WORK ZONE SAFETY

While various signs, signals, and other warnings are crucial to obtaining good driver compliance in work zones, there are situations where positive shielding is needed. For these situations, Temporary Concrete Barriers (TCBs) are used. Each 20’ section weighs nearly 4 tons. They are joined together with stout connections to act as a continuous barrier. However, even with the large masses involved, the TCB can slide substantially when struck by an errant vehicle. This presents a risk that a worker could be crushed between a moving four-ton block of concrete and a large piece of equipment or material in the work zone. Alternatively, a piece of TCB could be knocked off of an overpass deck into traffic, or off a road into an excavation where workers were installing a pipe or culvert.

To minimize the movement of TCBs when struck, the TCBs are built with vertical holes through the shoulders so that 1” diameter steel pins can be driven through them and into the underlying pavement to anchor the TCB in place. While this practice may be tolerable on asphalt highway pavements, it is not desirable on bridge decks, as the holes, even when patched, can contribute to accelerated deterioration of the expensive bridge decks.

A means of reducing TCB deflection without having to drill into bridge decks was needed. Engineers in the Department’s Design Quality Assurance Bureau came up with the idea of stiffening the connection joints by fastening sections of 12’ lengths of box beam guide rail to the work side of the TCB across the joints. Crash testing was needed to determine how effective this treatment would be at reducing the deflection of a TCB into the work zone or towards the edge of a bridge.

Additionally, testing was needed to update the deflection data for normal TCB installations, since the old deflection data was not conducted to current standards.

The Midwest Roadside Safety Facility in Lincoln, Nebraska was contracted to perform crash testing.

In order to provide results that would meet current testing criteria well into the future, NYS-DOT chose to have the testing performed in accordance with the new MASH (Method of Assessing Safety Hardware) rather than the then-current NCHRP-350 criteria. The MASH criteria were officially accepted by AASHTO and the FHWA a few months after the TCB testing was completed.
To establish a baseline for determining the effectiveness of the box-beam-stiffening of the TCB, one test was run with the TCB in its standard configuration. This involved a run of ten pieces with only the pieces on either end pinned to the pavement. The MASH Test Level 3 impact had a 5000 lb pickup truck crashing into the TCB run at an angle of 25 degrees and a speed of 62 mph. When the concrete dust had settled, the TCB was cracked in several places and had moved 39 inches.

For the initial box-stiffened TCB test, 6”x6” box beam tubes with a wall thickness of 3/16 inch were bolted to the workers’ side of the TCB, as shown. When the same crash test impact was run, the TCB deflected 26 inches and again had several cracks. The deflection had been reduced by 1/3. While reducing the deflection by over a foot was a good result, it had been hoped that an even better reduction could have been achieved.

In the hopes of further reducing the deflection, it was decided to repeat the test, but with a stouter median barrier box beam as the stiffener. This box is 6”x8” and has a wall thickness of ¼”, making it nearly four times as rigid. Surprisingly, when the test was repeated, the deflection was once again 26”. It was concluded that the box beam were both effective at reducing the deflection at the joints, but that the concrete barrier itself was the controlling factor. With the barrier cracking and effectively bending, further stiffening of the joint would not lead to any significant improvements.

The question still remained as to how much the TCB would deflect if it was pinned to the pavement along its length, rather than just at the ends. The old guidance had suggested that only every other piece needed to be pinned in order to fix the run in place. One representative from the Department’s Construction staff pointed out that it is undesirable for workers to have to be between moving traffic and the barriers in order to install the pins through the shoulder. It would be preferable for the pins to only need to be installed on the side where the workers would be shielded from traffic while installing them. Prevailing national opinion was that TCBs needed to be pinned on both sides to prevent the TCB from pivoting about the backside toe and turning over. However, NYSDOT’s TCB connection is unique and sturdier than those used by other states. In particular, the arrangement allows adjacent pieces to better support each other against overturning. For these reasons, the Department intended to prove that it was feasible to pin our TCBs on the worker’s side only. The fourth crash test was set up with every other piece of TCB pinned on the worker’s side only and with four pins in each pinned piece.

When the test was run, the pickup was successfully, but violently redirected. Somewhat surprisingly, the maximum deflection, 53”, was greater than obtained with the earlier tests.
It was determined that the earlier tests had allowed the impact energy to be absorbed by the minor movement of several barriers. However, with alternate pinning of units, all of the impact energy into an unpinned piece had to be absorbed by shear force on the connection. The concentrated force ripped the connection open, allowing localized large deflections of the loose ends.

It was decided that an additional test was needed with four pins in the worker's side of each TCB unit. When the crash test was run, the deflection of the TCB was reduced to only 8”.

