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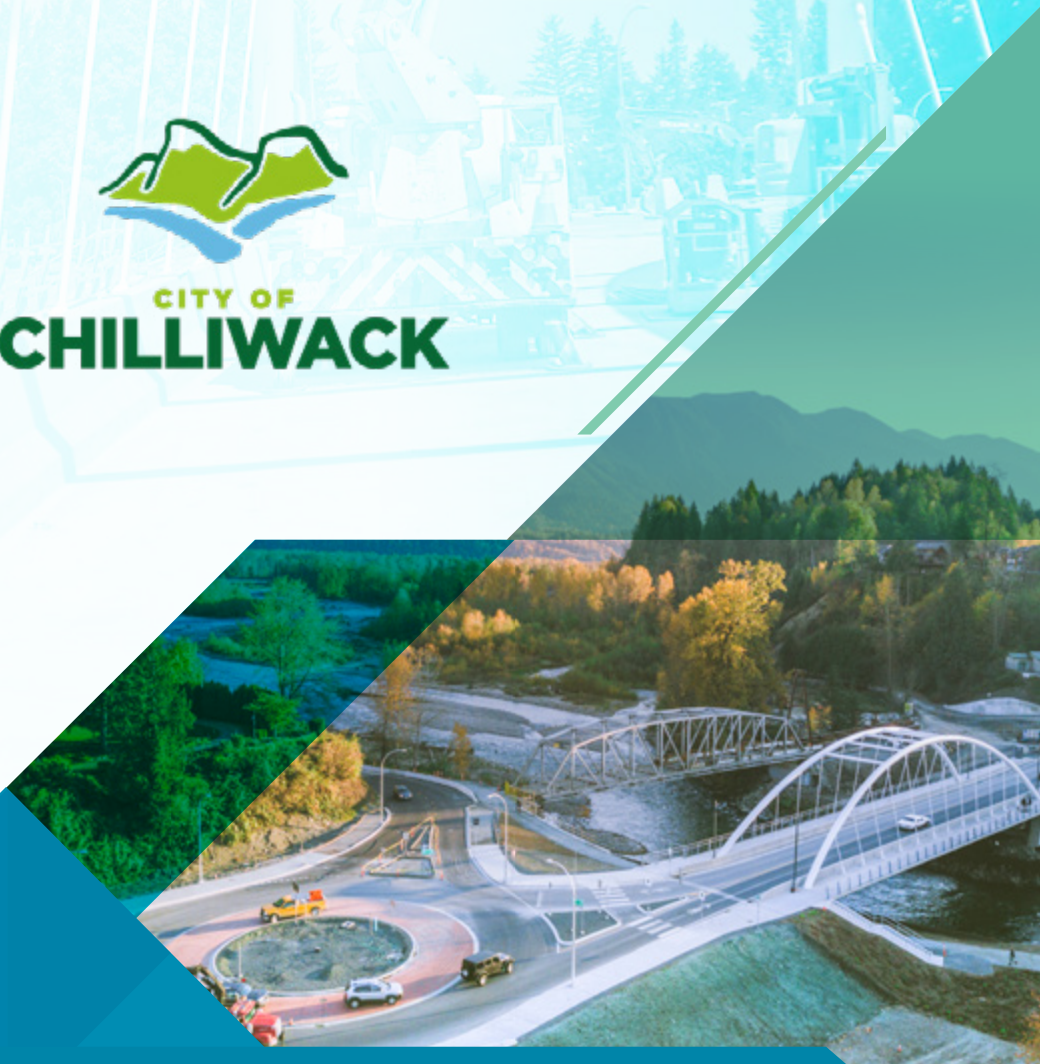
Klohn Crippen Berger

VEDDER BRIDGE REPLACEMENT DESIGN BUILD PROJECT

CITY OF CHILLIWACK



CANADIAN CONSULTING ENGINEERING AWARDS 2018

INNOVATION

Moving the 80-metre-long bridge across the river, without support on one end of the arch, posed an interesting construction-engineering challenge. The design-build team planned its construction by assembling the steel superstructure on site behind the north abutment and launching it in one piece from north to south across the river.

