



Photo courtesy of Brooke Duthie

Beauty and Durability Samuel De Champlain



With a tight timeline and harsh conditions to overcome, the design-build team took on the challenges with high expectations and lofty ambitions.

By Kirk Stelsel, CAE

The Samuel De Champlain Bridge features extensive use of precast concrete and is one of Canada's most well-travelled bridges.

ty Shine with in Bridge



Photo courtesy of Beton Prefabrique

Replacement of a bridge structure requires a deep understanding of current challenges and future needs, as well as thorough planning and coordinated execution. There are the obvious design, demolition and construction stages, but behind the scenes, many other factors loom such as environmental concerns, traffic mitigation plans, public support campaigns, funding models and the imperative selection of the right partners.

The larger the project, the more complex all these considerations become, so when the planned bridge is a \$2.4 billion replacement for one of North America's busiest spans, with 50 million vehicles passing over it each year, the stakes ratchet up to peak levels.

A WORK OF ART MADE TO LAST

Among the top considerations for the Samuel De Champlain Bridge – a 2-plus mile span over the St. Lawrence River that serves as a major link between the U.S. and Canada and the gateway to Montreal – were the timeframe, aesthetics and lifespan. It's no easy task to design and build a bridge of that magnitude that will both complement the city it serves and have a useful lifespan of 125 years. To attempt to do so in just 42 months, due to the state of the existing bridge, takes things to a new level.

More than 10,000 precast concrete elements ranging from pier leg segments to architectural elements were produced by Beton Prefabrique for the project.



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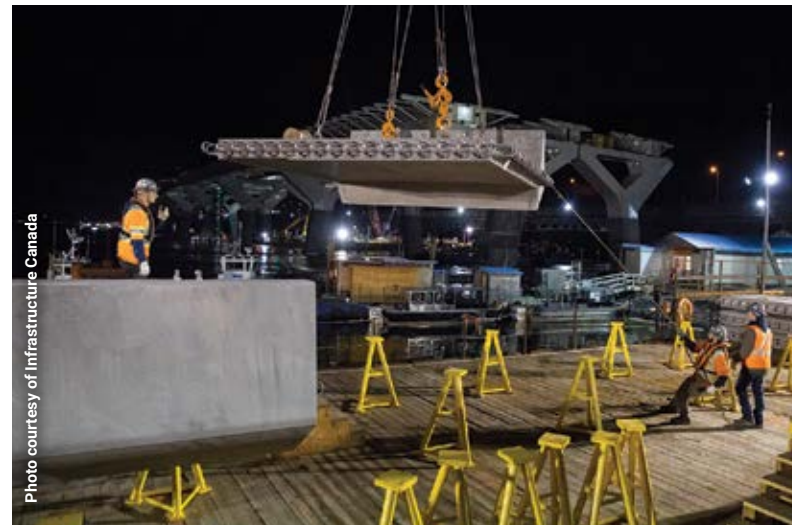
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“On a megastructure like this, even if you’re in very friendly weather, that would have been considered a very aggressive schedule,” said Marwan Nader, senior vice president with T.Y. Lin International Group and engineer of record for the bridge. “When you come to Montreal, there will be at least 3-4 months of very harsh conditions so what happens is you’re basically dealing with a much shorter duration of effective time. That, to some extent, was the focus of the design-build team when we were looking at construction means and methods.”

The design team chose methods tailored to these factors. One element of the plan called for segments that a standard crane could lift to

minimize the amount of field work and increase pace. In addition, construction crews performed work in parallel in three sectors: the west approach, the cable-stay bridge and east approach. The team also chose to use various precast products to accelerate the construction schedule. A major application was precast concrete pier sections to avoid having to deal with cast-in-place concrete and to be able to build during inclement weather while still having a high degree of quality.

“With precasting inside a shop, you have a lot more control in



Photo courtesy of Infrastructure Canada

The bridge deck is made up of 9,638 precast concrete deck slabs.

terms of the spacing of the rebar and where you place things and match casting,” Nader said.

The structural precast concrete match-cast segments were used for the lower portion of piers along the west and east approaches and the inclined lower portion of the main span tower up to the upper crossbeam, referred to as

the bow tie because of its peculiar shape. The segments of the west approach piers were set on gravity-based footings and pier starter segments cast in a CSA Group-certified temporary precast plant on-site due to weight.

