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CANADIAN CONSULTING
ENGINEERING AWARDS

2016

BILLY BISHOP TORONTO CITY AIRPORT PEDESTRIAN TUNNEL

PORTSTORONTO



ARUP

SUMMARY

Opened in 1939 the Billy Bishop Airport ushered in a new era of airplane travel in Canada. Since that time, PortsToronto implemented many improvements culminating in 2010 with the Pedestrian Tunnel project. Dillon undertook overall planning for the tunnel project and acted as Technical Advisor from the start of the project to commissioning, with Arup in charge of the engineering design for PCL Constructors Canada Inc. This complex, unique transportation facility opened in July 2015.





PROJECT HIGHLIGHTS

COMPLEXITY

As Canada's ninth busiest airport, welcoming more than two million travellers each year, the Billy Bishop Toronto City Airport (BBTCA) was previously only accessible by ferry across the 120m wide Western Channel of Toronto Harbour, operating every 15 minutes. Sometimes dubbed as the "shortest ferry ride in the world", relying on boat access often meant passenger delays, uncomfortable travel due to weather conditions, surge loading of the adjacent road network and periodic ferry shut downs due to heavy winds and channel ice. The pedestrian tunnel involved constructing a 185m long, 35m deep tunnel that takes less than six minutes to travel between the mainland and the island airport using elevators, moving walkways and two long flights of escalators.

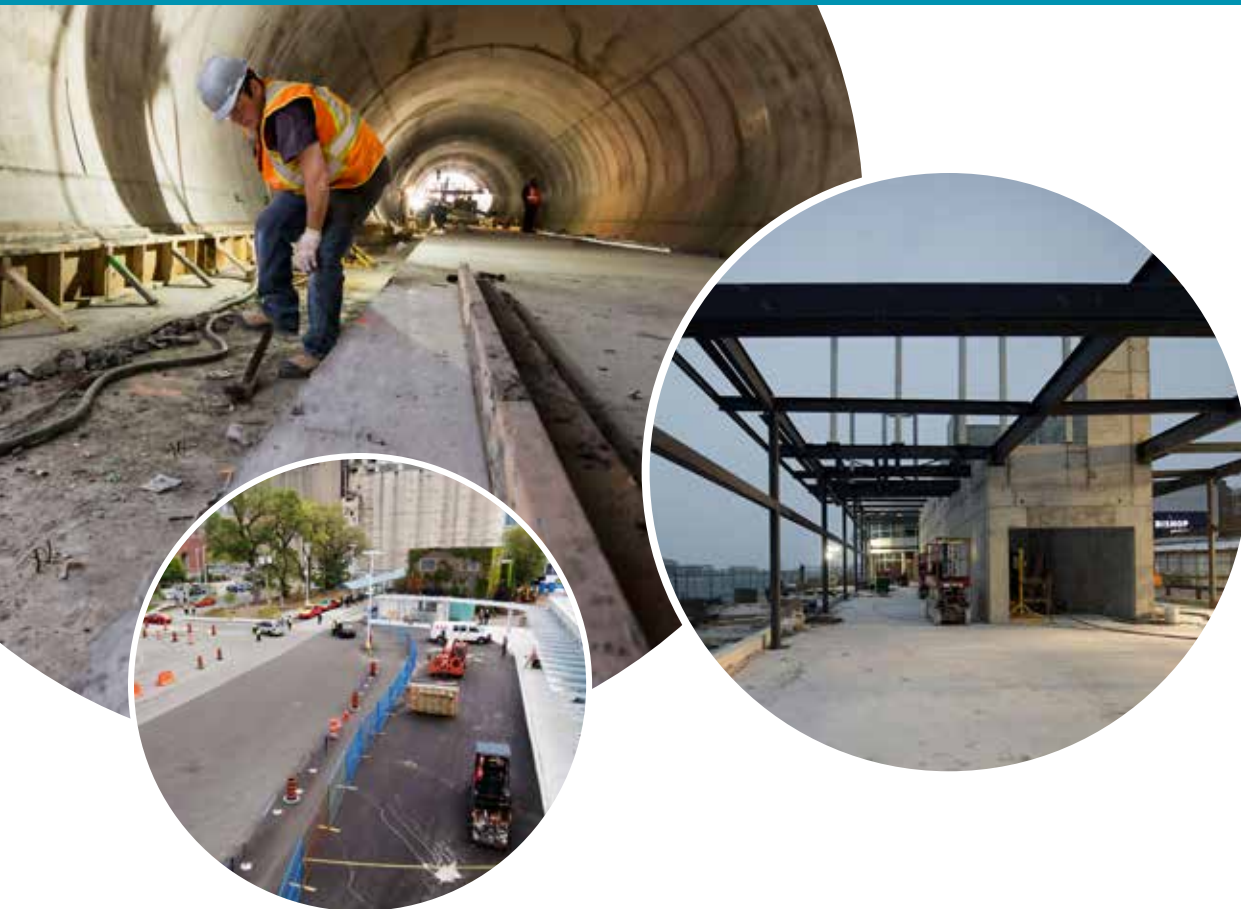
This complex, unique transportation facility was opened to the public on July 30th, 2015, a milestone reached in a short period of time, within the \$82.5M budget and has significantly improved traffic flows and airport access times.

