

CANADIAN ■ CONSULTING  
engineer

AECOM

# CCE AWARDS 2016

Union Station  
and Front Street  
Revitalization









Union Station is Toronto's primary transportation hub for transit & rail passengers. Over 26 million people pass through its doors annually.

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## Project Background

Union Station is Toronto's primary transportation hub for transit and rail passengers alike. Over 26 million people pass through its doors annually – more than Pearson International Airport.

Recognizing the challenges associated with the aging infrastructure at Union Subway Station, the Toronto Transit Commission (TTC) and the City of Toronto (the City) initiated the restoration and refurbishment of the station and its surrounding areas.

For this project, TTC's in-house Engineering Department prepared a preliminary design, and TTC retained AECOM for project management, detail design and construction support of the Union Station Second Platform and Concourse Improvements. This project involved complex engineering solutions to minimize disruptions to existing subway operations, roadway traffic and pedestrian flow throughout construction. AECOM was responsible for managing the work of 15 sub-consultants providing a broad range of technical services.

Since an excavation of Front Street would be required to enable the Union Station Improvement Project, the City seized the opportunity to reduce costs and minimize future disruption with a Front Street revitalization at the same time. It retained AECOM to redesign Front Street as a major new public space with strong emphasis on pedestrian circulation, bicycle lanes, wider sidewalks, designated lay-bys for parking and a number of other aesthetic features.

"More than 250,000 people move through Union every weekday. They travel on foot, bicycles, cars, buses and cabs. Some are being dropped off, some picked up; others are going to and from work."

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## Innovation

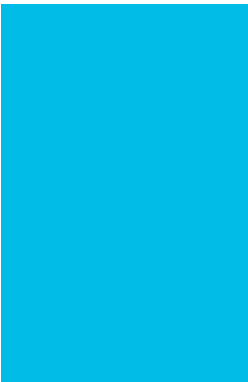
The Union Station project required innovative engineering solutions to minimize disruptions to existing subway operations, and roadway and pedestrian traffic during construction. The addition of the south platform and concourse improvements involved complex shoring and staging to compensate for unbalanced loading conditions created by the excavation south of the station. In-depth structural analysis was utilized to ensure the structural integrity of the station throughout the construction period.

In performing the design, AECOM established a means to control and contain dynamic and static operational, gravity and ground forces to sustain stable support of the existing platform, the new subway platform and the underground structures. This occurred throughout excavation, construction, commissioning and operating the new platform while the subway station was being extended. The existing alignment and geometry of the older platform had to be maintained for the range of forces without compromising the normal operation of the station.

The project team began by studying base load cases; modeling the forces, and assessing how they could be contained to limit any potential displacement or deformation of existing structures while excavation and construction of the new platform were underway. This knowledge and understanding was used to design the supporting structures that would be in service throughout the implementation of the new platform.

AECOM also created robust, technological methods by which it could verify to third parties that its detailed design for the station extension would result in a negligible transfer of contaminants, noise, and vibration into adjacent properties.

On Front Street, AECOM created a high quality public realm in a heavily used street by paying attention to the smallest details. It was the first time granite pavers were used on the traveled portion of a City street. All elements of the Union Station plaza were selected and designed for H2O loading and heavy use by people and vehicles during events. Attention was also paid to the ease of future repair and maintenance of these elements.







A number of significant grading challenges were addressed with software programs to simulate existing conditions and verify that the re-grading exercise would maintain the minimum cover on existing underground utilities. Stormwater management studies were performed on the proposed grading design to ensure that existing vents and stairs were protected during the design storm event. Structural soil cells were also provided to determine adequate soil volumes for optimum tree growth, root aeration and manual irrigation.

