

ARCHITECTURAL MERIT Cast-In-Place

TTC PIONEER VILLAGE SUBWAY STATION



PROJECT CREDITS

OWNER

Toronto Transit Commission

ARCHITECT OF RECORD

IBI Group

ENGINEER OF RECORD

WSP Canada Inc.

GENERAL CONTRACTOR

Walsh Canada

FORMING CONTRACTOR

Limen Structures

MATERIAL SUPPLIER

St Marys CBM

ADDITIONAL PARTICIPANTS

- AGC Glass
- Alsop Architects
- BASF Canada
- Benson Steel Ltd.
- Bird Mechanical Ltd.
- Carpenters Union Local 27
- Core Metal Inc.
- Deep Foundations
- FCFP
- Harris Rebar
- HH Angus
- Ironworkers Local 721
- LEA Consulting
- LIUNA Local 506
- Plan Group
- Richard Stevens Architects
- Ritz Architectural System
- The Spadina Group Associates

PROJECT FACTS

LOCATION

Vaughan, Ontario

CONTRACT TYPE

Lump Sum

PROJECT TYPE

Transit

CONSTRUCTION VALUE

\$223,825,706 M

PROJECT SCHEDULE

Start: October 1, 2011

Completion: June 15, 2017





PROJECT NARRATIVE

Pioneer Village Station is a brand-new transit hub straddling the northern border of Toronto. This project forms part of Toronto Transit Commission's (TTC) \$3.2 billion, 8.6km subway extension called the Toronto York Spadina Subway Extension (TYSSE), which includes six new stations. Pioneer Village Station and the YYSSE connect the downtown core to the booming Greater Toronto Area with an underground subway, commuter parking lots, and local bus routes.

THE PIONEER VILLAGE STATION PROJECT CONSISTS OF:

- Two landmark surface-level entrance buildings with weathering steel, fritted glazing, and porcelain enamel panel cladding mirroring each other across Steeles Avenue West.
- A traction power substation, one of two servicing the new extension, which is a critical functional component of the YYSSE.
- A twelve-bay bus terminal extending south to York University and featuring an elaborate weathering steel roof line, faceted aluminum ceiling, sloped steel columns, and an extensive green roof.
- An open-cut subway station and crossover structure that extend diagonally below the bustling Steeles Avenue West and required an extensive earth-retention system, multiple traffic management plans, and a temporary four-lane steel bridge.
- A notable amount of exposed architectural concrete including a curved ceiling slab, iconic rock-wall, and massive sloped elliptical columns.
- Two vast weathering steel smoke baffles and artwork lighting lining the platform and train way, with porcelain enamel panels and terrazzo flooring rounding out the interior finishes.

QUALITY OF WORK/COMPLEXITY OF PROJECT

UNIQUE DESIGN

The design of Pioneer Village station includes several unique and innovative features that make the station stand out among others:

THE SADDLE SLAB is a mass concrete curved ceiling that spans between both station entrances under Steeles Avenue West, up to 8 metres below finish grade.

The curve was designed to accommodate underground utilities and potential future projects such as an LRT on the road above.

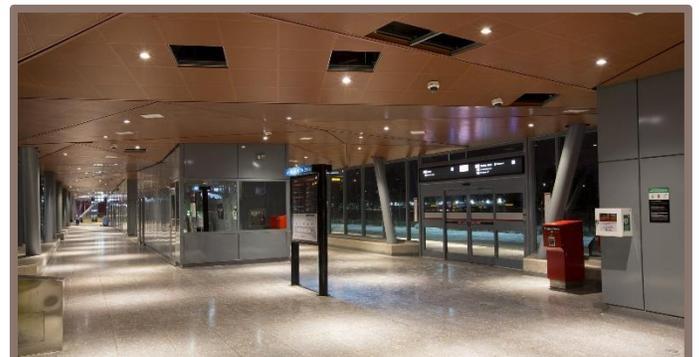
Due to the complexity of the slab's geometry and curves, there was no magical solution to framing the slab deck – it was built with traditional stick-frame mass scaffolding.

The slab was described by the project team as an upside down halfmoon with a four-foot step-up. It was built in 14 total concrete pours ranging in size from 700 to 1,100 cubic metres, which were determined by the location of the expansion and contraction joints.

WEATHERING STEEL PANELS used for exterior cladding, bus terminal soffit and smoke baffle provide high strength, low maintenance, durability and cost efficiency. Its beautiful rusty appearance can be associated with 'Steeles' Avenue, where the station is located.

ARTWORK LIGHT FIXTURES located at the platform is a hybrid between the lighting of the subway station and an art exhibition that can be admired while passengers wait for the trains. Customers will be able to instantly display messages on the 40 fixtures by using touch screens found on the platform. Innovative controls adjust the light intensity to ensure illumination remains constant regardless of the messages displayed.

THE LIGHTCONE provides natural light to the North Concourse. Its shiny stainless-steel cladding reflects light beautifully and provides a unique kaleidoscopic effect.



