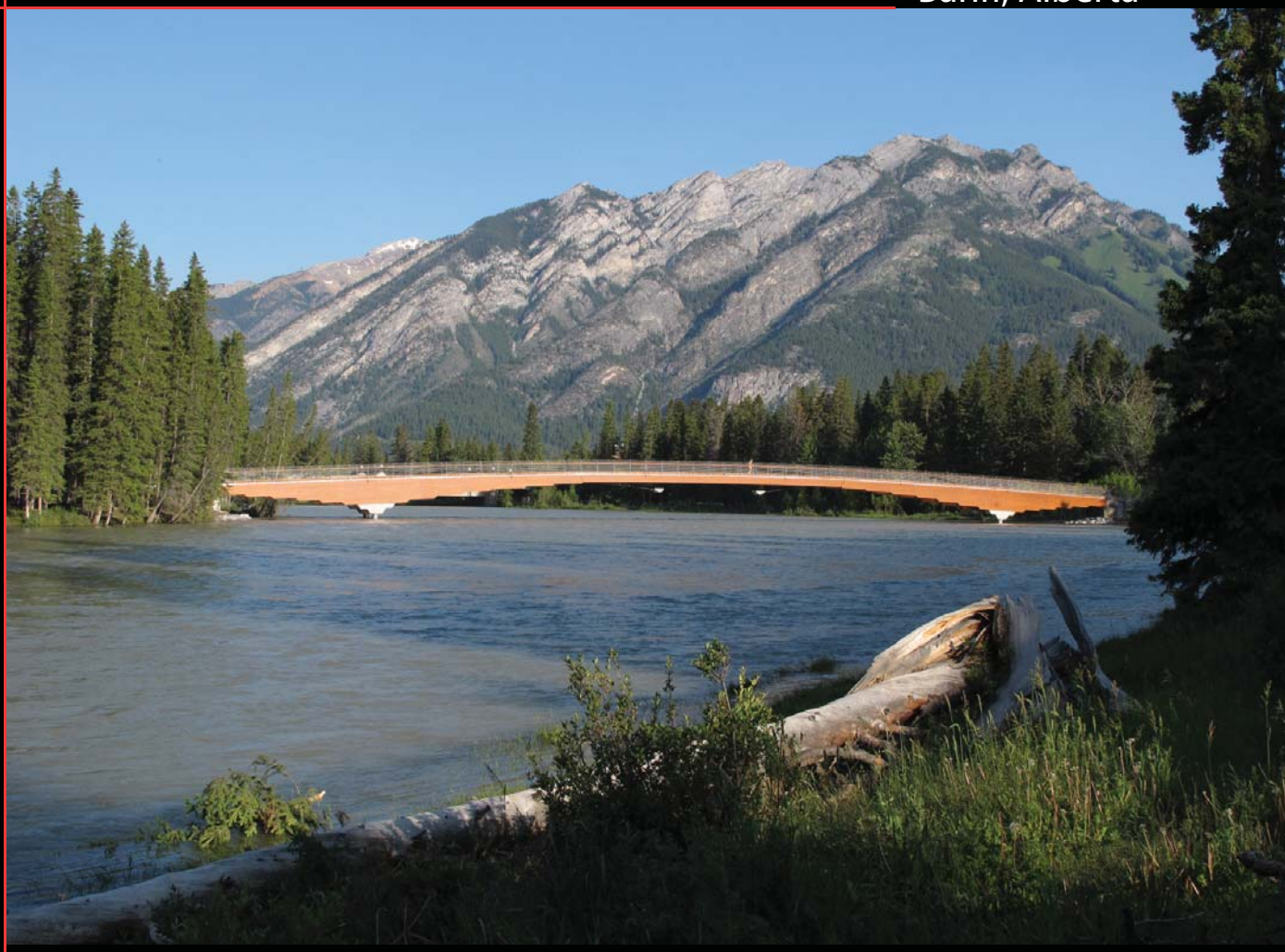
Fast + Epp

# BOW RIVER PEDESTRIAN BRIDGE AND UTILITY CROSSING

Banff, Alberta



CANADIAN CONSULTING engineer

ASSOCIATION OF CONSULTING ENGINEERING COMPANIES BRITISH COLUMBIA

# Bow River Pedestrian Bridge and Utility Crossing

## Banff, Alberta

**CANADIAN CONSULTING ENGINEERING: Awards 2014 Competition**

Year Completed: 2013

Category B: Transportation

Entering Firm: Fast + Epp — Structural Engineering

Project Leader: Gerald Epp

Project Owner: Town of Banff
(contact: Brennan David, Engineering Coordinator)

Project Client: StructureCraft Builders Inc.
(contact: Daniel Kravcak)

Project Contractor: Tritech Group
(contact: Jack Gill)

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**BOW RIVER PEDESTRIAN BRIDGE AND UTILITY CROSSING – Fast + Epp**

**75-Word Summary:**

Bow River Pedestrian Bridge and Utility Crossing is an iconic timber design-build project that spans the Bow River in Alberta. Featuring an 80m clear span, it facilitates foot and emergency vehicle traffic. In order to accurately assemble and erect the bridge, the individual elements were prefabricated in shop and shipped to the site as a kit of parts. A minimal, unimposing design was used to blend the bridge into the natural beauty of the park.