In an August 2015 Toronto Star article titled Remade Front Street a road to enlightenment, Christopher Hume wrote: 'Given that the country's busiest transit hub, Union Station, is on one side and the Fairmont Royal York hotel on the other, the street is among the busiest in Toronto. More than 250,000 people move through Union every weekday. They travel on foot, bicycles, cars, buses and cabs. Some are being dropped off, some picked up; others are going to and from work.'





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## Complexity


Several critical factors existed throughout the Union Subway Station and Front Street Revitalization projects. These included uninterrupted rail operations, safe pedestrian flow through the station, adequate egress capacities, fire/emergency access, ongoing power and systems operations, and feasible constructability. The design revolved around the complex staging of construction zones, while respecting the movement of vehicular traffic, pedestrian flows and transit operations. Each stage had to provide adequate construction space for laydown, temporary equipment and access, while also maintaining all utility operation in the project vicinity.

One of Canada's busiest intersections, Front and Bay, had to be maintained throughout the phasing of open-cut construction. At street level, traffic lanes and sidewalks were realigned, utilities were diverted and decking was provided to maintain access to buildings and roadways.

The roadway above the station is a major utility corridor with extensive communications trunk lines, electrical duct banks and trunk sewers, the majority of which had to be supported in place throughout construction. The negative consequences resulting from the failure of any of these would have been immense.

Early in the design all current best practices for construction, excavation protection, and waterproofing were studied to identify the most suitable previously tested methods to maintain a fully operational subway station. In constructing the second platform, the south wall had to be removed, requiring complex shoring to support the station roof and concourse slab, while maintaining roadway traffic over the station. Extensive excavation support systems were required to address unbalanced earth pressures on the station box during construction. Through design development, in excess of 40 distinct phases of construction were identified to permit the station to remain in service.

The design on Front Street needed to respond to the complex maze of shallow utilities, chambers and vent shafts as well as the roof of the subway box and the second platform below. Several ongoing concurrent







projects created numerous moving parts requiring consideration during the design and construction stages. The design had to go through several iterations to meet the requirements set out by the Front Street Environmental Assessment and the City's approved construction budget.

AECOM's team obtained inputs from several City Divisions before proposing an agreed upon solution that met the City's objectives. This coordination with all stakeholders continued during the construction phase.





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## Social and Economic Benefits

The Union Station project is an integral part of the overall Toronto Waterfront Revitalization. As the waterfront area thrives, increased transit and linkages to Union Station will continue to grow in importance. To meet these demands the station needed significant improvements that included:

- Modernization of Union Station
- New south side platform
- Improved centre platform
- One zone of fare control
- Vertical transportation and accessibility change
- Improved pedestrian flows
- New automated entrance
- Improved interchanges
- Fire ventilation upgrades and utility system changes

The solutions provided by AECOM met these objectives and improved a critical transit hub by creating much needed additional space for users of the Yonge/University line. The new platforms and concourse arrangements provide improved, safe pedestrian flow with enhanced access to GO Transit, VIA Rail, the PATH system, office towers and nearby attractions.

The Union Station platform features a 152-metre long piece of artwork by artist Stuart Reid and two-metre high glass panels that promote light flow between the subway platforms. To date it is the largest art project in the TTC System and it demonstrates a keen understanding of the evolution of the typical transit rider experience.

On Front Street, the City wanted to revitalize the streetscape and create a new major public space that is aesthetically pleasing while also providing greater usability, functionality and safety for City residents and visitors alike. The objectives of the Front Street Revitalization were to:

- Reduce the number of traffic lanes
- Create a centre median and left turn lanes
- Provide a mid-block pedestrian priority area
- Widen sidewalks and boulevard areas
- Plant trees and expand public realm and civic plaza
- Enlarge pedestrian areas and widen crosswalks
- Provide designated lay-by areas for pickup and drop-off

Through the work on Front Street, the City created a high quality, pedestrian-friendly public realm that met the complex needs of the one of the busiest roadways in Canada. It unifies the space between the historic Union





Station on the south and the Royal York Hotel and Royal Bank Plaza on the north.

