2021 Canadian Consulting Engineering Awards

FLORA FOOTBRIDGE

CONNECTING COMMUNITIES AND PROMOTING ACTIVE TRANSPORTATION IN A UNESCO WORLD HERITAGE SITE

Transportation

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Flora Footbridge: Connecting Communities

ABOUT THE FLORA FOOTBRIDGE: Connecting Communities and Promoting Active Transportation in a UNESCO World Heritage Site

Situated on a World Heritage Site in Ottawa, Flora Footbridge spans 125m over the Rideau Canal. The bridge is named in honour of Flora MacDonald, a pioneering Canadian politician and local resident. Since its opening, the structure has directly increased active transportation trips in the area, helping Ottawa towards its goal to create a healthier, more livable environment. The project was led by the City of Ottawa, with WSP as prime and engineering consultant for this elegant steel bridge which includes V-Piers and a widened deck at centre-span that showcases vistas of the Rideau Canal.

INNOVATION

Flora Footbridge is a striking new pedestrian and cyclist bridge spanning 125m across the Rideau Canal in Ottawa, which is designated as a UNESCO World Heritage Site, with universally accessible approach pathways on each side. Completed in July 2019, it provides a direct link between previously separated mid-town Ottawa communities, improving connectivity for all users. The project was led by the City of Ottawa, with WSP as prime and engineering consultant, and DTAH responsible for bridge architecture and landscape architecture. The scope of work encompassed concept design right through to implementation, including a challenging design approvals process requiring extensive input from NCC, Parks Canada, City of Ottawa and neighbourhood residents. The design team had to be innovative to create a bridge design worthy of a site with local, national, and world cultural significance.

The bridge features a 5m wide concrete deck, finished with a distinctive sand-coloured aggregate wearing surface, supported on two open steel V-frames on elliptical-shaped concrete piers that frame the canal's central navigation channel. High quality, durable materials are used to express finer details, including stainless steel for railings, ipe wood that provides natural warmth to the handrails and the feature west lookout bench, and Ontario limestone that clads and "grounds" the approach landings on each side. The bridge profile is expressed as a clean white "ribbon" within the setting, with a delicate, veil-like aluminum railing floating beyond the deck edge. An understated lighting scheme utilizes concealed LED fixtures in the handrail, as well as below-deck accent lighting to illuminate the V-frames, providing pleasing reflections in the water by night. The overall pathway configuration creates a series of different viewing opportunities, allowing people to appreciate the unique beauty of the Rideau Canal setting.

Open navigation channel

V-Pier shipping

Challenges to building a bridge at this site included year-round canal operations and the availability of sufficient space to accommodate a bridge of appropriate size and scale for the Rideau Canal landscape, which is designated as a World Heritage Site. A navigation clearance of 6.7m required a slender structure for the span while the clearance at midspan posed several geometrical challenges for accessibility and to maintain a maximum approach slope of 5% challenging structural switchbacks were implemented along the approaches. Structural steel was chosen to provide an elegant architectural solution to spanning the Rideau Canal with visually striking steel V-piers that eliminated any central pier support and maintains an open navigation channel on the canal.

Due to the complex nature and geometry of the signature bridge crossing, a more refined structural analysis was necessary than would normally be conducted, and included advanced finite element analysis, 3D structural modeling and detailing for the challenging steel connections, including a detailed analysis for staged construction to maintain navigation at all times, and given the large span and slender structure a detailed dynamic analysis for pedestrian footfall was conducted to ensure satisfactory performance under serviceability conditions. The unusual form of the structure meant that it fell outside standard Canadian Highway Bridge Code provisions for dynamic response, as such through collaboration with experts at Western University the design team implemented special design checks from the Eurocode. In addition, given the irregular form of the structure non-linear structural analyses were required to demonstrate seismic adequacy for the high seismic zone in which the structure is located.

V-Pier fabrication

Assembling the bridge

COMPLEXITY

The design team addressed the following extraordinary problems:

- The Rideau Canal acts as a barrier to active transportation. The length of the Canal between Pretoria Bridge and Bank Street Bridge, at approximately 2 km long, was previously one of the longest linear east-west barriers in the city's urban pedestrian and cycling network.
- The project was faced with the challenge of designing a new landmark within a UNESCO World Heritage Site. The demanding design approvals process required extensive input from NCC, Parks Canada, City of Ottawa and neighbourhood residents.

