

# Canadian Consulting Engineering Awards 2011

*Project Entry for*

## **DUFFERIN STREET UNDERPASS** Toronto, Ontario



ASSOCIATION OF CONSULTING  
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D'INGÉNIEURS-CONSEILS | CANADA





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## PROJECT HIGHLIGHTS

For more than one hundred years, the southbound journey on Dufferin Street in Toronto, Ontario was stopped short by a major, multi-track rail corridor. Cars, buses and emergency vehicles alike were forced to turn left, entering the infamous "Dufferin Jog". This three block circuitous route through a residential neighborhood added only time and confusion to those wishing to travel further south.

Delcan was contracted to remedy this by designing and engineering a smart solution that would seamlessly link the two parts of Dufferin Street. The City of Toronto billed this project as an exercise in "urban place-making", wanting to both improve access and revitalize a community at the same time. Delcan's crisp urban design met these requirements by drawing on community input and imagining a bright, open corridor with a stone parkette, a grassy knoll and well lit walls for the installation of art. At the same time, the straight-through alignment was not only the most effective in its final configuration, it also minimized property taking and provided the smallest footprint in the community in terms of construction and permanent infrastructure. These recommendations were enthusiastically supported by the City and local residents.

The challenge facing Delcan engineers was that the underpass would need to be constructed under a busy, active multi-rail corridor. To achieve this, and in order to make the geometry fit, designers elected to raise two tracks marginally rather than lower the roadway. This allowed the existing traffic on Queen and Dufferin Streets to continue undisrupted, while limiting major works on the railway corridor itself. The resulting solution evolved to sneak in a rigid frame structure beneath the railway tracks envisioning a "bridge on a bridge". Observing minimal clearances, tight confines, very large loads and the desire to keep trains running, the new underpass was built to have existing railway bridges actually supported on the underpass' roof.

The scope of Delcan's design and engineering included:

- Concept design;
- Environmental assessment;
- Bridge and structural engineering;
- Construction engineering and temporary works;
- Utilities and services relocation;
- Stormwater management;
- Landscaping and urban design, public consultations;
- Electrical engineering and lighting; and
- Provisions for artwork.

In November 2010, the new Dufferin Underpass opened to ringing endorsements from city residents and local media. Having met its technical goals with minimal interference to the neighborhood, travel times were reduced and the Toronto

Transit Commission announced expected savings of close to \$450,000 per year by making Dufferin bus trips more efficient.

Plans are currently underway to improve the neighborhood formerly "trapped", north of Queen Street. Improved access, including the pedestrian walkways and bike-friendly features in the Delcan design, has inspired forward thinking residents to redefine the area as a modern, vibrant, growing community with plans for new development and cultural improvements.

The project's creative engineering solution solved a century old problem while reinvigorating a downtown community and opening it to exciting new possibilities.

## PROJECT DESCRIPTION

### Project Expectations

The City required that Dufferin Street be connected beneath the operating CN, CPR and GO Transit rail traffic at Queen Street, in order to eliminate the jog in Dufferin Street which for some 100 years had required that traffic use local streets to get around the railways, as Dufferin Street dead-ended north of the tracks, and ended at Queen Street south of the tracks. The goal was to effect this construction with limited or no interference with rail, vehicular, bus, street car, bicycle and foot traffic which use or affect Queen Street, Dufferin Street and the local streets in this area, and with minimal or no effect on existing structures including the massive heavily-traveled Queen Street Underpass.

### Services Provided

As Prime Consultant, Delcan's services included concept design, feasibility studies environmental assessment, preliminary design, final detailed design and contract documentation, and engineering services during construction. The scope of engineering disciplines included bridge and structural engineering, construction engineering and temporary works, utilities and services relocations, storm water management, landscaping and urban design, public consultations, approvals, liaison with stakeholders including railways and property owners, electrical engineering and lighting, provision for artwork, and other tasks necessary for urban projects.

