RECONSTRUCTION OF WYNDHAM STREET – CITY OF GUELPH

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Summary

With the construction of a New City Hall, the core area of Guelph has undergone a significant transformation. An integral component of this was the reconstruction of Wyndham Street, from Wellington Street to Carden Avenue, which is the primary gateway to the City's core area of institutional and commercial uses. The reconstruction included new underground services as well as streetscaping, widened sidewalks and bicycle lanes. In order to make this new connection functional, the CN Subway required replacement.

The existing CN Subway on Wyndham Street dates back to the early 1900's, and had reached the end of its service life. The bridge abutments were solid concrete, more than 1.0 m thick, with minimal reinforcing and the beam was steel, single span. It was deficient in terms of vertical clearance, had ongoing maintenance issues, and did not provide the horizontal clearance required for the proposed road cross-section.

During the preliminary design phase of the project, several issues arose which needed to be addressed as part of the work; these included:

- The corridor is operated by Rail America, under lease from CN Rail, and had to be maintained for freight and passenger service.
- The City proposed to construct a bus transit hub at the VIA station area to create a multi-modal station.
- GO Transit was in the process of implementing daily train service to Guelph, which required new platforms and tunnel access from proposed parking areas.
- The City wished to implement a pedestrian friendly Wyndham Street corridor including bike lanes, wide sidewalk and street scaping.

In addition, given narrow right-of-way and the historic structures in the core area, i.e. an Armoury, VIA Station, Cenotaph and designated heritage buildings, setbacks were minimal and the work area was tightly controlled.

The AMEC design team, in close consultation with the City, developed a phased construction approach which maintained rail traffic through the construction site. Key elements to the construction approach included:

- Design of a bridge structure which was essentially four (4) bridges to enable rail traffic be maintained.
- Temporary and permanent relocation of rail lines during construction.
- Temporary shoring to meet the phased approach.
- Tie-back systems in the area of the Armoury and the heritage buildings to mitigate foundation concerns with regards to the Heritage Structures.
- Co-ordination with outside organizations such as CN Rail, Rail America, GO Transit and VIA to ensure all needs were met.
- Design bridge structure to AREMA requirements while minimizing changes in rail grade while implementing new platforms, pedestrian walkways, stairs and tunnels.
- Relocation of Steam Locomotive and Tender 6167.

The bridge design chosen was a post tension structure which provided the flexibility to implement the phased approach to the project.

The reconstruction of Wyndham Street took place over a three year period, with the successful opening of the reconstructed Wyndham Street in May 2013.

Introduction

AMEC was retained by the City of Guelph in 2009 to complete the total upgrade of the existing the Wyndham Street from Carden Street to Wellington Street. The railway corridor is owned by Canadian National railway Company (CNR), but leased to Goderich Exeter Railway (GEXR). GEXR's parent company was Rail America for the duration of the contract.

The scope of the work included the design and construction services and to coordinate and obtain approvals from the three railways, VIA Rail and GO Transit who are all users of the track. The road work included the replacement of the sanitary sewer, storm sewer, watermain, buried utilities, sidewalks, pavement structure, decorative lights, landscaping and signage.

Design and Construction Services included:

- Railway Bridges for E-90 Loading;
- Mechanically Stabilized Earth (MSE) Walls – 175 m;
- Cantilevered walls – 24 m;
- Other walls – 12 m;
- 2 Stairways to GO Transit Platforms;
- Security Railing to separate incarcerated persons from the General public;
- Track design for bridge construction staging;
- Track design for permanent mainline layout;
- Preparation of contract package and assistance during tendering;
- Construction Inspection;
- Construction Administration.

Background

The Wyndham Street subway replacement project is one element of the renewal plan for downtown core in City of Guelph, also known as the "Royal City". The City was founded in 1827 and it was one of the first planned cities in Ontario featuring radial streets extending out like spokes on a wheel from the heart of the City, which coincides with the location of this project.

In the 1860's, the Toronto and Guelph Railway constructed the tracks connecting the Toronto to Guelph; however shortly after the construction the line was sold to the Grand Trunk Railway. Soon after Grand Truck Railroad ran into financial crisis and it was award to the Canadian National Railways who are the current owners of the track. In 1911, during the Grand Trunk Railway ownership, the Wyndham Street subway was constructed along with the retaining walls north and south of the tracks

The Wyndham Street Subway and retaining walls project is surrounded with historical buildings like the turn of the 20th century railway station and the cenotaph on the north east quadrant, City Hall and the Court House on the northwest quadrant, the Armory (1905) on the southwest quadrant, and a historic wooden frame building that was owned by the City recently sold the property to Metrolinx (GO Transit) for their parking area south of the tracks. This parking area was to be connected to the VIA Train Station by means of an underground pedestrian Tunnel.