The design overcame these site challenges and conditions by maximizing lightness and transparency to integrate into the World Heritage Site context as seamlessly as possible.

The unique aspects of this bridge required thorough and accurate detailed engineering calculations, drawings, specifications, and special provisions. The box girders and the V-Piers represent complex steel fabrications, therefore establishing appropriate welding, fit-up, tolerance, and coating requirements was crucial to the overall success of the project. In addition, proportioning the size of components so they could be shipped to site, and ultimately outlining how the erection could be done while maintaining vessel navigation required careful consideration, expertise and skill through the design phase.

The weld joints for the V-Piers were optimized for constructability by introducing bevels which permitted welding in the flat and horizontal positions and minimized welding in the overhead position. Automatic and Semi-Automatic weld processes were specified so that the assembly and welding of the main V-Pier shape could be done in one position, eliminating the complexities of moving/flipping these components. Special provisions for a match assembly methodology during the shop fabrication assured the V-Piers connected to the Pier girders above during field erection. In addition, provisions for a high-quality finish included surface preparation, special coating operations, and a final coat which was field applied.

To attain accessibility requirements on approaches the bridge geometry of the main span required two different longitudinal slopes with a curved section of bridge deck in between. Given the highly aesthetic design, geometry control and layout was meticulously detailed to ensure accuracy of the components during field assembly. Each section of railing was unique and was detailed to fit perfectly to meet the architectural expectations which required calculating differential temperature profiles of the wooden handrails on stainless steel railings.

Boats passing under the Flora Footbridge

Winterlude Festival

SOCIAL AND/OR ECONOMIC BENEFITS

The origins of a Rideau Canal crossing near Fifth Avenue and Clegg Street dates back more than 100 years when a small ferry boat operated for several decades in this vicinity. A bridge crossing at this location was also identified in the Holt Plan (1915); the Greber Plan (1950); and National Capital Commission (NCC) Plans (1968). Through the 1950s and 1960s, the NCC annually constructed a wooden footbridge in this vicinity in the winter months to provide this connection.

More recently, a crossing of the Canal at this location was added to the Ottawa Cycling Plan (2008), the Ottawa Pedestrian Plan (2009) and the Old Ottawa East Community Design Plan (2010). In June 2009, Council directed staff to include sufficient funds for an Environmental Assessment of the Flora Footbridge in the 2010 budget as part of the Ottawa Pedestrian Plan approval process.

The design maximizes lightness and transparency in order to integrate into the Rideau Canal UNESCO World Heritage Site context as seamlessly as possible

The Canal acts as a barrier to active transportation. The length of the Rideau Canal between Pretoria Bridge and Bank Street Bridge, at approximately 2 km long, was previously one of the longest linear east-west barriers in the city's urban pedestrian and cycling network.

The existing Pretoria and Bank Street Bridges offered poor active transportation links, with sub-standard pedestrian and cycling facilities and limited opportunity for improvement due to geometric constraints and heritage considerations.

The new bridge has changed travel behavior in the area. Enhanced connectivity helped improve the use of active transportation and supports the City's mode share targets. In the 2013 EA it was projected that a new crossing would be used for 2,500 trips per day. It now averages over 3150 trips per day.

The following social and economic benefits have been realized as a result of an effective and constructive design process:

- Enhanced connectivity by linking the new bridge to the existing pedestrian and cycling network;
- Maintained navigation envelope on the Rideau Canal (6.7 m by 25.0 m);
- Maintained continuity of the historic Canal walls;
- Integrated and continuous cycling access;
- Universal and equitable access;
- In scale with the setting;
- Compact, quiet and gentle in this important cultural heritage landscape;
- Minimizes visual impact of the structure and approach ramps for drivers, pathway and Canal users; and
- Transparent, slender and light as possible within the viewscape.