KCB designed a temporary king post support system to support the bridge during installation. Using the king post, the bridge was picked up from its temporary supports and propelled across the river in one metre increments using hydraulic jacks on four travelling skid shoes. The critical part of the launch – the first 60 metres when the bridge was cantilevered over the river and unsupported at one end – was successfully completed in one day before a large audience of Chilliwack residents. The final 20 metres of travel, involving several resets of the jacks to place the end of the bridge on its permanent abutment, was completed over the next few days.

The Vedder Bridge is believed to be the first steel arch bridge in the world launched into place using a king post support system. Arches are normally not strong enough for the temporary loading conditions of launching. These challenges were met using an innovative combination of the continuous longitudinal tie girders on the south side span being used as a launching "nose", localized reinforcement of the tie girders and the temporary global support provided by the kingpost system.

After the new bridge was constructed and in service, the same kingpost system was modified and reassembled to support the existing steel truss bridge during demolition. The demolition method has been designed to avoid all work within the wetted perimeter of the river. Once the deck was removed, the kingpost was installed to support the bridge from above the floor beams. The kingpost system's longitudinal launch girder was connected to the old bridge at the floor beam nodes. Tension was applied to the cables to pick up the truss with temporary supports and retract the structure across the river in one meter increments using hydraulic jacks on four travelling skid shoes. The truss was then disassembled on land. This innovative demolition method eliminated any temporary supports in the river and reduced the risk of lead contamination through components falling into the river. Therefore, the project schedule and cost were significantly reduced.

COMPLEXITY

A fundamental goal in construction of the new bridge and demolition of the existing bridge was to avoid any work within the wetted perimeter of the river. This was important both from an environmental standpoint in protecting the important salmon river, and providing schedule flexibility as the fisheries windows for working in the river were very short. Safety risks in construction were also reduced. Launching was therefore chosen for the erection method. This method allowed all the steel bridge components to be assembled on the north side of the river.

Ordinarily the through-truss bridge demolition method would require temporary piled support bents in the river. This would have been very difficult in the environmentally sensitive site and would have extended the project schedule and significantly increased costs. The solution was to modify and re-use the kingpost cable system and "de-launch" the old bridge.

Geotechnical conditions were difficult and variable at the site. Liquefaction of the soils in a seismic event is expected at the south pier location and horizontal movement of the soils are anticipated. A stiff pile foundation was designed to minimize the movement of the pier and south abutment, and the bridge superstructure was isolated from the movements through the use of a guided sliding bearing at the tie girder/pier interface which allows the pier and abutment to move towards the river up to 400mm. The substructure piles were filled with reinforced concrete to minimize movements. This design approach eliminated a costly ground improvement program for the client.

SOCIAL AND/OR ECONOMIC BENEFITS

The completion of the new Vedder Bridge brings safe and convenient access for tourists and residents to the popular Cultus Lake and Chilliwack Lake, contributing to the development of the community.

The design build project delivery method offered a unique opportunity for the project team to develop a cohesive and efficient bridge design package for the client. EAC teamed with steel fabricator Canron during the bid. The Contractor, fabricator and designer closely collaborated throughout the project from concept through to construction. This factor resulted in a number of cost saving decisions and unique constructability concepts.

A major achievement of the design build team on this project was the increased safety and efficiency gained through avoiding any work within the river.

The launch of the new bridge and the de-launch of the old bridge were both completed in one day each.

The bridge's two arches are inclined slightly, in what is known as a "basket handle" arrangement, and are connected above the roadway with six horizontal pipe struts. Inclining the arches performs the structural function of shortening the cross-members, which allow the use of lighter, more slender sections, while also providing a captivating aesthetic.

The bridge has already become favorite destination for many local residents, photographers; artists; hikers, joggers, cyclists and amateur fisherman. KCB's engineering team is proud to have participated in the rewarding project that will benefit local residents, tourists and British Columbians for decades to come.