TECHNICAL ADVISOR TEAM

- Dillon Consulting
- Hatch Mott Macdonald
- NORR Limited
- H.H. Angus & Associates Ltd.
- SHAL Consulting Engineers Ltd.
- P1 Consulting

DESIGN-BUILD TEAM

The project was procured by PortsToronto as a public-private partnership (P3) structured under a design-build-finance-maintain model with Forum Equity Partners. In this capacity, Forum acted as lead developer, with PCL Constructors Canada Inc. as design-builder, Arup as lead designer, ZAS Architects as architect, Technicore Underground Inc. as tunnel contractor, and Johnson Controls as facility manager.

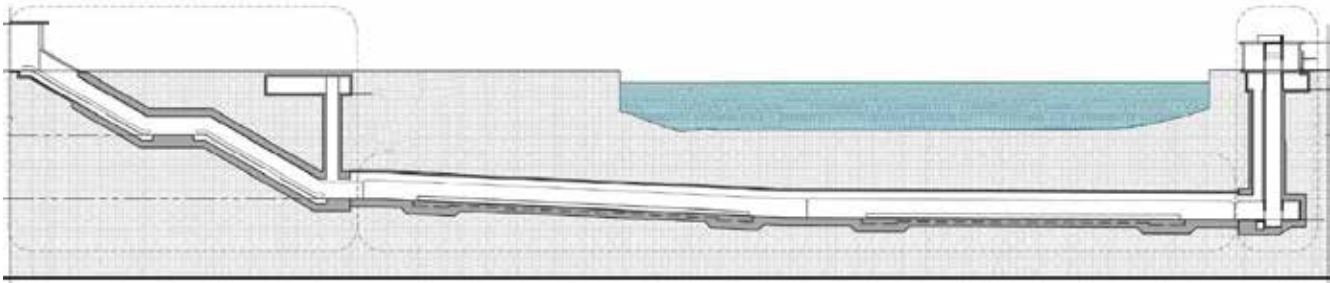
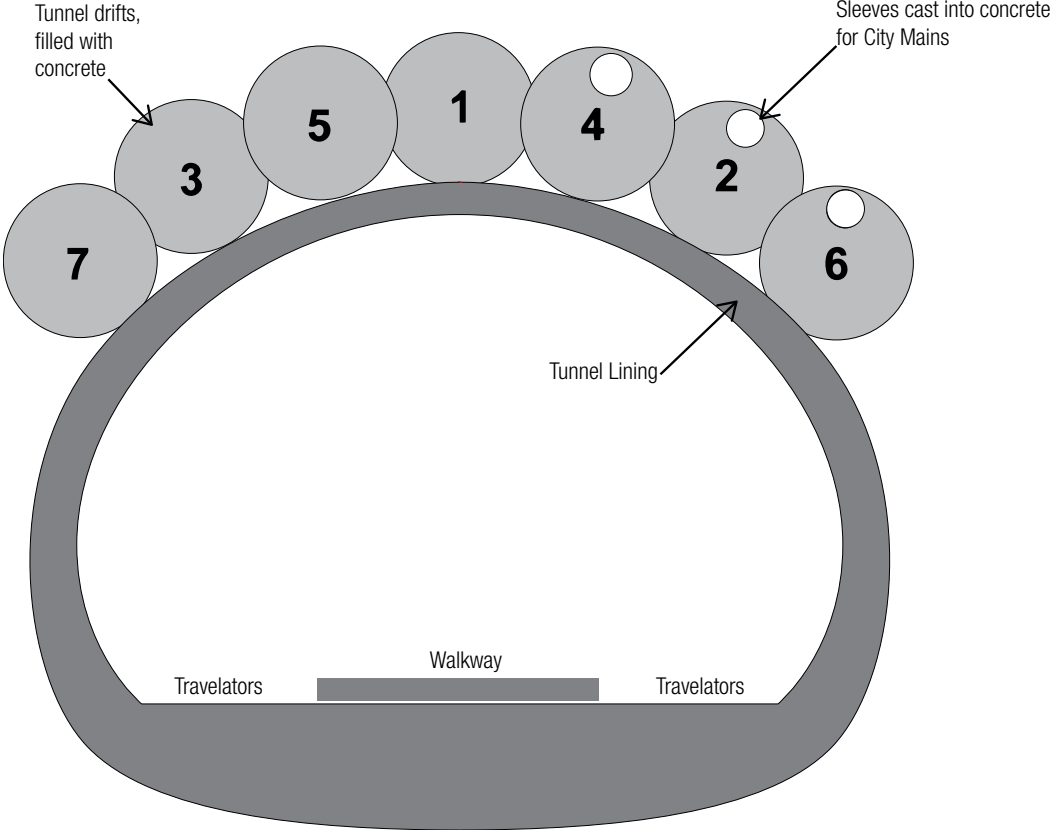