As a result of the testing program, a new Standard Sheet has been developed showing the details of the 6”x6” box beam stiffening. Revision to Section 619 of the Standard Specifications was initiated to reflect the newly determined standard deflections of:

- 39” for ends-only pinned,
- 26” for box stiffened, ends pinned
- 8” for all work side pieces pinned.

NYSDOT COMPLETES I-90/SCHODACK COMMERCIAL VEHICLE ELECTRONIC SCREENING PROJECT

NYSDOT, in partnership with the I-95 Corridor Coalition, Federal Highway Administration (FHWA) and Federal Motor Carrier Safety Administration (FMCSA), has completed the installation of a commercial vehicle electronic screening (e-screening) system deployed on Interstate 90 in the Town of Schodack, Rensselaer County.

Located along the westbound portion of I-90 one-quarter mile west of Exit 12 (Hudson), the innovative installation is the first integrated commercial vehicle e-screening system deployed in New York State. Utilized by NYSDOT and New York State Police (NYSP) commercial vehicle roadside enforcement personnel, the e-screening system will soon become an integral component of the commercial vehicle inspection operations that routinely take place at the I-90 Schodack Rest Area, situated in close proximity to the new installation.

This ITS installation collects, stores and transmits a variety of real time highway information including traffic speeds, volumes, classes and weights as well as weather and road conditions. The prototype system will provide continuous 24/7 highway data collection, which will meet all current State and federal traffic data collection requirements. It will be integrated with other NYSDOT data collection systems and used for many NYSDOT program area purposes including planning, capital programming, commercial vehicle weight compliance and safety enforcement, asset management, operations and maintenance.

Additionally, the system will be capable of pre-screening commercial vehicles for weight compliance and credential status incorporating advanced ITS technologies such as transponder readers, license plate reader (LPR) cameras and mainline high speed weigh-in-motion (WIM) devices. The information ob-
tained from this non-intrusive system will assist roadside enforcement personnel in making more in­
formed and strategic decisions concerning commercial vehicle enforcement activities and will ultimately
allow credential and weight compliant vehicles to bypass inspection/weigh stations altogether. This
installation at Schodack will also serve as a prototype for all future e-screening system deployments
Statewide.

The direct advantages of utilizing e-screening technology, which include improving efficiency and pro­
ductivity for New York State’s commercial vehicle enforcement operations as well as the commercial
vehicle industry in general, is complimented by the resultant environmental benefits. As a result, com­
mmercial vehicles are less likely to be required to park and idle at inspection stations equipped with such
technology, thus greatly decreasing exhaust greenhouse gas emissions and noise pollution in the sur­
rounding areas, and improving fuel economy for all compliant commercial vehicles not required to stop
or decelerate/accelerate needlessly. Additional benefits include an easing of traffic flow in the areas
surrounding the inspection/weigh station by reducing congestion in such areas as well as a presumed
reduction in infrastructure damage associated with heavy commercial vehicles.

WIM technology is the most critical component of these
roadside commercial vehicle e-screening based systems. However, using WIM technology for high speed mainline
commercial vehicle pre-screening is a relatively new appli­
cation for this equipment. Consequently, verified perform­
ance data and real world based comparative field results for
important factors such as system life cycle costs can be diffi­
cult to obtain. In addition, the WIM device and the pave­
ment it is installed in (type and condition) are the single
largest roadside cost factors and drive the overall cost of the
roadside installation. Since most commercial vehicle e­
screening safety operations, by necessity, will involve nu­
merous statewide e-screening sites involving many roadside
devices costing millions of dollars, it is imperative that the
many factors involved in choosing the best WIM technology be investigated and researched based on
real world, field based evaluation for successful regional/Statewide deployment and long term opera­
tions.

Due to this lack of available information, NYSDOT is utilizing
the Schodack/I-90 e-screening system as a test bed, in order to
identify the most appropriate WIM technology for integration
with electronic screening systems. At this site, NYSDOT has
researched, procured and installed the three most promising
WIM technologies available for integration with roadside e­
screening operations. These selected WIM technologies have
been installed at the same location and are being field tested
(ongoing) in identical weather and traffic conditions to allow for
an objective evaluation and comparison. Additional factors to
be evaluated include weather impacts and the WIMs’ field per­
formance on standard, asphalt based pavement. While there
have been individual studies on the various types of high speed
WIM use and accuracy involving high cost, specialized concrete pavement, there is very little, if any,
data available for a comparative analysis under field conditions at a specific, integrated site where
pavement conditions are less then ideal. This research effort is addressing many of these issues and
will ultimately provide comprehensive, field based data and information that will help transportation
agencies decide the most appropriate and cost-effective WIM technology for e-screening integration and
asset management.