The parking and the tunnel were not part of our assignment however did required coordination with the other consultant handling this work.

The Court House was under renovations during the initial stages of the Wyndham Street design and there was construction overlap between the two projects however the overlap was minor and project proceeded without any significant schedule changes. Other projects included the new Bus Terminal for Guelph Transit, Greyhound and GO Transit. The terminal is located just east of the VIA Station. The Bus Terminal was scheduled to open in May 2012 as GO Train Service to Guelph commenced.

Photo 1 - South Elevation of the Bridge

Photo 2 – North Elevation of the Bridge

The stretch of road, including the original subway was constructed in 1911 over Wyndham Street. The bridge was designed to Cooper E-50 loading, in accordance with AREA (American

Railway Engineering Association). The subway provided a grade separation between the four railway tracks and the 2 traffic lane on Wyndham Street. A pedestrian tunnel was built behind the east abutment (left on photo 2) providing for a safe pedestrian friendly crossing under the tracks. On the photograph, many of the pedestrians have chosen to walk on the shoulder of the road rather than using the pedestrian tunnel. Also note that on the west side (left side on photo 1) on the Armory Project, a canon was placed which seems to be precariously pointed at the train, in this case a passenger train.

The Wyndham Street Subway consisted of 37 steel beams spaced at 457 mm. The beams were encased in concrete with the bottom flanges exposed and the two end beams which were a deeper section. The beams were encased in concrete to provide more rigidity and minimize deflection. The design was not uncommon for bridges constructed in the early 19th century especially in urban areas where vertical clearance was a challenge. The overall length of the bridge was 10.97 m and the bridge had a width of 21.7 m providing ample room for the 4 tracks provided. There was space for one additional track, however was never constructed. The clearances provided were 4.267 m vertical and 9.75 m horizontal.

Directly south of the VIA Station, three paved platforms were constructed, complete with crossings to the north and south providing access to the trains for passengers and the light freight that could be loaded or unloaded by hand.

In 1967 the City of Guelph became proud owners of Engine 6167, complete with Steam Engine and the Tender. Engine 6167, during Centennial year arrived under its own stream and was parked on a piece of track immediately north of the railway yard east of the train station. Unfortunately the Locomotive and the Tender was parked in the middle of the proposed Bus Terminal planned for this area and needed to be relocated.

The Engine weighed 183 tones and the tender weight 127 tone. Not included in these weights are the 5.3 tones of water and 16.3 tons of coal that would normally be used when the engine was in service. The first task was to relocate Engine 6167 from the area next to the existing Greyhound Bus Terminal and the proposed *Guelph Bus Terminal* to an area 200 m south, next to the GO Transit parking area south of the railway corridor.

It was decided to truck the engine across the tracks. This was accomplished on June 15th and 16th of 2010. The engine was the first to be moved and it was lifted up off the tracks, a truck backed up under the engine, and then lowered onto the truck. The truck consisted of a tractor and a long flat bed with 12 axles of steerable wheels. A temporarily roadway was constructed across the yard and the tracks exclusively for this move. The move went smoothly. The following day the tender was moved in the same manner and with the same results.

The final display area for the locomotive unit was south of the tracks and next to the platform for the GO Train platform. The engine and the tender were placed the engine on a new plinth, complete with ballast, composite ties, tie plates and all the track material to resemble a typical track. The only difference was the composite ties were used as they would be more durable. See Photo 3.

Photo 3 - Engine on the New Plinth

The Bus Terminal requested a shift in the alignment of the mainline to provide additional space to improve the width of the commuter's awaiting their respective buses. This was accomplished by shifting the mainline track 2 m south. The final item was the construction of a pedestrian tunnel between the south platform to the VIA Station on the north side of the tracks.

