

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.

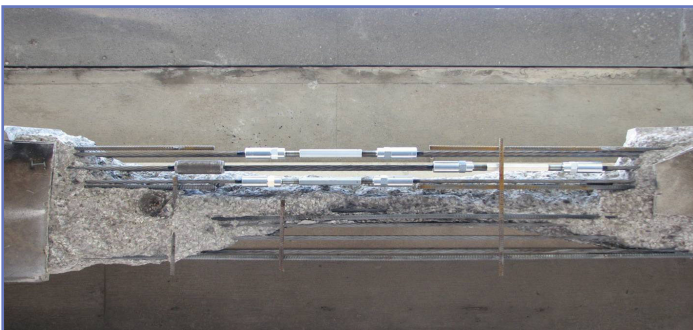


Damage to the Dingman Drive Bridge, looking eastward.

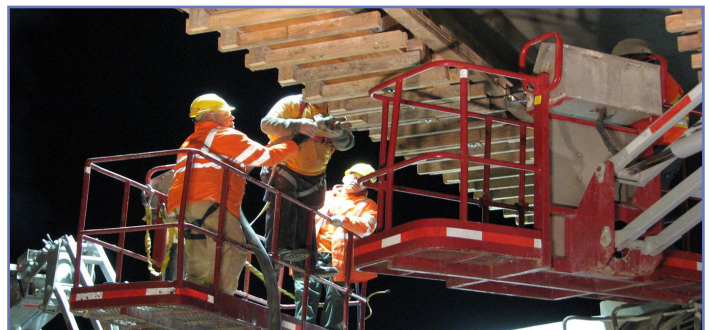


Collision-damaged strands on one of the bridge girders.

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 restate 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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