For the implementation of the tunnel to be successful, PortsToronto worked closely with the City of Toronto (City) and local community while focusing on the complex engineering and construction issues created in a dense, urban environment in downtown Toronto. Through negotiations with the City, the adjacent vacant City lands were made available for construction staging and ongoing airport taxi, shuttle bus and parking which greatly lowered the traffic impact on adjacent streets and the surrounding community while also securing a tunnel easement through the City-owned dock wall lands to allow the tunnel to cross underneath City property. This collaboration extended to an agreement with PortsToronto to include in the tunnel key, strategic sanitary sewers and watermains servicing the Toronto Island community.

Dillon assisted PortsToronto in completing the preliminary design of the tunnel, preparing bid documents, identifying and evaluating P3 bidders and supplying PortsToronto with technical advisory services throughout the design and construction phase. As technical advisor, Dillon aided PortsToronto in working with the multiple stakeholders including municipal government departments, local residents and Arup and their P3 partners that enabled this project to be completed successfully.

Working closely with the City was a key element in the project's success. While building a tunnel is not a unique endeavor, the challenges of moving large numbers of people with baggage from ground level through a relatively short distance at a significant depth required the use of innovative logistics planning and design.

Tunnel Construction Sequence





MEETING THE CLIENT'S NEEDS

The project's main goals were to provide a world class standard of access at the island airport in a short a period of time and in a cost-effective manner while maintaining a high level of service to airport customers during the construction period. From design to construction to final finishes the tunnel exemplifies innovation and addresses the priorities of travellers. Whether it be the number of elevators, moving walkways and escalators; the acoustics and shape of the tunnel's interior; or the state-of-the-art digital screens that create a visual experience as people move through the tunnel, every detail of the project was carefully thought out to ensure a tunnel that would not only deliver travellers to where they needed to go, but would also engage them along the way.

Project requirements were developed that specified to the design-build team that no reduction in access level of service during construction would be allowed. This was made possible through innovative vehicular and pedestrian traffic management measures that effectively ensured unencumbered access through a significantly complex and challenging construction site over a three year period. The project was delivered on time and on budget with no cost to taxpayers.