Prior to construction, all the rail traffic was handled on the mainline; however as GO Trains service is extended to Kitchener, located just west of Guelph and the frequency of commuter train service increases it is expected that a second line will be required. To accommodate this traffic, it was assumed that a No. 20 turnout be designed for to keep speeds up for the future requirements. The change in the track alignment accounted for this change in the future and zone speed was incorporated in the design of the curvatures. The No. 12 turnout just off the bridge on the east side of the yard will be left in place but the replacement with the much longer No. 20 turnout can be accommodated once the need for the extra speed arrives.

Nearly 100 years after the construction of the original grade separation, the structure was showing signs of deterioration and City of Guelph realized that some effort was need to bring the downtown areas back to its previous splendor. The following photos provide some of the areas of concern, included the server scaling and delaminations exposing reinforcing at the abutments seats and wingwalls, the rotation of retaining walls, cracking, delaminated concrete on the abutment walls, and the corrosion on the steel beams on the superstructure.

Photo 4 - South West Retaining Wall and Bearing Seat Deteriorations

Photo 5 - Retaining Wall

Photo 6 - East Abutment Wall and Bridge Soffit

Projects neighboring the Wyndham Street Project

During the course of the project, the following projects were either in construction or in the design phase:

- Court House renovation;
- City of Guelph's New Bus Terminal;
- GO Train Service to Guelph May 2012;
- A New City Hall (completed in 2010).

The *Court House* was in the construction phase when the Wyndham Street project was in the design phase and continues into the construction phase. At the start of construction the area on the photo below was in the court house project and the Road reconstruction project. This was

cleared up within a short period of time after construction began which created some dialogue between the City and their contractors and their consultants.

Items address late in our design phase included the access from Carden Street for the transportation of incarcerated persons to the holding cell and the 2 m high security fencing to separate the area and the general public.

Photo 7 - Court House Project

Vehicle access to the back of the court house and the fencing was required in the area shown in Photo 7.

Railways

The railway corridor is owned by the Canadian National Railway Company Limited. The mileage on the Guelph Subdivision at the Wyndham Street crossing was crossing is 48.79. There were two bridges at both ends of the yard. The east bridge is over the Speed River, Wellington Street and Elizabeth Street and the mileage at the west end of the bridge is Mile 48.94. The bridge at the west end was over Wilson Street at Mile 49.94. In addition, the Neeve Street pedestrian tunnel was located at Mile 48.86.

The design, or zone, speeds on the tracks were 50km/h (30 mph) from Wyndham Street east and 80 km/h (50 mph) from Wyndham street west. CN Rail is near the middle of a 25 year lease of the corridor to the Goderich Exeter Railway (GEXR). GEXR operated the railway; however their parent company, Rail America, with their head quarters in Florida reviewed all the railway related designs and issued insurances, inspections permission to enter agreements with the City. The bridge was designed for Cooper E-90 loading, in accordance with American Railway Engineering and Maintenance of Way Association (AREMA) and CN's Guidelines for Design of Railway Structures.

The railway required that their traffic would not be interrupted during the construction; however track blocks would be available during times when trains, including VIA Rail, were not scheduled. Track blocks were arranged through GEXR.

Track relocations for the Bus Terminal were accomplished but designing track alignments to accommodate the zone speeds and providing adequate tangent track between the reversing curves to meet the railway's requirement. The selected radius to maintain the zone speed of 80km/h was 1164 meters. The shift was to accommodate the extra space required in the Bus Terminal for the bus stop. Track designs were sent to Rail America and CN for their approvals.

The preliminary structural design was completed for a twin railway bridge and two pedestrian platforms each 4 meters wide, for GO Transit. The Train bridge structure selected was a post-tension concrete deck with semi-integral abutment bridge. The GO Transit's platform bridges to carry pedestrian loading. The platforms were slope at 2% rising towards the tracks to prevent the stroller rolling towards an oncoming train if the stroller was momentarily left unattended.

The construction was staged to maintain traffic on the railway. As the siding track had to be rebuilt to make it passable, it was decided to maintain traffic on the mainline and start the construction for the south track.

The first task of any construction project is to secure the area, to separate keep the general public from the construction zone and train operation. At this site at the north end Neeve Street, a pedestrian tunnel was constructed in 1987 under the tracks to allow pedestrians a means to cross under the tracks safety. Stairs were provided on the north side, while the south side had favorable grades to provide the ramp for the pedestrians.

The tunnel was rarely used as the general public typically crossed the tracks at grade level as seen in Photo 8 below.

