

ATHABASCA RIVER BRIDGE REHABILITATION PROJECT



COWI

PROJECT INFORMATION

Project Name

Athabasca River Bridge Rehabilitation Project

Location

Highway 40 (over the Athabasca River), Entrance, Alberta

Year Completed

2014

Category

B. Transportation

Entering Firms

COWI North America Ltd. (formerly Buckland & Taylor)

Role of Entering Firm

Prime Consultant - Structural Engineer

Contact Names

Shahab Afhami, P.Eng. - Project Manager
(Engineering inquires)

Hannah Price - Communications/Marketing Administration
(Submittal/Gala inquiries)

Winning Project Team

Contractor: Alberco Construction

Engineer: COWI North America Ltd

PROJECT OUTLINE

PROJECT SUMMARY

Alberta Transportation needed to rehabilitate the Athabasca River Bridge to safely extend its service life by another ten years, providing time to secure funding for a replacement. COWI North America Ltd (COWI Bridge) proposed innovative rehabilitation measures that would restore the bridge capacity, widen it to modern standards and extend the life for 20 to 30 years. This came at less than 25% of the cost of replacement and was constructed within a year.



PROJECT HIGHLIGHTS

Innovation

The Athabasca River Bridge was constructed in 1913 as a deck truss railway bridge. In 1969 it was improved to a two-lane highway bridge with a clear roadway of 8.23m and a total length of 203.4m. It is a life-line bridge for emergency access to communities west and north of Athabasca River.

By 2003, the remaining life of the bridge was estimated to be ten years. Traffic volumes had increased to warrant a wider deck and a replacement bridge was designed. However, due to competing economic circumstances, the design was shelved until funding could be secured.

In 2012, Alberta Transportation engaged COWI Bridge to determine what measures were required to safely extend the life of the existing bridge by ten years. This would buy time to secure the necessary funding for a replacement bridge. The assessment revealed serious deck deterioration, which resulted in confining traffic to a single lane. It found that 240 precast concrete HC stringers were in various stages of deterioration.

1. We identified serious deterioration of **90 HC stringers**:
 - a. **60** exterior HC stringers were beyond repair
 - b. **30** interior HC stringers required urgent repair or replacement
2. The remaining **150** stringers deterioration was not as extensive, but required accurate load evaluation.

This project included two key innovations:

- › Replacing all 240 stringers would have been costly and required another construction season. To determine if any stringers could be saved, we developed an innovative approach to load capacity evaluation of reinforced concrete stringers. This method considers the effect of code nonconformities and material deterioration, providing a more in-depth evaluation while satisfying all requirements of the Canadian Highway Bridge Design Code. This significantly saved on construction cost and duration by eliminating the need for the strengthening or replacing 150 stringers. This was the first implementation of this technique, but it can be applied to most types of reinforced concrete stringers, beams, and girders to determine if costly strengthening/replacement is truly required, or if it can be safely avoided.
- › Replacing the remaining 90 stringers with similar stringers would have been a slow, impractical rehabilitation approach and required the closure of the narrow bridge. COWI Bridge's innovative solution was a custom designed precast deck, which was the first use of this replacement option to the HC stringer. This out-of-the-box design solution provided a wider deck and was crucial for the accelerated construction while keeping the bridge open to traffic.



INSTALLATION OF NEW PRECAST PANELS

Complexity

The main complexity of this project was the combination of a tight schedule and limited funding for a rehabilitation of this scale. Designing the rehabilitation, tendering the job, fabricating the specialized custom panels and installing all new panels and traffic barriers within a year was a challenging feat. To stay on track and on budget, the team worked closely with the client to compile a comprehensive list of all rehabilitation items and prioritized them based on safety, benefits they would provide and impact to the schedule. This design strategy was a complete success and the bid price matched the estimated tender price.

