Ontario's Transportation Technology Transfer Digest
MINISTRY OF TRANSPORTATION
RoadTalk
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A New Angle on Safety!

Innovative Mobile Work Zone Barrier on Highway 115 Project

This past summer, the Ministry of Transportation (MTO) tested an innovative work zone barrier system during a full and partial depth concrete repair project on Highway 115, a busy four lane highway southwest of Peterborough. The new barrier system is fully mobile and consists of a modular unit on wheels pulled by a standard truck tractor. The reversible axles of the mobile unit allow it to be easily reconfigured for either right or left applications in as little as 30 minutes. The mobile unit's bright, construction orange colour helps alert drivers that road work is taking place. The unit also comes equipped with an approved energy attenuator.

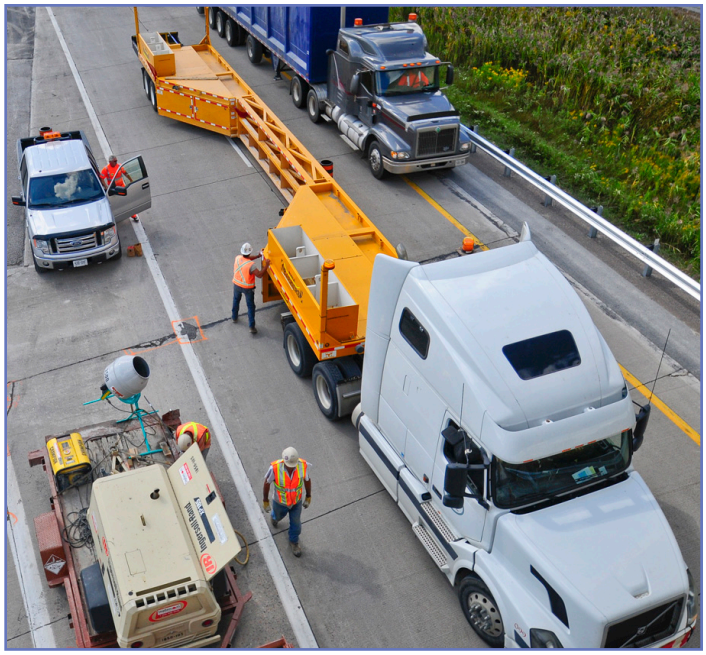
The mobile unit can be deployed in minutes and alleviates the need for road crews to use Temporary Concrete Barrier (TCB), allowing them to finish road work and re-open a highway lane in less time; an important factor as Highway 115 has a peak daily traffic average of 16,699.

The mobile work zone barrier increases the safety of the maintenance and construction crews and is customizable to suit the job site. By adding panels, the mobile barrier can be expanded from 13 to 31 metres in length. Other options available to customize the mobile work zone barrier include adding one or more of the following: Portable Variable Message Sign, speed detection device, portable generator, lighting, rear wheel steerable axle, and privacy barrier. The unit meets U.S. National Cooperative Highway Research Program 350 TL-3 crash test requirements.

A presentation about mobile work zone barriers at the 2010 Annual Conference of the Transportation Research Board meeting in Washington brought this innovation to MTO's attention. After some initial investigation, MTO decided to trial a mobile unit on the Highway 115 project as an alternative to TCB.

The contract for the Highway 115 project was advertised with two options. Option A specified the use of TCB for all full and partial depth concrete repair areas; while Option B specified the use of a mobile unit for partial depth repairs and TCB used only at full depth areas. When the competition closed, bids for the Option B came in priced about one quarter less when compared to average bids for Option A.

The mobile unit performed extremely well in providing a safe area for workers and was positively received by other external agencies such as Ministry of Labour and Ontario >



A mobile work zone barrier being moved into place for Highway 115 road work.

Road work takes place on Highway 115 while traffic moves safely along the other side of the mobile work zone barrier.

Innovative Mobile Work Zone Barrier on Highway 115 Project, *continued*

Provincial Police. Once the project started, Tyler Graham, MTO Contract Administrator on the Highway 115 trial, observed, "It was readily apparent that the mobile work zone barrier was very time effective… [The construction crew] easily adapted to working behind it and felt very confident in the level of protection it provided." In addition, a Change Proposal was submitted by the Contractor to eliminate almost all of the remaining TCB and use the mobile work zone barrier in its place. This Change Proposal saved an additional $80,000 from the original winning bid.

Due to the use of the mobile work zone barrier on the Highway 115 project, the Contractor's schedule was advanced. Repair work, saw cutting, concrete removal, installation of dowels, placement of concrete, and curing were all done as a single operation.

