



WITH ITS THREE PARALLEL steel arches, the new Strandherd–Armstrong Bridge, in Ottawa, spans the Rideau River, a waterway that forms part of the Rideau Canal. The canal, on the basis of a recommendation by the Historic Sites and Monuments Board of Canada, has been designated a national historic site, and it also appears on the World Heritage List, which is compiled by the United Nations Educational, Scientific and Cultural Organization (UNESCO). Although the new structure is an iconic crossing that links Strandherd Drive with Earl Armstrong Road in the growing southern portion of the city, the project had to comply with numerous strictures imposed by environmental and conservation authorities, and there were also periods during which construction work could not be carried out in the river, explains Jack Ajrab, P.Eng., a senior structural engineer in the Ottawa office of Parsons, formerly Delcan. Parsons was responsible for the engineering of the bridge, which was designed by the architecture firm DTAH, of Toronto.

Since at least 2007, when preliminary design work was conducted by the City of Ottawa, the bridge had been delayed by various prob-

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Ottawa Bridge Spans UNESCO Heritage Waterway

Crossing a historically significant and protected waterway in Ottawa, the Strandherd–Armstrong Bridge features a 125 m long main span supported on three parallel arches.

lems, including the cancellation of a light-rail project that had included the bridge and the default in March 2012 of the original general contractor. A new contractor, Horsehoe Hill Construction, Inc., headquartered in Bolton, Ontario, completed the C\$48-million (U.S.\$44-million) structure, which

is painted white and opened to vehicular, pedestrian, and bicycle traffic in July of this year. The Strandherd–Armstrong bridge crosses the Rideau River in a roughly west–east alignment and is 143 m long. Its 125 m main span is supported by three parallel arches—a large central arch flanked by two smaller arches. On each side of the central arch is a bridge deck roughly 17.75 m wide that has one lane for buses (which could accommodate light-rail rather than buses at some future date, Ajrab notes), two lanes for vehicular through traffic, a turning lane, and a lane for bicyclists. At the outer edge of each deck is a pedestrian sidewalk that is separate from the main deck section. The bridge ranges in width from 55 m at the end abutments to 58.7 m at the midspan because the sidewalks bow out and then back along the length of the bridge.

The design of the structure was somewhat inspired by Santiago Calatrava's Lusitania Bridge,

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which was completed in Mérida, Spain, in 1991, Ajrab says. Like the Lusitania's single arch, the Strandherd–Armstrong's arches each feature three chords, which in the Ottawa structure involve two top chords and one bottom chord connected by diagonal and K-shaped braces that form a triangle in section, Ajrab explains. Rising to a height of approximately 21 m above the bridge decks, the arches form space trusses and are made from steel pipe sections typical of the petroleum industry that are roughly 500 mm in diameter and have walls 1 to 3 in. thick, depending on location, Ajrab says. The top chords of the center arch are 4.25 m across and approximately 3.5 m deep, whereas the top chords of the side arches are roughly 3.5 m across and 2.5 m deep. Each arch features 25 pairs of steel hangers that support the bridge decks.

The concrete-topped decks and sidewalks are formed from a steel grillage that includes floor beams running transversely at each hanger location and trapezoidal steel boxes that run longitudinally, each of the two decks supported by three boxes, Ajrab says.

The arches are supported on reinforced-concrete thrust blocks at each end of the bridge. The central arch block is approximately 5.5 m high, 8.5 m wide, and 8 m long, whereas the side arch blocks measure roughly 5.5 m high, 5.5 m wide, and 8 m long, Ajrab says. The arch blocks are attached to one another below grade via footings and an abutment wall that is 8.25 m

high on the west side of the bridge and 10 m high on the east side. These foundations are also supported on steel-lined concrete caissons 6 ft in diameter driven through the overburden and socketed into bedrock at a depth of roughly 12 m at the eastern abutment and 16 m at the western abutment.

The foundation systems were constructed approximately 9 m back from the riverbank on the east side and roughly 10 m back on the west side to accommodate a preexisting footpath along the river that had to be demolished and then reconstructed and replanted with native vegetation, Ajrab notes.

Because of the historical and environmental importance of the site, the design and construction teams carefully coordinated their efforts with various organizations, among them the Rideau Valley Conservation Authority, Parks Canada, Transport Canada, and Canada's National Capital Commission. In addition to lengthy permitting processes, the coordination involved erosion and sediment control monitoring, frequent reports, and periods during which construction work could not be carried out in the river because of, for example, fish spawning and recreational boating, Ajrab notes. No permanent structures were allowed in the river, but temporary construction work in the water could not be avoided, Ajrab says. In particular, the contractor opted to assemble the bridge structure in sections on land on the eastern side of the river and then slide it into the correct plan

position on temporary structures over a two-day period.

The bridge launching operation was completed in July 2013 and involved a series of rollers that moved the bridge across elevated temporary trusses that had been erected in the river. The bridge structure was pulled via cables attached to hydraulic jacks located on the western side of the waterway. Boat traffic was temporarily halted during each moving phase of the operation and then resumed while the jacks were being repositioned and reset, Ajrab notes. Once across the river, however, the bridge structure was still roughly 5 m above its final position because of the height of the temporary trusses. It was therefore supported at each end on temporary towers while the trusses were removed. The bridge was then carefully lowered into place, the towers were removed, and the final connection work began. Over the next year, the approaches were constructed to link the bridge to the existing roads on either side; the storm-water sewers were installed; the concrete for the decks, sidewalks, and barrier walls was placed; the electrical cables, lighting, and traffic signal systems were installed; and other key features were completed.

Because the Ottawa region is one in which seismic concerns cannot be ignored, the bridge abutments feature seismic isolation bearings so that the arches can move freely. The decks, suspended from the hangers, also can accommodate seismic movement, Ajrab notes.

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CITY OF OTTAWA

STRANDHERD–ARMSTRONG BRIDGE ELEVATION VIEW