One of the most challenging aspects of the design and construction was the removal of the existing concrete barriers (20-ton) and installation of the new exterior precast units (also 20-tons) while maintaining traffic. Typical crane operation was not feasible at this site. To overcome this, a truck mounted crane was used to remove the existing barriers, and a 110-ton crane was used to install the new precast panels. As an alternative to a gantry, this heavy crane would install the panels consequentially, one at a time, then move longitudinally onto the installed panel to lift the next one into place. Provisions were developed by the consultant and implemented by the Contractor to ensure the panels and all other bridge elements could safely support the combined weight of the crane and a panel during its entire operation. This successful one of a kind operation reduced the construction length noticeably.



SETTING FORMS FOR WING WALL WIDENING

Social and/or Economic Benefits

In the assessment report, COWI Bridge presented three solutions to Alberta Transportation that addressed the project objective of repairing and extending the life of the existing bridge another ten years. However, we also proposed an informal, innovative fourth alternative, which was chosen. While COWI Bridge's alternative came at a higher cost compared to the ten year solutions, it provided another important advantage; the widened deck could function as an alternative to bridge replacement at only 25% of the replacement cost. Alberta Transportation was in favour of this alternative solution, providing that the bridge widening could be completed and the bridge open to traffic by the end of 2013.

This \$7M rehabilitation and widening project was designed, tendered, and substantially complete in just ten months, providing the bridge users with an economical solution that improved the functionality of the bridge and extended its service life by at least 20 years at a fraction of the replacement cost.

COWI Bridge's innovative design meant that the bridge remained open to traffic during the construction period, minimizing the interruption to bridge users. Also, COWI Bridge's findings from their innovative load rating method meant that a reduced amount of stringers had to be replaced and, as such, the construction period was limited to just one season. This saved on time, cost and delays to the bridge users on this arterial road.



REMOVAL OF EXISTING HC STRINGERS

Environmental Benefits

The environmental footprint of the rehabilitation design was minimal, and significantly less than a bridge replacement alternative. This would have involved significant in-stream activity, energy usage for the fabrication of new parts and demolition of the old structure. Furthermore, the original replacement bridge that was designed (and shelved) intended on using an adjacent alignment. This would have required significant roadway work, including rock blasting and substantial tree removal, within a mountain topography.

During our inspection of the bridge, we took an underwater survey of the piers within the river. This found deterioration of the pier concrete (such as large holes and scour in the concrete) at some locations. Repairing these would have involved creating a berm to provide access – which would have required in-stream activity, relocation of soil and extensive energy expenditure through the use of heavy equipment. Thus, rather than repairing the piers, COWI Bridge have implemented a monitoring program to avoid any unnecessary in-stream activity or to minimize the environmental impact if repairs become crucial.



PLACING CONCRETE OVERLAY

Meeting the Client's Needs

Alberta Transportation had two project goals – to temporarily extend the life of the Athabasca River Bridge by ten years in a short timeframe, and to permanently replace it after those ten years had passed. COWI Bridge provided an innovative option that surpassed Alberta Transportation's project goals with an economically long term solution to the preservation of the bridge at this site at 25% of the cost of a bridge replacement. We solved an urgent need for structural repairs and improved traffic safety on Highway 40 years in advance of a bridge replacement. With the rehabilitation, the bridge superstructure was widened and its structural capacity was improved. The widened deck is expected to have a service life of approximately 20 to 30 years.

COWI Bridge kept the project on track despite the extensive project challenges and completed it within just ten months. The design started in January 2013, was tendered in May 2013, and the contract awarded to Alberco Construction in early June 2013. The bridge was restored to two lane traffic on a full 10m wide deck on November 15, 2013.

The success of this challenging project can be accredited to the innovative design solution and evaluation techniques performed by COWI Bridge as well as the agreement and collaborative approach implemented by Alberta Transportation. It is an example of what can be achieved when the knowledge of Alberta Transportation is integrated with consulting engineering and construction excellence.