THE ROCKWALL is a prominent architectural feature of the subway station's South Concourse level. The straight-line layout was developed well in advance of the pour date to allow for multiple levels of quality assurance. The complex, three-dimensional layout was facilitated by the use of AutoCAD, which enabled the production of GPS coordinates that were extrapolated into a 3D model.

The model, including the specific coordinates and projection points underwent several levels review and approval at the subcontractor, general contractor, consultant, and owner levels prior to confirming the final layout with the utmost precision.

The Rockwall required a tailor-made, self-consolidating architectural concrete mix from St. Marys/CBM that contained a 10 mm (pea gravel) aggregate and produced a high spread rating (750 mm) and slump to ensure even, consistent coverage within the intricate form shapes. To minimize air entrainment, honeycombing and cold joints, the concrete was poured from the bottom-up, through a guillotine valve. This configuration also ensured that the concrete was poured at a slow and steady rate to maintain a level pour, resulting in massive consolidation, and a smooth face that concealed the aggregate.

One of the logistical challenges with the Rock Wall was that the concrete mix was quick-setting, therefore once we started pouring, we could not stop or allow any lag between trucks. As a result, Walsh had to carefully plan the concrete truck delivery schedule, route and site staging areas, further supported through constant communication among Walsh Superintendents and Limen Structures' Foreman. It was a high-pressure pour, as Walsh had two pumps running simultaneously with back-up pumps on stand-by.

Prior to pouring the Rock Wall, the project team had concerns about the Styrofoam forms sticking to the cured concrete and to mitigate this risk, vegetable oil was specified to be sprayed on the forms to create a barrier. The vegetable oil did not perform as expected, with some of the foam sticking to the concrete. As a result, the project team held collaborative meetings to develop a remedial plan. The ensuing recommendation was to buff the concrete face with a high-grit sandpaper.

The TTC and the Architect ended up loving the texture of the final product and in the process we established a best

practice that is applicable to future projects with similar concrete features.



ELLIPTICAL COLUMNS Combining structural integrity with aesthetic quality, the elliptical columns are another prominent concrete feature on this project. Starting on the subway platform level, every column shaft rises at an angle and some of the adjacent columns actually split through the platform in opposite directions to form a Y-shape. There were 14 of these unique columns constructed on the project and every single one of them had its own custom-casted concrete form from a specialty manufacturer in Texas. The only component of the forms that were reusable were the intermediate sections, but the top two and bottom two forms of each column were different shapes and radii.

With the complexity of these massive columns, we tested two different methods of framing them. First, we framed one side of the column all the way to the top, braced and structure it with a crane, and then installed the reinforcing steel, however, this method did not work as well as expected.

The second and ultimate option was to tie the reinforcing steel to the column pier sticking up from the platform slab and then, with the help of surveyors, the ironworkers constructed the elliptical column reinforcing steel, freestanding, with the angle and X-Y-Z coordinates. The rebar structure was double-checked by survey and was then braced before the forms were placed around it.

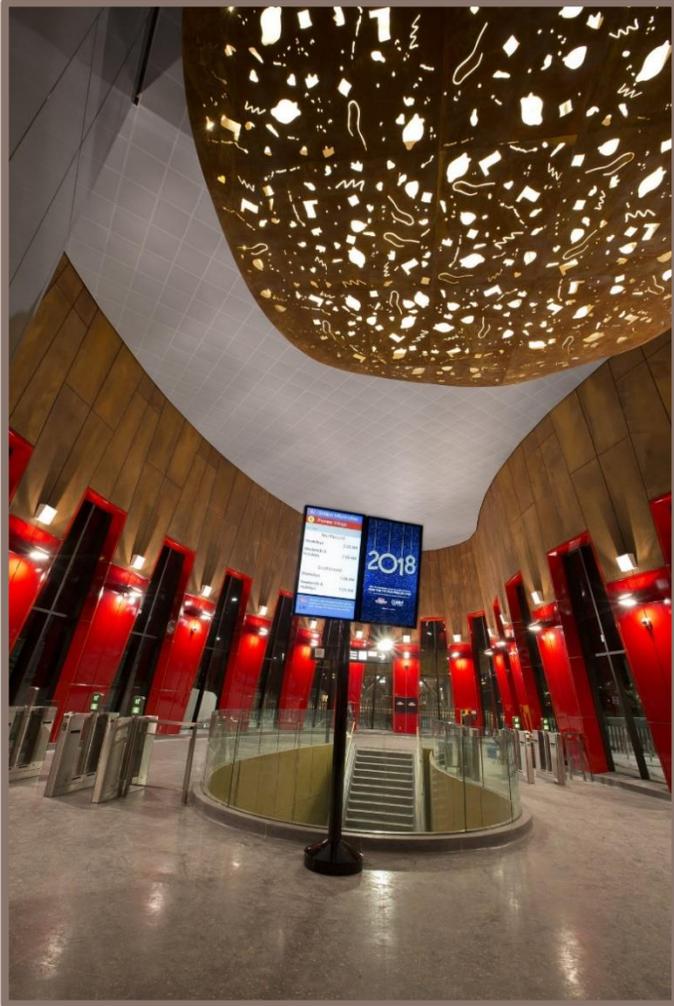
The erection of the column structure and forms required a multitude of specialty rigging. As an example, Limen Structures used reinforcings off the temporary bridge spanning the Steeles Avenue West roadway to hoist the column frames underneath the bridge.