One area of major concern for the design team was the effect ice abrasion has on bridge piers over time. Another was the generous use of



road de-icing salts through the winter seasons. To mitigate these future issues, the designers specified high-strength/high-performance concrete for the segmental precast pier starter pieces to create built-in ice abrasion resistance. In addition, all deck precast elements required stainless steel rebar to withstand the corrosive nature of the salts. Elements were also cured

in humid chambers to achieve the required durability.

NO TIME TO WASTE

As the existing Champlain Bridge has approached the end of its service life, it has received extensive structural repairs and reinforcement just to keep it in operation until the new bridge opens. To keep time on their side, the designers specified precast concrete elements for not only the piers but also the deck panels and other facets of the project.

“Extensive use of precast concrete as a construction strategy for this project was based on a number of factors including the project’s tight schedule, Canada’s requirements for the delivery of a highly durable product and the fact that the bridge needed to be built while accounting for Montreal’s rigorous winter season,” said Guy Mailhot, chief engineer at Infrastructure Canada, the owner of the project. “The design-build team was able to achieve the expected results through careful planning, attention to detail and the use of good surveying methods to ensure proper geometrical control in assembling the large number of precast components.”

BPDL, a precast company with its head office in Alma, Quebec, manufactured the precast elements. During the project, four BPDL plants – primarily the St-Eugene’s plant, which is 56 miles from the job site – manufactured 315 pier leg segments; 44 pylon segments; 9,636 deck slabs; 32 box girders; 142 girders; 66,415 square feet of architectural precast panels; 495 precast panels for the electrical rooms; and other precast concrete elements including retaining walls, pipes and more. Once on site, crews installed the deck slabs at a rate of 440 panels per week and constructed the lower legs in just 36 days. The architectural panels were used for the walls of the uniquely shaped east and west abutments, the latter of which is 231 feet wide.

“As the project was design built, it required a lot of flexibility for our whole team,” said Robert Bouchard, CEO of BPDL. “We had six draftsmen



Photo courtesy of Beton Prefabrique

The new bridge was constructed adjacent to the old one to limit traffic disruptions. With the old bridge nearing the end of its service life, crews wanted to build the new bridge as quickly as possible.



Photo courtesy of Beton Prefabrique

full time during the two years dedicated to this project. We had to double our labor in a situation where Quebec is struggling with a lack of labor and workers and double, even triple our transport teams – we are talking here of approximately 5,000 loads in a timeline of a year and a half.”

READY FOR THE SPOTLIGHT

The team completed the bridge’s major structural works in December, and the bridge is expected to open to traffic in June 2019. This spring, some of the permanent finishing work, notably waterproofing and paving, will be completed.

The new bridge was built just downstream of the existing Champlain Bridge, which remained fully operation during construction. This approach kept traffic disruption at a minimum. The new bridge includes two three-lane roadways, a path for pedestrians and cyclists, and accommodations for a light-rail system.



Photo - courtesy of Beton Préfabrique

“I would say everyone has been pleased,” Nader said. “It’s really a streamlined process, and I think you’d get folks from design and construction to say that they are quite satisfied.”

Bouchard agreed. “All BPD employees are particularly proud to have participated in such an important project – after all, the Champlain bridge is one of the bridges with the most important traffic demands in Canada!”

Most importantly, the Canadian government is pleased with the work completed to date and the overall appearance of the structure, and feedback from the public about the construction process and the appearance of the structure has been overwhelmingly positive. Adding to the

kudos, the bridge has earned high honors for its sustainability. The project earned the Envision Platinum award – the highest there is – from the Institute for Sustainable Infrastructure, the first large-scale bridge to do so in Canada.

As millions of motorists, cyclists and pedestrians begin to use the structure for its intended purpose for the first time later this year, its safety, beauty, functionality and sustainability are sure to earn their admiration and appreciation as well. **PS**

Kirk Stessel, CAE, is NPCA’s director of communication.

The Samuel De Champlain Bridge should be open to traffic this summer with finishing work being completed this spring.