This new e-screening system will result in focused commercial vehicle enforcement and increased com­
pliance, increased highway safety due to improved inspection station traffic flow, and will ultimately
lead to significant environmental advantages. The installation will also serve as a research and development site for the various deployed technologies and will serve as the model for all future developments.

If you would like additional information about this installation or commercial vehicle e-screening systems in general, please contact Richard McDonough, rmcdonough@dot.state.ny.us or Brian Galvin, bgalvin@dot.state.ny.us.

RENSSELAER’S LIGHTING RESEARCH CENTER DEVELOPS RECOMMENDATIONS FOR ROADSIDE LIGHTING AND VEGETATION

Through Program Opportunity Notice 1173, Sustainable Transportation Systems, a joint effort of the New York State Department of Transportation (NYSDOT) and the New York State Energy Research and Development Authority (NYSERDA), the Lighting Research Center (LRC) at Rensselaer Polytechnic Institute was funded to conduct a study to identify opportunities for energy-efficient lighting systems, used in conjunction with roadside vegetation. The aim of the Phase 1 feasibility study was to evaluate options for low-power lighting solutions which, in combination with vehicle headlights and appropriately planned vegetation, could provide visually effective information to drivers and improved detection of pedestrians and potential roadway hazards.

The evaluations included photometric simulations and economic analyses for several roadway facility types including roundabouts, curved exit/entrance ramps, and tree-lined urban boulevards. Roundabouts proved to be an especially good candidate for energy-efficient lighting solutions because they are typically illuminated to relatively high light levels using overhead, pole-mounted roadway lighting systems that are quite energy-intensive. The LRC project team also measured the color and lightness properties of a number of potential roadside bushes, grasses and shrubs that could be candidates for use along roadway edges to provide additional visual guidance to drivers.

The project team evaluated combinations of vegetation and landscape lighting along roadways to provide visual information to drivers, including during conditions of wet pavement.

The LRC's approach to integrating lighting and vegetation, coined *ecoluminance*, uses existing headlight illumination and low-power landscape lighting to illuminate vegetation, retroreflective delineators, and bollard-level lighting for use in traffic conflict areas, crosswalks and pedestrian areas. The objective of this lighting approach is to utilize lighting only where it is most needed, and allow the luminance (or reflected brightness) of materials such as vegetation to serve as part of the planned visual...
environment, with resulting reductions in energy use and light pollution.

The results of the project team’s analyses were presented to a roundtable group consisting of individuals from NYSDOT, NYSERDA, the Federal Highway Administration, the Capital District Transportation Committee, the Town of Colonie, National Grid and Friedman Fisher in order to obtain feedback and to finalize recommendations for a potential Phase 2 demonstration of the ecoluminance concept.

The ecoluminance toolbox includes (a) vegetation, (b) retroreflective delineators, (c) landscape lighting and (d) low-level, optically controlled lighting for illuminating traffic conflict points.

Based on the LRC’s evaluation results, the project team recommended a demonstration of the ecoluminance lighting approach at a roundabout in New York’s Capital District. The LRC will collaborate with the State University of New York’s College of Environmental Science and Forestry on the demonstration project, which will also have in-kind support from General Electric Lighting through lighting system product donations. The Phase 2 project is slated to commence in 2010, and will also include a short-term demonstration of “white light” from light-emitting diode (LED), induction or metal halide lamps to test whether these sources can provide increased brightness while using less energy than conventional overhead lighting systems.

This article was contributed by John D. Bullough, LRC, Rensselaer Polytechnic Institute. The Phase 1 report is online at: http://www.nysdot.gov/divisions/engineering/technical-services/trans-r-and-d-repository/LightingVegetation-C-08-03-10628.pdf. For additional information, please contact Joseph D. Tario, NYSERDA, at mjdt@nyserda.org.

TRANSPORTATION RESEARCH BOARD ANNUAL MEETING

The Transportation Research Board (TRB) 89th Annual Meeting was held in Washington, D.C., January 10-14, 2010. The information-packed program attracted more than 10,000 transportation professionals from around the world. The Visual Aids Presentations Online Library from the majority of Workshops, Lectern and Poster Sessions presented during the TRB 89th Annual Meeting and e-Sessions (visual aids, video, and audio recording) from more than 40 sessions will be available on the TRB website via the Video on Demand Series very soon. The TRB 89th Annual Meeting Compendium of Papers, which includes more than 1,900 papers, is now available in the Research Library.