Similar to the Rock Wall, we used an architectural, selfconsolidating concrete mix with 10mm and employed a guillotine valve to facilitate the concrete pour from the bottom-up. To optimize the aesthetics of the concrete finish, the guillotine valve was set within the column pier with a sleeve running up into the middle of the column so that it wouldn't show in the finished face. Some of the sleeves



reached up to 40 feet in length to reach the top level of the station.

The columns were required to be free of pour joints, so once we started pouring, we could not stop or allow any lag between trucks. As a result, Walsh had to carefully plan the concrete truck delivery schedule, route and site staging areas, which was supported through constant communication among Walsh Superintendents and Limen Structures' Foreman.



OVERCOMING BUDGET, SCHEDULE & QUALITY CONTROLS

The Pioneer Village Station project underwent several challenges related to schedule and cost. The project suffered an unexpected delay at the early stages which forced the project to proceed with out of sequence activities and the team had to restructure the action plan several times overtime. Additionally, the project received over 600 design changes (most of them with multiple revisions), and this created additional obstacles for Walsh and the subcontractors as work needed to proceed even on unresolved changes.

Quality control was also very important in this project, every major activity had to follow strict quality standards and work method statements previously approved by the TTC. Walsh and the subcontractors had to regularly perform QC checklists, shop and site inspections and we had to engage the services of third-party inspectors for virtually every scope of work. The project was subject to different tiers of reviews by the TTC/TYSSE inspectors.

SITE LOGISTICS

Many factors made logistics at Pioneer Village Station a challenge including its very narrow site layout diagonally crossing Steeles Avenue West required an extensive earth retention system, implementation of a staged traffic management plan, and the installation and subsequent removal of a temporary steel bridge. Access through seven entry gates with approximately 300 field personnel, 72 subcontractors, multiple tower cranes, numerous mobile cranes, pumps and manlifts.

UNIQUE SAFETY & ENVIRONMENTAL PROTOCOLS

Despite construction challenges, safety on the project continued to be a success and the number one priority. Pioneer Village Station totaled approximately 1.3 million man hours and had no fatalities or critical injuries. Mandatory jobsite specific safety orientations, daily THA and constant communication through weekly staff meetings, weekly subcontractor meetings, weekly safety meetings/walks, as well as subcontractor's daily "toolbox talks" were key to creating the safety culture.

The Pioneer Village Subway Station project was subject to an in-depth safety audit as part of the Certificate of Recognition COR program, where Walsh comfortably passed the evaluation, demonstrating a standard of excellence for our H&S program on transit projects and maintaining our status of good standing with IHSA.

BOMB THREATS

Being a high-profile project, Pioneer Village Subway station received numerous bomb threats in the latter half of 2014. Immediately after the first threat, Walsh worked with the TTC to develop a bomb evacuation plan which included instructions on how to handle the individuals making the threats, questions to ask, as well as procedures for assembly of, and evacuation of site personnel and a list of Dos and Don'ts. All workers and site personnel were prepared and aware of the new plan prior to the following threats. Fortunately, no bomb was found in the jobsite.

RAISE THE (RE)BAR

Being a civil project constructed at about 80 feet below grade with heavily reinforced mass concrete, the risk of injury due to exposed reinforcing steel was always a major concern. This was diligently addressed by investing in high

quality non-standard continuous rebar caps to protect the ends of the steel at all times. The rebar protection was enforced by all field personnel and the team was able to reuse the caps numerous times.

ENVIRONMENT

- Walsh exceeded some of the environmental regulation requirements on the project, including MOE Regulations 102/94 & 103/94, where Walsh developed a waste reduction plan, performed regular waste audits, and segregated waste to maximize recycling/re-use. We also implemented a strict soil erosion and sediment control plan that prevented adverse effects to surrounding lands and waters in accordance with the Environmental Assessment Act. Dust Control was implemented throughout the project life.
- Pioneer Village station served as home for a couple of Canada geese families – arguably an obstacle for a construction jobsite, but Walsh was able to work around their nests and provided a safe environment until they were able to leave on their own terms after the eggs hatched.

MOCK RESCUES AND FIRE DRILLS

The project team developed great relationships with the cities of Toronto and Vaughan’s fire department ensuring good lines of communication for proper safety precautions. We created 3D maps to help the firefighters find their way through the building in case of an emergency. Also, we were able to participate in mock rescues as part of our Safety Week initiatives throughout the years. Fire drills at Pioneer Village Station were conducted on approximately bi-monthly basis.