### Project Objectives, Solutions and Achievements

The objective of this project was to eliminate the long-standing Dufferin Street Jog at Queen Street. The Queen Street Underpass, when constructed in the late 19<sup>th</sup> Century, was intended to connect with a similar underpass carrying Dufferin Street under the railway tracks which cross the Queen Street and the Dufferin Street rights-of-way at a diagonal angle. However, the Dufferin Street Underpass was not completed until more than 110 years later, in 2010. Essentially, the requirement was to carry Dufferin Street traffic through an underpass below the railway tracks, thus connecting with Queen Street and eliminating any requirement that Dufferin Street traffic jog around the Queen Street Underpass, in order to traverse Queen Street and to continue on to Dufferin Street. The scheme which was recommended, accepted for implementation and which was built, involved no changes to the grades of Queen Street and Dufferin Street but, instead, involved raising two of the railway tracks by about 1 metre, a process which was much easier to accomplish than the lowering of Queen Street and Dufferin Street. A compact reinforced concrete twin cell rigid frame structure was built in a sequential manner to accommodate train traffic throughout construction, and with the goal of having virtually no effect on vehicular traffic on

Queen Street, Dufferin Street or adjacent streets. None of these streets were ever closed during construction.

The project was successfully completed with virtually no interference with rail, vehicular, bus, street car, bicycle and foot traffic. This was a remarkable achievement in the context of the intense urban development and heavily-used transportation facilities here. By raising two of the rail tracks marginally, rather than lowering the roads, to obtain the requisite clearances, the design allowed the retention of the Queen Street Underpass/Dufferin Street South complex, with virtually no effect on rail, vehicular, bus, street car, bicycle and foot traffic throughout the works. It has been acclaimed by the local citizens and has received a very positive reception from the Toronto newspapers and Internet contributors, as it clearly comprises an improvement both from transportation and urban design perspectives, adding a welcome new and long-awaited thoroughfare to the neighbourhood and to the City transportation network.

### **Technical Excellence and Innovation**

The project was designed and constructed with a high degree of technical excellence and was successful in reaching its goals of enabling the construction of a significant new transportation structure, with minimal interference to the neighbourhood, and with no interference with traffic on adjacent streets, including major arterial streets and bus and streetcar traffic. The key innovation here was the idea of raising the rail tracks rather than lowering the roads. This enabled the project to be constructed with a minimum footprint and a minimum cost as the scope of works required was as limited as possible. For example, works on Queen Street and Dufferin Street required by other schemes, and works associated with replacing the very large rail bridges on the Queen Street Underpass as well as works lowering Toronto Transit Commission streetcar tracks, all were totally eliminated. Similarly, all significant utility works on Dufferin Street and Queen Street were also eliminated. The effect on nearby businesses, including a shopping plaza, and on residents in the area, was extremely limited and related only to unavoidable construction traffic.

### **Level of Complexity**

The project involved an unusual confluence of railroad, vehicular, bus, streetcar, pedestrian, and bicycle traffic which, as a result of decisions taken in the 19<sup>th</sup> Century, were made difficult by the fact that the Dufferin / Queen Underpass complex was not complete, by the virtue of Dufferin Street not connecting through the project site. All the complexities of this project were resolved by a minimum scope and minimum cost solution involving a conventional principal structure in combination with a special structural steel portal frame which now supports the Queen Street Bridges intersecting with the new Dufferin Street Underpass.

## Contribution to Economic, Social and Environmental Quality of Life

The Dufferin Street Underpass project has made a significant improvement to the environment by allowing efficient traffic flow of all types including railroads, vehicles, buses, streetcars, pedestrians and bicycles. It has been part of a regeneration of the area by virtue of its brightly-lit interior, its full-service capability with respect to transportation modes, and provisions for artwork which are built into the fabric of the structure. In addition, it has been enthusiastically received by the local communities and it is a project of which the City of Toronto is proud.

## Acknowledgements

Delcan was the general consultant to the City of Toronto and designer of the Dufferin Street Underpass, and is the Engineer of Record for this project. As such, Delcan provided professional engineering services on this Underpass, from its inception in 1990 when the environmental assessment was undertaken, until the completion of construction in 2010. The geotechnical subconsultant was Golder Associates, and McCormick Rankin Corporation (MRC) provided construction administration services under separate contract to the City. The railways carried out works using their own consultants.

## Project Completion

Construction of the underpass was completed in 2010 at a construction cost of \$30 million.



Urban design of the newly created public spaces was a key element to the design development

*"It's a huge improvement from a transportation perspective, plus it's created a really nice place in the community."*

David Miller, Mayor of Toronto (2003-2010)



**Before:** Dufferin Street northbound traffic is interrupted by the railway corridor, cutting the neighbourhood in half, and causing congestion in the community.



**After:** The newly completed underpass accommodates the existing railway bridges over Queen Street, enabling a minimum footprint of construction on the surrounding neighbourhood.













