have been placed to date. Future projects may include: I-81 over Penn Central, 200,000 tires; Rte 17 Elmira-Lowman, 21 million tires; Rte 213 Rifton Slope Repair, 85,000 tires. Tire shreds are proven to perform as designed, are easy for the contractor to place, and make a positive contribution to the Department’s Environmental Initiative.

For additional information on the Department’s use of tire shreds in embankments please contact Don Dwyer ddwyer@dot.state.ny.us.

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