Stantec

2024
CANADIAN CONSULTING
ENGINEERING AWARDS

Twinning of Stoney Trail over the Bow River in NW Calgary

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PROJECT INFORMATION:

Project Name	Twinning of Stoney Trail over the Bow River in NW Calgary
Location	Calgary, Alberta
Year Completed	2023
Entering Firm(s)	Stantec Consulting Ltd.
Role of Entering Firm(s)	Prime Engineering Consultant
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75-WORD SUMMARY

Completing the Calgary Ring Road required twinning the first Stoney Trail bridge over the Bow River for the Alberta Ministry of Transportation and Economic Corridors, reducing traffic congestion and delays. Stantec designed a new 470m-long, five-span bridge over the Bow River, directly west of the existing Stoney Trail bridge. The new bridge was segmentally cast-in-place using a balanced cantilever method—an innovative technique that allows for bridge construction using a small working area.

1 PROJECT HIGHLIGHTS (CATEGORY B)

1.1 Innovation

In the 1970s, Alberta Transportation and Economic Corridors (TEC) and The City of Calgary (The City) began planning the Calgary Ring Road (Stoney/Tsuut'ina Trail) to accommodate Calgary's growing population. Recently opened, the Ring Road creates a 101 km-long free-flow freeway around Calgary, reducing traffic congestion and improving access to major road arteries. The twinning of the Bow River Bridge completed the northwest segment of this vision.

This project involved two components: the design and construction of a collector-distributor road and bridge between Crowchild Trail NW and Scenic Acres Link NW, and a new five-span, 470m-long bridge over the Bow River. The main innovation was the construction method used to build the new bridge; a segmentally cast-in-place, balanced cantilever method, meaning segments of the bridge would be cantilevered out from each pier and joined mid-span to create the bridge's superstructure. Over a two-year construction period, a sequence of 98 superstructure segments were cast. This method required the bridge design to align with this selected construction method—it needed to be pre-planned in a way that would normally be left to the contractor. The bridge also required in-river work to build the foundations for two of the piers and detours to The City of Calgary's pathway network to facilitate pier and abutment construction.

In addition to planning, designing, and constructing the bridge, Stantec provided hydrotechnical, geotechnical (with Thurber Engineering Ltd.) and environmental support throughout the project. Working closely with the constructor (Flatiron Aecon Joint Venture [FAJV]), and TEC, bridge construction took place over a four-and-a-half-year period. Stantec supported both FAJV and TEC in achieving the end goal when this project opened fully to four lanes on both bridges in November 2023.

We believe this large infrastructure project goes beyond the community and The City by providing a critical link in the provincial economic corridors system and connecting the community on each side of Stoney Trail with enhanced pathways and improved access to Bowness Park, thereby increasing access to Calgary's natural beauty. Stantec is proud of this project, and the technological and intangible aspects of this project; our 2023 International Bridge Conference presentation was very well received. Completing a quality-built bridge of this complexity, especially during the COVID-19 pandemic, is evidence of the success the combined team brought to the project. The team spent over 750,000 hours without a lost-time incident while maintaining high quality standards with no significant impacts to the travelling public.

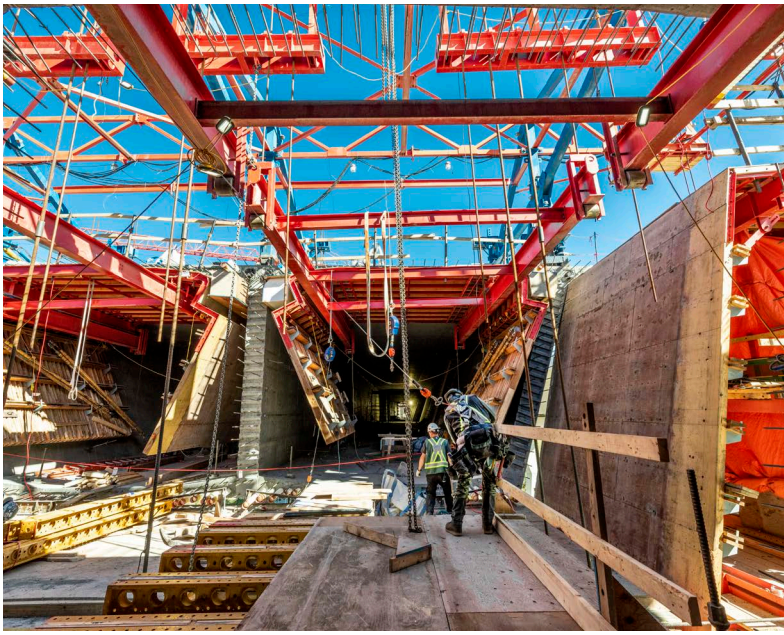
1.2 Complexity

The rarely used balanced-cantilever construction method is optimal for the construction of multiple 100m+ span bridges, especially when precast options is not as economical. The concrete superstructure segments were cast in a balanced sequence over each pier, with each un-cast segment supported by a form-traveller formwork system that was launched after the previous segment was cured and post-tensioned (as much as 50m+ cantilevered). This process was repeated until each opposing segment met at mid-span and was joined.