**Project Highlights:**

**Innovation**

The historical Town of Banff, set in the beautiful Canadian Rockies, is one of the most visited tourist destinations in North America. The town sought a new crossing which would not only be functional but enhance the stunning mountain and river setting. It creates an important community link, encouraging walking, jogging, and cycling in a recreational town, whereas previously there was only the sidewalk of a road bridge, with its inherent congestion and danger.

The design of Bow River Bridge needed to meet some very demanding guidelines that included creating a minimal, unimposing design, suitable to the spectacular setting. It was to be designed within a 135m crossing length, with maximum 5% slope for accessibility, using natural materials.

The natural inclination in choosing structural materials for long span bridges is steel and sometimes concrete. While using wood for uncovered bridges is not conventional wisdom, the Town of Banff did desire natural materials for environmental and aesthetic reasons, and were motivated to explore the use of timber. Further, the client desired a 75 year design life. Through much discussion about issues of durability for both the primary beams and the decking, the client came to be convinced that the new bridge could be maintained and remain beautiful for the design life and beyond.

To match the setting, and to avoid placing piers in the main stream of the sensitive river, the design features an 80m clear span, which for a timber bridge is perhaps the longest of its kind in the world. This, with an extremely slender curved profile, created the primary structural design challenge for the bridge: its dynamic behaviour due to pedestrian excitation.

To address the potential liveliness of the bridge, an increase in the structural damping was required. While tuned mass dampers are commercially available, there was no room to conceal them below the deck. Instead, a completely unique, custom alternative was developed: two cable-suspended masses were visually exposed (for honesty) as unique tuned-mass dampers beneath the bridge. These masses each have different fundamental frequencies, and address footstep and jogging excitation respectively. The dampers consist of carriages containing a series of steel plates (the "mass"), suspended with cables (the "spring"), and tuning was simply addressed with the addition or subtraction of plates. In-place

testing using 6 accelerometers at key points along the span was carried out to ensure these TMDs were effectively tuned.

**Complexity**

Driving the design agenda was a pressing concern that existing sanitary pipes installed below the river at this location some fifty years earlier could fail, spilling raw sewage into the pristine Bow River. The bridge needed to carry new pipes, creating an important dual use for the new crossing. In addition, it was required that the bridge be constructed so that it could accommodate medium sized emergency vehicles as well as foot traffic.

A tight, remote site, huge structural elements, and harsh winter weather all combined to make the bridge erection a challenge. This put a huge emphasis on ease and accuracy of assembly in the field.

The main structural elements of the bridge were too large to be transported to the site in modules ready for installation; and fitting up the pieces over the river with a smaller crane would have presented significant environmental and safety challenges. In order to accurately assemble and erect the bridge, the individual elements were prefabricated in shop and shipped to the site as a kit of parts. All cutting, drilling, sanding and finishing was performed indoors under controlled conditions so that members were protected from the elements both in transit and on site. Jigs were built to ensure accurate assembly of the main bridge components in the field. In all, the entire bridge superstructure was erected in 3 lifts over 2 days, with the heaviest assemblies weighing in at over 50 tonnes.

**Social and/or Economic Benefits**

Footbridges are an excellent opportunity to exploit the use of timber, especially in beautiful settings and this was a world class opportunity. However, great care in design and execution must be taken in account for its unique properties, and to ensure the structure will remain an enhancement to the setting which all can enjoy for many years to come.

As mentioned, timber usage in significant bridges is often discounted, because of durability perceptions. The intent of Fast + Epp and the builder/client StructureCraft, was to address these concerns so thoroughly through design and construction detailing that such perceptions will start to change. Further, that the strengths timber brings can be celebrated – beauty in the natural settings which bridges often call for, and all the environmental benefits which timber, by far the most sustainable structural material, brings.

The team was one of seven design-build competitors, and the only proponent of a timber bridge. It was chosen for its unique design proposal as well as strict attention to the Town of Banff's budget. The project has been well received by both the client and the surrounding community including the 3 million people which visit Banff every year!

## Environmental Benefits

Both the Town of Banff and Parks Canada have jurisdiction at this site, and environmental stakes were high: the brief included a 178 page Environmental Assessment, enforcing a wide range of controls, from sediment control and emergency response during construction, to long term issues such as avoiding use of de-icing salts on the bridge deck. These were a significant part of the challenge in designing and building a bridge in this location especially affecting the selection of pier installation techniques.

