REMOTE MONITORING OF THE BROOKLYN BRIDGE

The Brooklyn Bridge has been a major transportation artery for New York City since 1883. With a length of 1595.5 ft (486.6 m), the main span nearly doubled the record of its time. The bridge approaches represent 72 of the 75 spans, and include both steel structures as well as masonry arches of varying size. One-third of the current and future rehabilitation projects on this bridge have been and will be related to the approach spans. While awaiting the execution of some of the pending contracts, the Brooklyn Bridge approaches are under intensive visual monitoring by the bridge inspection forces of New York City Department of Transportation (NYCDOT). Brick masonry arches are notoriously unsuitable for visual inspections because of their high sensitivity to the smallest of motions. In particular, the brick and stone masonry arches on the Manhattan side had developed cracks. Decisions were made to instrument and monitor these vaults in order to ascertain their safe operation until the forthcoming rehabilitation. In addition to safety considerations, the monitoring program was designed to provide feedback to the bridge authority on the severity of the crack openings and their cause. It is anticipated that such data will not only provide reassurance on the structural stability of the arch structure but will also help provide guidance to design more economical and efficient repairs.

The main assumptions behind the principle of unreinforced vaulted masonry structures are that they only carry forces in compression, and no support sliding is allowed to occur. Sliding or movement of supports induces tension and causes cracking of the vaults. Because of the existing vault cracks it was decided to also monitor the wall movements using tilt-meters and wall displacement gauges. Temperature sensors were used to compensate for thermal movements. Accelerometers were also employed to correlate the structural movements with traffic and other live load induced motions on the bridge. A fiber optic sensor system based on Bragg gratings (FBG) was used for this project. The system provided the most economical monitoring solution since it only required one instrument for all the different sensor types, i.e. crack gauges, tilt-meters, displacement and temperature sensors, and accelerometers (Fig.1). Moreover, it had the capability for...
serial multiplexing of the sensors simplifying the installations and monitoring, since all the forty sensors installed in the bridge required only four cables for data acquisition and monitoring. The fiber optic sensors are controlled by a computer and interrogator system that is housed in a metal cabinet within the arch structure (Fig.2). Dedicated software was installed for remote monitoring of the various sensors. Electrical power was available at the bridge site, but there was no means of internet access for transmitting the data from the remote site. Instead, a cellular broadband modem was used. The cellular reception inside of the arch structure was limited due to the thick masonry walls. To remedy this problem, an RV antenna was used with a low-loss coaxial cable to extend the cellular signal from outside. The installations were completed in early March 2009, and the approach slabs have been monitored over the internet by NYCDOT since then. Typical signal history from one of the vault crack sensors is shown in Fig.3.

This project was funded as part of a pooled fund study participated in by the New York State Department of Transportation. The project Principle Investigator is Prof. Farhad Ansari of University of Illinois at Chicago (fansari@uic.edu) working closely with Dr. Bojidar Yanev of the New York City Department of Transportation (byanev@dot.nyc.gov). For more information on this project, contact either Prof. Ansari or Dr. Yanev. Dr. Sreenivas Alampalli was the technical contact for the pooled fund study from the NYSDOT (salampalli@dot.state.ny.us). If there are any potential applications for use of this technology in the Department, contact Dr. Sreenivas Alampalli.
TRUCK STOP ELECTRIFICATION INFRASTRUCTURE

Truck Stop Electrification (TSE) and Advanced Truck Stop Electrification (ATSE) have become national catch phrases in recent months as a result of the American Recovery and Reinvestment Act of 2009, which included a $200 million stimulus to develop a “Green Corridor” infrastructure along the major truck routes. The country comes late to a program that the New York State Energy Resource and Development Agency (NYSERDA) has been working on for several years. NYSERDA has worked with companies such as IdleAire and Shorepower Technologies, and most recently, with EnviroDock, Inc., to develop TSE and ATSE technologies and to have these systems installed at several New York state truck stops and rest areas.

Truck Stop Electrification is a phrase that covers systems that allow long haul truck drivers the option of turning off their engines while they rest the required ten hours out of every twenty-one hours on the road. TSE systems provide electrification to the parking area of the truck stop so that the drivers can power their own on board heat and air conditioning, or connect to an off board heating and air conditioning system (ATSE). The diesel idling regulation is found in Title 6 NYCRR, Subpart 217-3 and will be enforced by Department of Environmental Conservation Officers. For idling more than five minutes, a driver may be fined from $375 to $15,000 in the case of a first violation.