Modern re-interpretation of the historic Lily Pond

Active transportation

The landscape design features a modern re-interpretation of the historic Lily Pond, one of the first projects of the Ottawa Improvement Commission early in the 20th Century, on the west side of the canal

> *"By connecting our neighbourhoods and helping people get around Ottawa on foot, by bike or on transit, we are making our communities safer and healthier, supporting local businesses, and protecting our environment"*
>
> *Catherine McKenna, Ottawa Centre MP, Flora Footbridge Opening, June 26, 2019"*

Flora Footbridge at dusk

ENVIRONMENTAL BENEFITS

The footbridge project exemplifies the City's transportation objectives to foster healthy communities by promoting active transportation through enhanced cycling and pedestrian connectivity. This new permanent high-level footbridge crossing minimizes the distance between existing crossings, provides a more desirable pedestrian/cycling alternative to the existing crossings, and has revolutionised travel behaviour for trips across the Canal, already surpassing 1 million users per annum.

Flora Footbridge was initiated to help the City achieve its mode share targets by reducing travel distances for active transportation trips and improving accessibility, comfort, and personal security. The City of Ottawa established a strategic goal of achieving target mode shares of 10% walking and 3% cycling for 2031, compared with the 2005 mode shares of 9.3% and 1.7% respectively. The new bridge over the Rideau Canal connecting Fifth Avenue and Clegg Street has provided numerous environmental benefits by:

- Eliminating longest linear east-west barriers in the city's urban pedestrian and cycling network.
- Easing pressure on existing sub-standard facilities on Pretoria and Bank Street Bridges
- Changing travel behaviour: enhanced connectivity has improved the use of active transportation in support the city's mode share targets.
- Creating a neighbourhood where one can access most of your day-to-day needs within a 15-minute walk from ones' home, including when using a wheelchair or other mobility aids.

Public consultation has been an integral part of this project since the EA. Community and stakeholder feedback was received and integrated into the design, these include: a kick-off visioning and design charrette, advisory committees, First Nations consultation with the Algonquins of Ontario, four well-attended public open houses, an online interactive blog, interim online surveys, consultation with federal approval agencies, and a transportation committee. Since completion the high early public adoption and usage of this structure is testament to public engagement and the creation of cleaner more inclusive communities.

Catherine McKenna, Ottawa Centre MP – February 5, 2021

Winterlude Festival

Multiple users on the bridge and canal

MEETING THE NEEDS OF THE CITY OF OTTAWA

The overall design of the bridge enhances its historic setting without overwhelming it, adding a new landmark within the Rideau Canal that is clearly contemporary, yet also reflects the legacy of engineering innovation and high-quality design associated with previous crossings of the Rideau.

The design provides an active transportation link that embraces seasonality, an important factor for Ottawa. The pier bases provide a place to sit during canal skating in the winter; in the summer boat traffic moves through the centre channel while canoes, and kayaks/paddle boards can safely travel between the canal edge and piers.

The City of Ottawa's original goals for this project included new and transformative connectivity between neighbourhoods, while minimizing the visual impact of the structure within the UNESCO World Heritage Site. The design achieves this with an understated, elegant visual expression that will stand the test of time, with an emphasis on universal access, providing an inviting, comfortable and memorable experience for all users.

"Please accept my sincere thanks for your hard work leading up to today's official opening of the Flora Footbridge. I recognize significant work was undertaken to reach this major milestone.

It has been an excellent partnership and pleasure working with you over the past number years on this project. The enthusiasm, ongoing commitment, patience and above all else quality of service, has been instrumental in the opening of this new multi-use-bridge, ahead of schedule and under budget.

I am very proud of our beautiful new landmark in the City of Ottawa.

Thank you again for the amazing achievement on this project"

Alain Gonthier, P.Eng./ing., General Manager, City of Ottawa Public Works, June 28, 2019

Flora Footbridge at night

SUCCESSES OF THE FLORA FOOTBRIDGE

As well as pleasing the City of Ottawa, the Flora Footbridge has been a success with the public: daily use is 25% higher than anticipated (see Shawn Menard Twitter feed, below).

The project has also received industry recognition, winning the “2019 Ottawa Urban Design Award of Excellence” for both “Public Places and Civic Spaces” and for “Urban Elements,” and the “2019 CISC Ontario Steel Design Award of Merit, Bridges.”

Project team at the 2019 CISC Awards ceremony

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