Future MTO applications using the mobile traffic barrier are expected due to the trial's positive outcomes. Potential uses for the device are numerous and could include providing work zone barriers for pothole filling; crack sealing; pavement testing; bridge repairs, investigations, and washing; accident scene investigations and cleanup; guide rail and barrier repairs; illumination repairs and maintenance; and, pre-engineering activities. •

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Listen to audio interviews on the MTO Website:
Interview 1 (1:49 min) and Interview 2 (1:44 min) with Darren Waters, Senior Project Engineer, about the trial while it was underway.

Transcripts for both interviews can be located here: Interview 1 and Interview 2.

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Water Works

An Innovative Alternative for Culvert Clearing

The Ministry of Transportation (MTO) has found a cost effective, time-saving alternative to culvert clearing that does not involve the use of vacuum trucks. In July 2008, the ministry tested the use of high-pressure water to clear a 1.2 m x 20 m, corrugated steel pipe culvert on Highway 590, a low-volume secondary highway near Thunder Bay, in Northwestern Ontario.

MTO typically uses vacuum trucks to clear culverts that accumulate large amounts of granular deposits, over time or after excessive rain fall. However, vacuum truck operations are expensive, time consuming, and cannot remove larger rocks. Culvert replacement is also expensive.

When a major storm in June 2008 clogged a Highway 590 centreline culvert with gravel and rock, blocking 75 percent of culvert capacity, MTO staff conceived an innovative solution to wash out the culvert. MTO contacted the local Fire Chief to develop a culvert clearing plan using a few interested volunteers and a high pressure fire hose. The culvert in question was in good condition and absent of standing water.

On the day of the trial, the ministry's Area Maintenance Contractor prepared the site by using a backhoe to dig a 1m x 1m x 0.5 m hole at the culvert outlet, to serve as a sump for material to be washed out. Volunteers from the Township of O'Connor Fire Department arrived with a pumper truck and a tanker truck filled with 20,000 litres of water. Fire Department volunteers then set up a ground mounted, mechanically aimed, monitor nozzle at the inlet end of the culvert. The 3 cm monitor nozzle, attached to a 6.35 cm pressure line connected to the tanker and pumper trucks, aimed a precise water stream to clear the furthest reaching point of the culvert debris first. Water was pumped at 1,230 litres per minute at 100 psi.

Once the monitor nozzle began pumping water into the culvert, it became evident to trial observers that the experimental cleaning method would be successful. After 28 minutes and 40,000 litres of water, 20 tons of debris were flushed from the culvert; in fact, gravel and rock exited the culvert faster than the backhoe could clear the sump at the end of the pipe. Ministry staff concluded that any pipe not more than 80 per cent blocked with material, with a span short enough to reach near the end with a similar pump/nozzle configuration, could be flushed out very economically using this method.

Several conditions should be present to consider future possible culvert locations for clearing with high-pressure water. They include: accessibility of appropriate equipment; a local fire department able to participate; a culvert in reasonably good condition; and absence of standing water. Many of MTO's ditches dry up during the summer, making this time-frame optimal in applications for culvert flushing by water, and avoiding Ministry of Natural Resource or Department of Fisheries & Oceans issues.

MTO will continue to consider similar flushing applications of suitable culverts to compare costs with typical solutions of culvert replacement or cleaning using a vacuum truck. A schedule to flush culverts that regularly accumulate debris could avoid more involved and costly maintenance measures in the future. •

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The culvert on Highway 590 filled with gravel and rocks after a June 2008 rain storm.

Township of O'Connor Fire Department assisted MTO in clearing the culvert with an experimental high-pressure water method.

Culvert debris was easily displaced and discharged.

The Highway 590 culvert after high-pressure water cleaning.

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Many Innovations Make Light Work

Dingman Drive Bridge Repaired Using a Suite of Cost-Saving Innovations

On August 3, 2010, a truck carrying a hydraulic excavator struck the four-span Dingman Drive Bridge over the westbound lanes of Highway 401 near London, Ontario. The truck hit three out of five pre-stressed concrete bridge girders, resulting in extensive damage. Several innovative products and processes were used to perform the repairs, resulting in cost and time savings for the ministry compared to full girder replacement.

