INFRASTRUCTURE

DERRY ROAD CN GRADE SEPARATION

PROJECT CREDITS

OWNER
Halton Region

ENGINEER OF RECORD
R.V. Anderson Associates Limited

GENERAL CONTRACTOR
New-Alliance Ltd.

MATERIAL SUPPLIERS
Dufferin Concrete, a Division of CRH Canada Group Inc.
Con Cast Pipe

ADDITIONAL PARTICIPANTS

- Deep Foundations
- Euclid Canada
- Harris Rebar
- Ironworkers Local 736
- LIUNA Local 183

PROJECT FACTS

LOCATION Milton, Ontario

PROJECT SUMMARY
A four-span, 53 metre long solid slab concrete rail bridge/grade separation. The project includes architectural cantilever retaining walls and 4000 cubic metre, 4 metre tall cast-in-place/precast combination storm tank.

2016 Ontario Concrete Awards

Overview

A rapidly increasing population, and consequential traffic impacts in Milton, led to Halton Region constructing a new CN Rail grade separation underpass for Derry Road. Located on Derry Road and immediately west of Bronte Road, this new grade separation will add much needed capacity to one of the busiest east-west thoroughfares in the Region.

Among the project's significant challenges were addressing on-site stormwater management, protecting the adjacent Milton Hydro Transformer Station, and maintaining all rail and road traffic through the site during construction.

Project Plan

The CN Rail Bridge has four-spans, with a 53 metre cast-in-place concrete deck. The structure supports one existing track and one future track. The bridge deck is supported by three piers and two abutments, founded on 34 cast-in-place augured caissons, which extend down 20 metres into bedrock. Throughout the construction phase, the rail traffic was maintained on a detour track to the east. The road traffic was maintained on a detour road to the south.

The grade separation features raised, multi-use trails/sidewalks for pedestrians, as well as flood control by utilizing a 4000 cubic metre stormwater detention tank underneath the roadway and a pumping station to lift the stormwater to the downstream sewers.

Project Team

The construction team consisted of the owner, Halton Region; design engineer consulting firm, R.V. Anderson Associates Limited (RVA); general contractor, New-Alliance Inc.; foundations subcontractor, Deep Foundations; and a number of other subcontractors. The ready-mixed concrete supplier was Dufferin Concrete. Precast arch elements for the stormwater detention tank and concrete pipe was supplied by Con Cast Pipe.

Concrete Components

Concrete Mixes

The bridge structural components mostly used cast-in-place Class C-1 concrete. The 1.5 metre thick, 8.8 metre wide cast-in-place concrete deck slab contains 680 cubic metres of concrete. The concrete includes 30% slag substitution, which provides highly durable concrete, while reducing the overall heat of hydration in the slab.

Deck & Bridge Construction

The bridge was constructed by drilling cassion piers into the ground; partially excavating to support the deck forms; pouring the concrete deck; and later excavating the full site to the required depth.

Due to the deck slab's heavy weight, the deck excavation was only dug to partial depth (approximately 2 metres below the deck underside) prior to pouring. This approach substantially reduced the amount and cost of falsework. Further cost savings and risk mitigation was achieved by reducing the height of the adjacent track protection wall.

Stormwater Detention Tank Construction

The 4000 cubic metre stormwater detention tank is 10.5 metres wide and 125 metres long. The tank has varying heights up to 5 metres. It comprises 66 - 1.8 metre wide precast concrete arch units placed side-by-side and supported by a 350 mm thick, V-shaped, cast-in-place concrete slab.

After completion, the tank was backfilled with engineered fill before the roadway was constructed above.

Additional Works

Concrete was utilized for a variety of other works, including the temporary caisson shoring systems, permanent caisson retaining walls, stormwater pumping station, watermain relocation and surface works.

Why Concrete?

The original Environmental Assessment called for a single-span steel girder bridge. During the design, a four-span, solid-slab concrete bridge was accepted instead for two key reasons:

1. Concrete was far more visually appealing. Since the area is within a mixed residential/commercial environment, addressing public concerns regarding structure aesthetics was important to the project's success.

2. Concrete allowed for less complex and less costly construction. The concrete deck was formed and poured at grade, with the excavation for the underpass occurring after the concrete set. This type of construction offered less risk to the contractor, which means that the construction costs were lower due to the ability to eliminate most of the falsework required to support the deck. This also reduced the required height for the track protection walls.

Concrete Choice

Cast-in-place (CIP) concrete was selected to construct most of the bridge superstructure and substructure as it is the preferred material for short span rail bridges. CIP concrete is perfectly suited to this application because it provides the flexibility, strength and durability to carry the heavy railway loadings, with visible surfaces that are corrosion resistant and aesthetically appealing.

The mix of CIP and precast concrete for the stormwater tank maximized the benefits of durability and strength. The use of precast arch units greatly expedited construction since they could be quickly lifted into place. The use of various forms of concrete was a great success and allowed for the acceleration of the construction schedule.

Pumping Station

To pump out the stormwater from the detention tank, it was necessary to add a pumping station at the grade separation. A 3 metre diameter concrete shaft, constructed 15 metres deep, housed three submersible pumps. Using concrete achieved cost savings, and expedited the construction schedule.

The shaft was constructed of CIP walls, with a CIP concrete lid. The lid was designed to accommodate highway loadings. Whenever the tank is full of water, the pumps turn on automatically and a forcemain conveys the stormwater to a nearby sewer manhole.

Watermain

As part of this project, 500 metres of 300 mm diameter cast iron and 400 metres of 750 mm diameter concrete pressure pipe watermain required relocation to accommodate the proposed grade changes.

The 190 metre watermain crossing of CN Rail was performed by microtunnelling, using two 1200 mm diameter concrete casing pipes. The remaining watermains and water services were installed by open cut methodology.

Shoring Walls

Complex temporary shoring was required to protect the railway traffic along the detour rail line, as well as to protect roadway traffic along the detour roadway.

The railway grade separation required a temporary track shoring wall to support the relocated CN Rail mainline tracks while excavation adjacent to the tracks proceeded for the bridge structure. The secant pile wall was formed by constructing intersecting concrete caissons. Tie-back anchors were used to stabilize the wall. To protect the railway, both the temporary wall and detour tracks were monitored daily for movement.

A second temporary shoring wall was also required to support road traffic loads along the detoured Derry Road as the excavation for the stormwater tank proceeded. It was constructed using soldier pile and lagging method with concrete footings.

Abutments

To provide sufficient stability, the abutments rested on 900 mm diameter caissons, which were drilled 20 metres deep to bedrock. The abutment themselves were constructed using CIP concrete.

Retaining Walls

To protect the Milton Hydro Transformer Station, which supplied power to much of the area, a retaining wall was constructed. The new 4 metre secant wall comprises 62 soldier piles, each 1.35 metres in diameter. Each pile extends up to 15 metres below grade. After excavation to the finished grade, the wall was faced with CIP concrete with an architectural liner. The Ashlar Stone facing-pattern was chosen to compliment the bridge structure and slope paving used elsewhere on the project.

The transformer station was monitered for potential ground settlement. None occurred during the entire construction period.

Material of Choice

The Derry Road Grade Separation is a showcase project for concrete construction techniques – precast, cast-in-place, reinforced and unreinforced concrete. The flexibility of concrete as a building material allowed for innovation during the construction phase of the project to accelerate the schedule and deliver an aesthetically pleasing and durable product for Halton Region.