Working effectively with the City of Toronto ensured that project reviews and approvals were secured in a timely manner. The incorporation of major City water and sanitary sewer trunk services into the tunnel provided strategic municipal infrastructure to Toronto Island residents while saving approximately \$10M if these facilities were constructed as a separate project.

ENVIRONMENTAL BENEFITS

From the tunnel project's inception, it was designed and constructed with sustainability in mind. The tunnel serves to reduce the airport's impact on the local community through improved pedestrian and traffic management and by reducing lineups given that passengers can now travel on their own schedules rather than the ferry schedule. The introduction of the tunnel eliminated the peak period loading of the area's road network that occurred when fully loaded ferry boats discharged passengers every 15 minutes, at times creating significant traffic queues and numbers of idling vehicles. Traffic congestion and queuing has been significantly reduced after the opening of the tunnel. The tunnel allows passengers to walk between the mainland and the airport, in less than six minutes, dramatically improving the convenience and efficiency of the airport.

The energy efficiency with which the tunnel operates was assessed as part of the Request for Proposals, and continues to be monitored and reported on under the project agreement. The tunnel's mainland pavilion and island atrium incorporate such "green" features as LED lighting and double-glazed windows to reduce heat loss in winter and heat gain in summer.

The tunnel is powered using renewable electricity through an innovative agreement that puts 100 percent renewable electricity onto the grid to match the amount of power the pedestrian tunnel uses. Overall, PortsToronto is among the 10 largest purchasers of green energy in Canada which reduces its environmental impact and supports development of new green energy projects across Canada.



INNOVATION

Built primarily through shale bedrock under the Western Gap of Toronto Harbour on Lake Ontario, the project involved the construction of a mainland shaft situated just 6m from the water's edge. Arup engineered Technicore's innovative pre-support technique that was used to drill seven 1.85m diameter interlocking drift bores, or mini tunnels, above the main tunnel crown using two tunnel boring machines. The drifts, which were backfilled with pumped concrete, allowed excavation to continue under the crown while enabling the tunnel to hold its shape. It was the first time in Canada that such a technique has been used. The airport remained open with access uninterrupted and maintained at a high level during all stages of construction.

An on-site concrete batch plant was set-up for this project. The plant utilized electrically powered equipment to measure and mix the ingredients resulting in no exhaust emissions. This batching operation allowed trucks to deliver gravel and aggregate while leaving with excavated materials. This approach nearly halved the number of concrete and excavation truck movements to and from the construction site thus reducing the disturbance to local residents through reduced traffic congestion, safety risks, noise, exhaust and dust.

Through negotiations with the City, PortsToronto established a taxi staging, customer parking and shuttle bus loading and unloading area on adjacent City lands, clearing up the area for construction activity. These lands were made available to contractors for staging, materials management and construction offices, limiting the potential for construction impact on the local streets and adjacent community.



SOCIAL AND/OR ECONOMIC BENEFITS

The tunnel was designed, constructed and financed using a public-private partnership model that ensured that no taxpayer dollars were used to fund the project. The tunnel was built at a cost of \$82.5M and was delivered on budget and within the 24-36 month timeframe announced for this project in 2012. In addition, PortsToronto worked with the City to include the construction of major City utilities servicing residents of the Toronto Islands as part of the tunnel saving the City approximately \$10M if they had to complete this work separately, as they had originally planned.

Although the primary feature of the project is the tunnel that moves people from the mainland to the island, it also required an innovative approach to traffic management. Careful consideration of the movement of people outside of the tunnel was just as important. Prior to the tunnel opening, road congestion was a major problem as the ferry would drop off large numbers of people at a time. The tunnel ensures that people are able to move more freely with a regular stream of traffic. This has greatly improved vehicular traffic on the airport and the neighbouring areas. A traffic survey conducted in the fall of 2015 found that the opening of the tunnel has assisted in smoothing out the surges in pedestrian activity and reducing the variability in northbound traffic demand. Traffic queue surveys revealed a substantial reduction in the length of idling vehicles waiting to exit the area, compared to the spring “pre-tunnel” conditions.