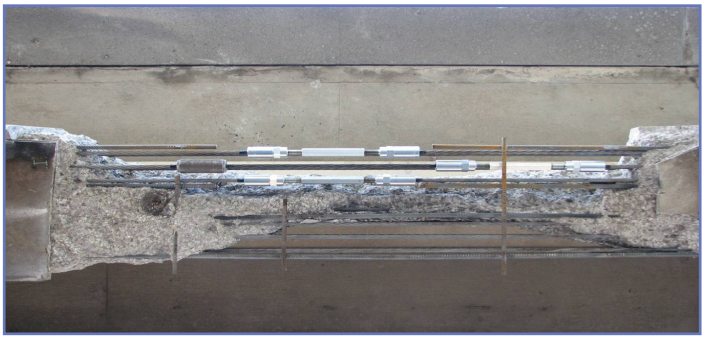
Innovations used in the Dingman Drive Bridge repair include: the use of *Grabb-It*® couplers, Self Consolidating Concrete, Carbon Fibre-Reinforced Polymer sheets and a Mobile Traffic Barrier. Bridge repairs were completed by the end of October 2010 through a successful collaborative effort between the Ministry of Transportation (MTO), and service providers: design consultant Stantec, contractor Steed & Evans, and structural subcontractor McLean Taylor.

Developed in the United States, the ***Grabb-It***® is a coupler system that permanently reconnects broken strands in bridge girders, to restore the load carrying capacity of the structure, without having to replace the damaged girders. The *Grabb-It*® device is attached to each end of the severed strand and a threaded coupler (similar to a turnbuckle) is tightened, thereby reinstating the prestressing force in the strand. Although MTO has been aware of the *Grabb-It*® system for a number of years, this repair project was the ministry's first opportunity to use the device. Before the couplers were used on the repair itself, MTO staff practised with the *Grabb-It*® on a model and developed a detailed procedure for the contractor to install the devices. Working with the *Grabb-It*® on site proved more difficult than expected to obtain the desired force in the strands. Force in each strand was determined using a torque wrench to tighten the coupler device and measuring the elongation of the strand. A total of six *Grabb-It*® couplers were installed on two girders, reinstating the pre-stressing force in the girders close to their pre-collision status.

Damage to the Dingman Drive Bridge, looking eastward.

Collision-damaged strands on one of the bridge girders.

Self Consolidating Concrete (SCC) was used to repair the damaged concrete girders. SCC is a highly flowable concrete that does not require vibration-based consolidation and can be readily pumped. It is well suited for use where there are tight confines within a given structural repair and concrete consolidation is a concern. Although the installation of *Grabb-It*® couplers caused significant congestion around the exposed prestressing strands and reinforcing steel in the repair areas, the use of SCC resulted in a high quality, durable concrete that required minimal finishing when the forms were removed. >



Using the *Grabb-It*® splice coupler system to re-tension girder strands.

Workers pumping Self Consolidating Concrete to reinstate damaged girder.

Dingman Drive Bridge Repaired Using a Suite of Cost-Saving Innovations, *continued*

Sheets of woven **Carbon Fibre-Reinforced Polymer (CFRP)** fabric were placed over the concrete repair areas to further strengthen and protect the girders. CFRP fabric is light and can be readily attached to the contours of a concrete girder with an epoxy adhesive system. Three layers of CFRP strips were installed on the underside of the girders and evenly spaced vertical strips of CFRP were installed on the webs of the girders using a multi-step process. The proprietary process included diamond grinding all sharp concrete edges, application of a primer and an epoxy putty, rolling the CFRP fabric onto the epoxy putty, coating the CFRP with a saturant and finally covering the entire repair area with an ultra-violet protective coating.

A **Mobile Traffic Barrier** was used for the duration of the Dingman Drive Bridge repairs to protect construction workers from freeway traffic. The mobile barrier unit consists of a trailer that is towed into place by a standard truck tractor and then parked to provide worker protection. First used by MTO on a project on Highway 115, the Mobile Traffic Barrier continues to impress contractors and staff in several ministries because of its ease and speed of set-up compared with conventional work zone protection equipment, such as temporary concrete barriers. To minimize disruption to Highway 401 traffic, two of the three westbound lanes were closed on a nightly basis to complete the repairs on the Dingman Drive Bridge. The Mobile Traffic Barrier was removed each morning, opening all lanes during peak traffic hours.

The collaborative relationship between ministry staff, consultant and contractors contributed to the successful implementation of new innovations for the repairs. The suite of innovative techniques was well matched to the repair project's needs and improved repair timelines. Also, the use of these innovations significantly reduced costs when compared to full girder replacement. •

Application of CFRP strips with a roller.

Mobile Traffic Barrier in use under the Dingman Drive Bridge.

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