INFRASTRUCTURE

HALTON ZONE 3 INTERCONNECTING WATERMAIN

Bronte Creek Crossing

PROJECT CREDITS

OWNER
The Regional Municipality of Halton

ENGINEER OF RECORD
R.V. Anderson Associates Limited

GENERAL CONTRACTOR
Varcon Construction Corporation

MATERIAL SUPPLIERS
Dufferin Concrete, A division of Holcim (Canada) Inc.
Munro Ltd.

ADDITIONAL PARTICIPANTS
- Advanced Precast Inc.
- BASF Canada Inc.
- Euclid Canada
- Innovative Civil Constructors Inc.
- LIUNA Local 183

PROJECT FACTS

LOCATION Oakville, Ontario

COMPLETION August 2013

BUDGET $12.6 Million

VOLUME
- 640 m^3 (1,535 tonnes)

QUICK PROJECT FACTS
- Concrete was used to revitalize the original highway's aesthetics and pay tribute to the Region's history, giving abandoned free-standing piers new purpose, with minimal disturbance to the environmentally sensitive habitat below.

2013 Ontario Concrete Awards

Bronte Creek is a 200 m wide valley known for its diverse habitat. It is officially designated as an Environmentally Sensitive Area and an Earth Science Area of Natural and Scientific Interest. An Environmental Study Report was conducted to determine the preferred solution to crossing this creek. Ultimately, that decision was to support the watermain over the creek, utilizing four existing concrete piers left behind from a former highway, which was constructed between 1918 and 1919, and then demolished in 1948.

CONCRETE COMPONENTS

Ten CPCI prestressed precast concrete girders are 1600 mm deep and vary in length between 32.8 m to 33.2 m. There are five spans which are supported by four rehabilitated concrete piers, and newly constructed east and west abutments. The total length of the bridge is 165 m.

The east and west abutments were constructed from cast-in-place (CIP) reinforced concrete. The abutments provide support for the bridge superstructure and watermain pipe. The end walls of the abutments function as a headwall to allow the exposed watermain pipe (on the bridge) to penetrate into the ground. The abutments sit on CIP concrete grade beams, which are supported on drilled concrete caissons poured in the Queenston Shale. Rock bolts were installed into the shale to secure the toe of the abutments from high overturning pressures during construction and service. A total volume of 290 m^3 of concrete was used to construct the abutments.

Chain link fences, 1800 mm high, were installed around the perimeter of the abutments to administer access by authorized personnel. In addition, the west abutment was designed to allow operation vehicles to drive onto the structure for pipe servicing and repairs.

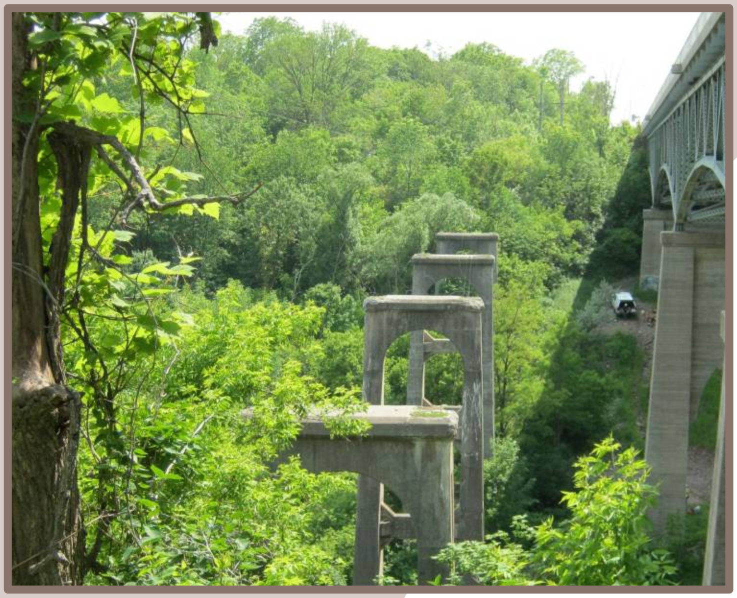
The exposed 900 mm diameter watermain was of Concrete Pressure Pipe (CPP) construction. The pipe consists of a steel cylinder with a concrete internal core. The pipe's external layer is lined with high tensile steel wire, which is covered in a dense cement mortar coating. The joints of the pipes consist of Victaulic couplers, which allow for lateral movements of the pipes over the piers and abutments.

Each pipe segment is supported individually by CIP reinforced concrete. The pedestals are equipped with a 12 mm thick neoprene pad to allow for lateral movement.

To prevent water in the pipe from freezing through temperature transfer from the deck slab, insulation and heat tracing were installed around the exposed portions of pipe and pipe pedestal. The entire assembly was then secured and wrapped in 18 gauge galvanized steel covers.