This project included other technical complexities:

- Daily surveys to ensure the joined segments were well aligned
- Monolithic pour of 100m^3 of 55MPa concrete for each of the 98 segments
- 24-hour operations to suit the short Alberta construction season
- Remotely monitored concrete temperatures for cold weather and mass-concrete pours
- Cooling for mass-poured concrete used water cooled in ponds on site before draining to the river
- Hydraulic modelling for bridge pier placement, flood, and ice events
- Circular secant pile cofferdam to eliminate de-watering for pier 2 foundation construction
- A set of test piles were used to justify a reduction in number and size of piles in the final design
- Construction of a permanent tangent pile retaining wall to reduce slope stability loading on pier 1

The project was a large advancement in engineering and construction in Alberta. The sheer size and magnitude of the Bow River Bridge required a joint venture between two very large contractors to execute the work, plus the involvement of an internationally recognized cantilevered bridge specialist.



1.3 Social and Economic Impact

The project is a crucial link in the Ring Road vision since its absence would lead to permanent traffic congestion due to the network's inability to handle the current and future
volumes, evident during our short construction periods. Considering all modes of transportation, an improved pathway system is also in place, including a new set of stairs on the south bank. For roadway users, moving from two to four lanes in each direction will decrease travel time in and around Calgary for thousands of people each day, resulting in a massive economic, environmental, and societal benefit.

We were able to design for the durability and expected service life of the bridge from a 75-year and 100-year period, using state-of-the-art high-performance concrete and post-tensioning for current and future load-carrying capacities; this approach optimizes the functionality of reinforced concrete and limits corrosion, meaning the required rehabilitation will be limited to replacing the bridge deck asphalt wearing surface, reducing future disruption on the environment and the surrounding community.

The most meaningful aspect of the project for those who worked on it lies in the unique engineering elements, particularly the rarity of bridges with girders of such magnitude. Walking inside the bridge evokes a sense of awe, emphasizing the project's engineering prowess. Excellent project safety led to completion of the project without a lost-time incident, even while managing multiple simultaneous work zones. This project represents a major success success in an over 50-year municipal vision and a transformation of how Calgarians can navigate the city for decades to come.

1.4 Environmental Impact

One of the biggest challenges was the complexity of the site, an environmentally sensitive and publicly accessible location in one of The City's most delicate areas, the Bow River. We designed a bridge to last 75 years, spanning the river basin that integrates into the natural environment while minimizing the impact of the piers on river flows under normal and flood conditions, an occurrence accentuated by climate change.

The design prevents roadway water from draining directly into the river, from the new bridge and the existing bridge was modified to remove deck drains. Instead, water from both bridges flows into a stormwater pond that allows grit to settle and salts to dissipate before draining into the river.

The balanced cantilever construction method minimized impacts to the river ecosystem and provided a reduced construction footprint, leading to less ecological restoration required when construction was complete. To compensate for the loss of fish habitat from the in-stream construction of berms and caissons, an existing snye (backwater) was improved to promote fish activity and breeding.

In the 2022 flood season, a forecast was received to overtop the construction berms, and as a precaution, all equipment was moved to higher ground, proving the emergency plans were effective and implementable to protect the environment. By finding unique solutions to environmental challenges, such as using a circular cofferdam which required nearly zero de-watering, we helped set new standards for future projects of its type—those with massive concrete construction in an environmentally sensitive setting.

1.5 Meeting and Exceeding Owner's/Client's Needs

TEC's key objective of a twin bridge posed considerable challenges when creating an aesthetic matching the existing structure while still adhering to their specific criteria. Their goals included emulating pier spacing, minimizing impacts on river hydraulics, and creating a larger trapezoidal girder section, without visually deviating from the original bridge. Despite these challenges, the twinned bridge so closely resembles the original that without knowledge of existing bridge construction details, one may assume they were constructed simultaneously.

As the project team evolved, Stantec embraced the changes as opportunities for improvement. Although staffing changes remained a challenge throughout the project, our ability to transfer knowledge while maintaining clear lines of communication ultimately proved to be a benefit, with individuals involved since the beginning assisting all team members by providing stability and continuity.

The project faced formidable hurdles, including a lengthy schedule, a significant budget, and environmental limitations, which were compounded by using a rare construction method. An interchange project south of the Bow River Bridge also started in 2020. Although this was not part of our project's design, the design and construction team adapted to this change and ensured a comprehensive roadway connection for the new TransCanada highway interchange.

Plainly put, this project took a long time to design and build. Designing a cast-in-place balanced cantilever superstructure is complicated and building it even more so. Despite the challenge, construction was substantially completed after nine years, with four lanes of traffic flowing in each direction, meeting the needs of the client and Calgarians.