Photo 8 - Public Trespassing Across the Tracks

A temporary chain link fence was installed; however it required repairs on a daily basis as the migration across the tracks by local residence was addictive. Eventually the repairs to the fence gradually reduced until the public finally accepted the fact that they were not allowed to cross over the tracks and through the Contractors work limits.

Prior to the removal of the south half of the bridge, the utilities on the bridge need to be relocated to for the installation of the temporary shoring. The fiber optics, which were on the south elevation of the bridge had sufficient stack at the bridge to accommodate shifting to cables without splicing. Bell 360 ran between the mainline and the siding track and was in conflict with the shoring and was relocated in a steel split tube to protect the utility and to relocate the utility at the stage of the second phase.

The Allstream line ran along the north side of the mainline west of the bridges, crosses to the south side just west of the bridge and then crosses back to the north side just east of the bridge to enter the VIA Station, The utility was protected in split tube pipe across the bridge.

After the south bridge was constructed the Allstream utility was inserted into the curb of the bridge as was the Bell 360. The fiber optics was placed into the steel box structure and supported.

After the utilities were relocated, the shoring was constructed, consisting of H-Piles and lagging. H-Piles were monitored regularly ensuring the shoring remained stable. The south section of the structure was removed and the construction of south half of the new structure started.

Photo 9 - Temporary Shoring

The abutments were completed for the railway bridge and the pedestrian platform before the mechanically stabilized walls could be started. The south walls and the superstructure were completed coincidently of the south the walls were installed.

Following the installation of the shoring the bridge and retaining walls south of the structure where removed and the new structure constructed.

Once the south abutments were completed, work on the MSE walls could start.

Photo 10 – Construction Works on Wyndham Street

Photo 11 - MSE Wall and Bridge Structure Shoring

This was followed by the stairs and the cantilevered piles on the east side next to the heritage structure.

Cantilevered walls were selected as no information was available on the framed heritage building. The selection was based on the inherent risk of undermining the building's footings while excavating for the retaining walls footings or tie backs. The area behind the cantilevered retaining walls was landscaped with shrubs and grass.

Photo 12 - Cantilever Wall

All the walls were formed with clean cut stone masonry designs which were carrier on through the bridge abutments providing clean lines complementing the heritage masonry structures for the Court House, Old City Hall, VIA Station and the Armory building.

Photo 13 - MSE Wall

The stairs and the retaining walls were constructed with the north bridge structure. Upon completion of the north structure, the north retaining walls were constructed. The 6 m wide stairs for the Armory were also constructed reflecting the previous stairs.

With the south structure completed, as shown on the photo 14, the bridge was ready to accept the train loading on the north track. The structure was water proofed using the MATACRYL waterproofing system which has been approved by the railways and AREMA. The system consists of a primer coat, 2 coats of Matacryl Membrane, Matacryl STC layer and a layer of Quartz. The waterproofing is exposed on the north tracks (right side) on Photo 12.

Photo 14 - Rail Bridge South Track Operational, North Track Ready for Ballast

Photo 15 - Track Design (Phase 1)

Photo 16 - Rail Bridge South Track Operational, North Track Ready for Ballast

Photo 17 - North Approach to Bridge

After nearly 200 years, this area is still considered the hub of the city and as such the infrastructure needed to be upgraded; therefore the City of Guelph initiated a revitalization program. Our assignment started after the City Hall Building was nearly complete however he landscaping that had already started and now the next phase was to revitalize Wyndham Street between Carden Street and Farquhar Street. The work was to upgrade the underground utilities, add new utilities, replace the retaining walls and the bridge structure to new standards but to been n with the historic features of the area. The project also included landscaping, illumination of the streets, the addition of lanes for cyclist and adequate pedestrian sidewalks. AMEC was honored to have been selected for this exciting and challenging opportunity to work in the heart of Guelph.

Clearances under the Bridge

The original bridge was posted at 4.1 m; however, the bridge had experienced several conflicts with trucks. To increase the clearance, the road section was reduced and the grades were increased to a maximum grade of 6.49% north of the bridge and - 3.59% on the south approach providing an effective clearance of 4.05 m for a WB20.5 m truck (MTO) or a WB 20 (TAC) There for the signage will be 3.9 m clearance.

The City is considering restricting Wyndham Street to trucks which will reduce the number of trucks the street to trucks which will reduce the trucks in the downtown core. Access is available to the streets from Wellington, and Wilson, one street east and west respectively.