EnviroDock, Inc. (a New York corporation headquartered in White Plains) has installed ATSE and TSE systems at two truck stops: Plaza 23 Truck Stop at the Port of Albany, and Canaan Truck Stop at exit B3 on I90 in Canaan, NY. The EnviroDock HVAC systems are “off board” systems powered by electricity from the grid. Each HVAC unit requires 20 amps for heat or air conditioning, 15 amps for powering the driver’s convenience items (like coffee maker or laptop) and 15 amps for an off board plug for engine block heaters used during cold weather. The off board TSE shorepower unit (called PowrDock) requires the same 50 amp power from the grid.

Over the course of the past three years, EnviroDock has been able to solve two very difficult problems: the issue of the dozens of different truck window configurations; and how the system is to be turned on and off for the required (paid) period of time. During the time of EnviroDock’s NYSERDA award period, the company was able to test these systems and both installations (in Canaan NY and Albany NY) are fully operational and well utilized. Drivers are very pleased with the performance of the systems and the ease of installation of the window service modules into their truck windows.

At Canaan, five EnviroDock systems and one PowrDock system were installed with NYSERDA assistance in July and August of 2009.

Every hour a diesel truck idles wastes one gallon of fuel. Every gallon of diesel burned discharges 22.2 pounds of CO2 into the atmosphere. Building an idle free infrastructure is critical to future reduction in greenhouse gases. NYSERDA is working hard to assist in the development of products like EnviroDock to build that infrastructure.

For more information, contact: Joe Tario  862-1090 ext 3215  jdt@nyserda.org
NDE/NDT FOR HIGHWAY BRIDGES: STRUCTURAL MATERIALS TECHNOLOGY (SMT) 2010 CONFERENCE: CALL-FOR-PAPERS

The New York State Department of Transportation is once again co-sponsoring the “NDE/NDT for Highway Bridges: Structural Materials Technology (SMT) 2010 Conference” and invites abstracts for presentation at the conference and publication in the conference proceedings. This conference will be held in the New York LaGuardia Airport Marriott near New York City, NY on August 16-20, 2010. The goal of this conference is to assemble owners, researchers, industry, academicians, and practitioners concerned with condition assessment and nondestructive evaluation (NDE) of highways and bridges. In an informal conference setting, participants and presenters discuss innovative new NDE/monitoring technologies, best practices for applying existing technologies, and significant challenges faced by owners trying to assess existing bridges and infrastructure. The conference is designed to promote the exchange of information between researchers, practitioners and highway infrastructure owners with emphasis on case studies.

More information on the conference, abstract submission instructions, and exhibitor information can be found at the following url: http://www.asnt.org/events/conferences/smt10/smt10.htm

Dr. Sreenivas Alampalli (salampalli@dot.state.ny.us) of the NYSDOT is chairing the conference with Frank Jalinoos (frank.jalinoos@dot.gov) of FHWA. If you need more information, you can contact either of them.

BRIDGE ELEMENT DETERIORATION RATES

How long will a new steel superstructure last? When will a concrete bridge deck need to be replaced? How much longer does a deck with epoxy coated rebar last versus one with uncoated rebar? These are the types of questions that the recently completed research project, C-01-51: “Bridge Element Deterioration Rates,” hopes to address. The objective of this project was to develop a computer program to calculate bridge element deterioration rates for typical bridge elements. Using the historical bridge inspection information that has been collected since 1981, deterioration rates can be generated for various bridge elements such as superstructure, deck, pier and abutment. The condition assessment of the bridge infrastructure of New York State (NYS) and the ability to predict life cycles is crucial in planning maintenance, repair and rehabilitation (MR&R) and in developing the capital program, as well as making bridge design type selections. The Bridge Element Deterioration Rates computer program will serve as an additional tool in making effective bridge management decisions.

Accuracy of the program’s results was improved using filtering and reconditioning of the inspection data to account for rehabilitation, inspector subjectivity, sudden drops in ratings due to vehicle or vessel collision, and miscoding of inspection ratings. Extensive investigation of different statistical approaches was carried out, and Markov chains and Weibull based approaches were selected to calculate the deterioration rates. The deterioration curves, i.e., condition ratings as a function of time, are output in the form of graphs and equations. The results can also be exported to a spreadsheet. These equations can be input into a Bridge Management System, such as Pontis, for effective bridge management operations.

The completed computer program includes the ability to investigate effects of numerous factors that may influence the deterioration rate, including AADT, climate, DOT regions, ownership, design types, etc. A versatile cascading approach was developed to classify bridge elements on the basis of selected factors. The pro-
gram also allows the deterioration model to be updated and re-calibrated with the availability of new inspection data. The obvious benefits of this research are the availability of new and continuously updatable deterioration rate curves for New York State bridge management decision making.

For further information contact Scott Lagace at slagace@dot.state.ny.us

A copy of the report can be found at:

http://www.trb.org/Main/Public/Blurbs/Bridge_Element_Deterioration_Rates_Final_Report_162045.aspx

Example output from the program developed as part of the research project.

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