Not only have the outcomes of these projects created an artistic focal point in the City, Union Station and Front Street are now places where the intense movement of pedestrians, cyclists and cars can be safely accommodated. Upon kick-off of the 2015 Pan Am Games, Union Station's front plaza became home to Union Summer, a new program featuring food vendors and live music. This area has been dubbed "the new entrance to the City, Toronto's front door."

The Union Station and Front Street Revitalization projects will have a unique impact on the fabric of Toronto. These projects improve a critical transit node that serves as part of the nucleus of Toronto's moving public, the most used interface in the City's transit systems. In a Toronto Star article published on August 20, 2014, columnist Christopher Hume wrote: "At the new Union Station, attention has been paid to details such as stairs, platforms, lighting, handrails, tiles, that sort of thing. The thought has gone into the quality of the space as well as how it's used."

Increased capacity and functionality, along with the aesthetically pleasing surroundings of Union Station and Front Street, are expected to generate increased transit usage from daily commuters and those wishing to visit local attractions alike, the end result being greater economic success for the TTC and local businesses.





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## Environmental Benefits

The Toronto Green Development Standards were implemented throughout both the Union Station and Front Street projects. Methods that were employed to promote environmentally responsible and sustainable practices included:

- the use of local materials
- implementation of processes to minimize air emissions and dust
- installation of energy efficient fixtures and appliances
- adherence to Greater Toronto Area Conservation Authorities guidelines
- recycling and salvaging, and
- observing bird friendly development guidelines

The improvements at Union Station and Front Street promote increased transit use and active modes of transportation such as walking and cycling, thereby encouraging reduced vehicular traffic and associated environmental impacts.

The revitalized Front Street design made provisions for taxi and bus laybys, a cycling connection, wide sidewalks and a centre median to direct traffic and provide a refuge area for pedestrians. The new streetscape plan accommodates the complexity of high volume vehicular, bicycle and pedestrian traffic within a very highly functional public space.

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## Meeting Client's Needs

The Union Station and Front Street Revitalization projects will have a unique impact on the fabric of Toronto. These projects improve a critical transit node that serves as part of the nucleus of Toronto's moving public; it's the most used interface between the City's transportation systems. The interests and objectives of the TTC and the City were integrated to create outcomes that met the goals of both clients. Both projects were delivered within budget and in advance of the 2015 Pan Am Games.

The quotes below demonstrate an appreciation for the successful outcomes created and the benefits for the clients, transit riders and many Toronto residents alike.

"The new concourse and second platform at Union station will provide TTC customers with a modern, convenient and less-crowded subway station for their commute. Thanks to our federal and provincial partners and our hard-working TTC staff, over 100,000 TTC passengers who travel through Union subway station daily will have a more pleasant journey."  
*Councillor Josh Colle, TTC Chair*

"Union Station is the hub of public transit in the GTA and so plays a pivotal role in Toronto's future. That is why our Conservative Government invested \$133 million in the Union Station revitalization project. The upgrades include a new platform, track and signal improvements and accessibility and roof enhancements, new retail space, PATH connections and exterior design refinements. They will create a better traveling experience for everyone and help reduce traffic gridlock throughout the region."  
*Hon. Joe Oliver, Former Minister of Finance and Minister Responsible for the GTA*



UNION

Northbound





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AECOM is built to deliver a better world. We design, build, finance and operate infrastructure assets for governments, businesses and organizations in more than 150 countries. As a fully integrated firm, we connect knowledge and experience across our global network of experts to help clients solve their most complex challenges. From high-performance buildings and infrastructure, to resilient communities and environments, to stable and secure nations, our work is transformative, differentiated and vital. A Fortune 500 firm, AECOM had revenue of approximately \$18 billion during fiscal year 2015. See how we deliver what others can only imagine at [aecom.com](http://aecom.com) and [@AECOM](https://twitter.com/AECOM).