Timber was chosen partly because of its strong carbon sequestration, and partly to demonstrate these values in a high profile location, when it would have been easier to choose a steel solution. An important part of sustainable design is material use reduction, achieved here through the shaping of the beams, and use of a tuned mass damper system. Further, use of easily removable modular deck panels encourages re-use and longevity of the bridge.

## Meeting Client's Needs

Given the many constraints and aspirations, a strong synergy between client, prime contractor StructureCraft Builders, and Fast + Epp Structural Engineers was critical to success, achieved through a design-build delivery model.

Environmental concerns were critical to the client, and over time a relationship developed that gave the client full confidence in the construction team for impacts of both the final design and the construction process.

Durability was a topic of significant interest to the client, and great care was taken in detailing to ensure the 75 year design life. Spacing between the paired glulams (glue laminated timer) allows full ventilation, and the shingled heavy gauge flashing creates a strong drip edge protecting the beam faces. All steel components are hot dip galvanized or stainless steel for durability, and rubber spacers or grommets separate the two where they interface. The guardrail system is anchored through the flashing to the beams in a unique way so that there are no penetrations. Glulams are coated with a system which behaves like a breathable membrane and is easily re-coated.

The bridge satisfied the full client brief, providing a unique, beautiful pedestrian bridge in a sensitive environment while serving dual purpose as a replacement sanitary crossing. The project came in under budget and ahead of schedule, and has put the Town of Banff on the map with a signature example of sustainable bridge construction.

Figure 1: Side view of completed bridge. Photo Credit: StructureCraft Builders

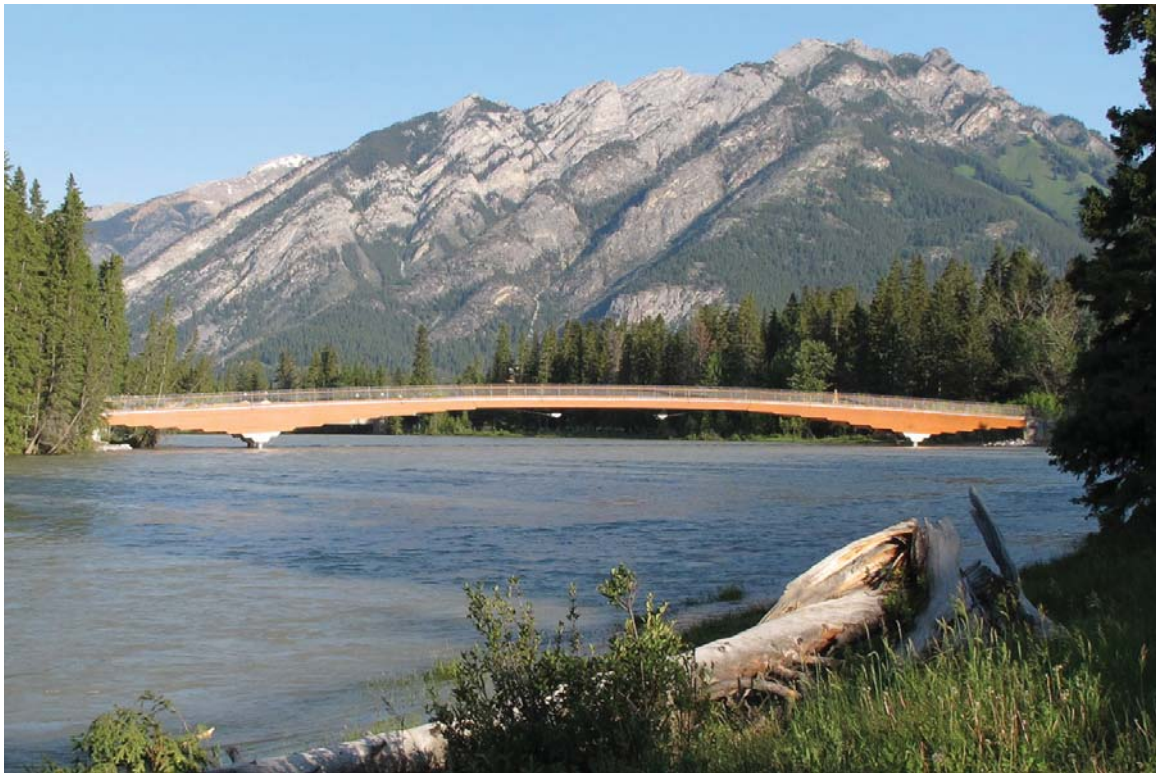

Figure 2: Full view of completed bridge. Photo Credit: StructureCraft Builders

Figure 3&4: Transportation of prefabricated bridge sections.
Photo Credit: StructureCraft Builders

Figure 5: Fitting of bridge end and center sections. PhotoCredit: StructureCraft Builders

Figure 6: End section of bridge installed. Photo Credit: StructureCraft Builders

Figure 7: Installation of bridge end section. Photo Credit: StructureCraft Builders


Figure 8: Installation of bridge center section. Photo Credit: StructureCraft Builders