The bridge deck is of CIP concrete construction. The deck is 200 mm thick and 4800 mm wide. The slope on the deck is designed to shed water towards the floor drains, which are located at each pier and abutment. Pipes connected to the floor drains direct the water away from the structure and onto the south side of the valley floor. The total volume of concrete used to construct the deck was approximately 160 m^3.

The precast concrete parapet walls run along both sides of the bridge, and consist of stainless steel reinforcement bars and custom architectural design features to provide historical highlights from the old Dundas Street bridge. The exterior of the wall consists of exposed aggregate and a brush applied clear coat sealant, which provides enhanced



durability against the environment and de-icing salt overspray from the adjacent bridge. A total length of 330 m of precast wall was installed.

90-YEAR-OLD PIER RESTORATION

Originally built in the 1900s, four concrete piers were used to support old Dundas Road across Bronte Creek. In 1948, the highway was realigned and the bridge which was used for crossing the creek was removed. Without a purpose, the concrete piers were left to stand freely for over 60 years.

RVA enlisted the help of professional climbers to obtain information for the engineering team to undertake a condition assessment for each pier. The climbers shot a bow and arrow from the valley floor, over the 30 m (100 ft) structure, and secured the lines to repel upwards to the top of the pier.

THE CONCRETE DECISION

It was concluded that supporting the 900 mm diameter CPP watermain on the old piers would have the least impact on the environment. Furthermore, with concrete as the predominant construction material and being readily available, this alternative was found to be less expensive and could be implemented more quickly than tunneling under the creek.

Tunneling below the creek would have caused permanent disturbance and encroachment in the environmentally sensitive habitat. It would have cost too much time and money to justify the end goal.

Concrete was used for its consistency. RVA went against traditional practices of building a watermain below ground to adapt to surrounding features and structures. This also proved to be the most environmentally conscious approach.

After careful inspection, the concrete in the piers was concluded to be in good-to-fair condition. Normal spalling and deterioration were observed, which was consistent with each structure's age. The condition of these piers serves as a true testament to these concrete structures enduring demanding environmental impacts over the past 90 years.

Repairs were necessary in order to revitalize the aged piers. Cosmetic repairs were administered by sealing cracks and chipping away the outer surfaces down to sound concrete. The chipped areas were then repaired with new reinforcing steel, followed by concrete and a cementitious coating to enhance durability and aesthetic appeal of the structures.

Restoration included the use of Class C-1 35MPa Self Consolidating Concrete (SCC) on the vertical applications of the piers. SCC was the material of choice as it provided the opportunity to eliminate the need for vibration, which greatly reduced the labour requirements on site.

HISTORY IN CONCRETE

The Region and design team wanted to build upon the history of the old Dundas Street crossing. They worked from the original structure to restore the piers into a functional piece of infrastructure, giving them a new purpose and visual appeal.

Various forms of concrete and concrete construction techniques were major reasons for the success of this project. Concrete was used to revitalize the original highway's aesthetics, to pay tribute to the Region's history, giving the piers a new meaning and purpose, while protecting the environmentally sensitive habitat.

PARAPET WALLS

Parapet walls were set in place along each side of the bridge. Precast concrete was carefully detailed to recreate the original 1900s design. These walls were designed to retain historical significance of old Dundas Street bridge. Precast concrete provided the ability to reconstruct key features of the existing highway, while maintaining high levels of resistance to corrosion with stainless steel bars and enhanced durability with strict build quality.

BRIDGE STRUCTURE

CIP concrete was selected to construct the bridge abutments. CIP concrete is perfectly suited to this application because it provides the flexibility, strength and durability to adapt to the challenging steep terrain of Bronte Creek.

The bridge superstructure consists of CPCI precast prestressed concrete girders, cast-in-place deck and precast parapet walls. Precast concrete girders were selected for the inherent durability of the material, which is reflected with a high-level quality assurance program from the precast fabricator. Its quick turnaround time and local availability were additional benefits for selecting precast concrete girders.

The 44,000 kg girders were swung into place using two 600 tonne Mammoet AC500 mobile cranes. The girders had to be lifted directly over the creek, which required careful coordination of both cranes; one of which was parked on the valley floor and the other on the abutment of the Dundas Street bridge above. Tied-down workers on the piers guided the girders into place.

The monolithic nature of the girders provided contractors with the ability to complete the installation efficiently and systematically by eliminating the need to assemble splice joints and connection pieces on site. The girders were stored in the precast facility until they were ready to be installed. Contractors were able to orchestrate between delivery and erection times, which mitigated road closures and traffic congestions during peak hours.