ENVIRONMENTAL BENEFITS

The City of Chilliwack selected the arched bridge option for the Vedder Bridge from two alternatives provided in the bids. Arch bridges are usually constructed in place and temporarily supported by "falsework", until the arch at each end is supported by permanent abutments, or else floated into place on barges. Neither method was practical on the Vedder River, an important salmon and steelhead river. In-river works were undesirable due to fisheries windows schedule limitations and sensitive environment.

KCB provided an innovative financial and technical solution for designing and constructing the bridge, minimal disruption to the surrounding community, environment and road/utility network. The kingpost system used the precast panels, which would later be used to form the bridge deck, as large counterweights. The continuous south side span tie girders also functioned as the "launching nose" extension required for launching. The same system was then re-used to "de-launch" the old bridge for demolition.

By assembling and disassembling the respective bridge structures on land, the design-build team increased safety for the construction team and minimized the environmental footprint of the project. Completing work over land is safe, efficient and cost effective.

Using precast deck panels as launching counterweight reduced the cost of hauling other types of counterweight to the site, thus reducing the construction cost. In addition, the precast deck panels also acted as formwork for the cast-in-place deck topping, avoiding construction of timber formwork over the water. These design efficiencies further contributed to minimizing the environmental footprint of the project.

MEETING CLIENT'S NEEDS

The existing Vedder River Bridge was deficient in clearance above flood water, and had many deteriorating components. The intersection at the north end did not have sufficient vehicle capacity during rush hours or peak weekend demand created by recreational traffic accessing Cultus Lake and Chilliwack Lake in the summer months.

The Project Owner, the City of Chilliwack (CoC), decided on the design build project delivery model for the bridge replacement. CoC had strict budget limits, but desired a unique attractive bridge for the popular and highly visible location in the community. The project also included an upgrade of the approaching roads and a new roundabout intersection on the north end to provide greater travel capacity and improve safety. Demolition of the existing Vedder River Bridge was also included in the project scope.

KCB was retained by Emil Anderson Construction (EAC) to provide structural, hydrotechnical, and geotechnical engineering, along with design management services for the engineering during the bid, and subsequently for the detailed design.

The winning design was an attractive tied arch bridge. The new 80m long Vedder River Bridge has two spans with a 60m steel tied arch main span with hanger rods in a "ray" arrangement. The longitudinal tie girders for the arch are comprised of steel rectangular "box" sections which connect the ends of the arches, and then continue through the 20m south side span as supporting girders. The continuous design avoids expansion joints and provides simple and consistent fabrication method for the entire bridge.

DISPLAY BOARD

CLIENT: CITY OF CHILLIWACK

CONTRACTOR: EMIL ANDERSON CONSTRUCTION

Klohn Crippen Berger

VEDDER BRIDGE REPLACEMENT DESIGN BUILD PROJECT

CHILLIWACK, BC

Klohn Crippen Berger Ltd. (KCB) teamed up with contractor Emil Anderson Construction Inc. (EAC) for the design and construction of an attractive arch bridge over the Vedder River in Chilliwack, BC. KCB led the structural, geotechnical and hydrotechnical engineering of the new steel tied-arch bridge. The project scope also included demolition of the existing bridge. During construction, the bridge was launched using a temporary kingpost column and stay-cable system, a world first for an arch bridge. The structure was balanced as a cantilever system using a massive counterweight comprised of the precast concrete deck panels. The construction team slid the balanced structure on tracks using hydraulic jacks to advance the nose of the structure over the Vedder River until safely reaching the pier. The existing steel through truss bridge was demolished by re-using the Kingpost system to retract the superstructure over the river, reversing the launch sequence. This method reduced work over water and completely avoided any in-water work in this important salmon river, resulting in a safer and low risk solution for the City of Chilliwack.

PHOTOS

Launching the new bridge across the Vedder River

View of the kingpost system and counterweights during launch

Nose advancing towards the pier on the south bank

Hello-Goodbye Vedder Bridge day event on opening day of new Vedder Bridge

The new Vedder Bridge blends into the local environment with minimal disturbance

The new Vedder Bridge improves the natural path and hydraulic performance of the Vedder River

Lighting of the bridge provides a captivating night time aesthetic and safe passage for pedestrians/cyclists

Retraction of the old lead painted Vedder Bridge during demolition

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