Wes Smith Bridge

Index, Washington

Community involvement was critical in selecting the replacement for an existing landmark bridge in Index, Washington. The new Wes Smith Bridge, named after a local resident that has lived and worked in the town of Index for 80 years, is a steel tied arch bridge with bolted box tie girder, welded box arch, Vierendeel struts, cable hangars and drilled shaft foundations. The steel coating consists of thermal metalized spray galvanizing.

While a concrete arch alternative was competitively bid against the steel alternative, the concrete arch was not cost competitive due to the remote site and requirement for significant shoring to be placed in the river.

Community

Index is a small community located on the bank of the north fork of the Skykomish River. The bridge serving this town is vital to its existence and is recognized as a signature of the town. The only other access to the town is a 25 mile long primitive gravel road not suitable for emergency services or school bus travel. The existing bridge was a 220' long, single lane, steel truss with a timber deck. Even though this 1917 bridge had been rehabilitated in 1980 it was classified as structurally deficient and functionally obsolete.

After numerous meetings of the Citizen's Advisory Committee it was decided that the new bridge would be two lanes wide with sidewalks on each side and would be built on the same alignment as the existing bridge. The preferred structure type was an 80 m tied arch, allowing for a long span with minimal structure depth and no supports in the river. The visual impacts of the arches above the roadway complimented the steep canyon walls.

Aesthetics

The aesthetics of the arch were considered when developing the structural systems for the arch. Vierendeel struts were used to provide maximum views of

the surrounding mountains. The barrier at the edge of the roadway was eliminated and combined with the pedestrian railing to better provide views up and down the river. Sidewalks were provided on both sides of the bridge for easy access for local town residents.

Temporary Detour

The existing truss was used as a temporary detour during construction so that the new bridge could be built on the same alignment as the existing bridge. A crane located on each bank of the river relocated the existing truss. There were no supports required in the river to accomplish truss relocation. Total roadway closure was six hours, with traffic temporarily diverted onto a gravel county road.

Structural Details

Four 1.8 m diameter drilled shafts were used to support the arch with one at each corner of the bridge. The steel box arch section was sized to accommodate erection and inspection. Splice locations were selected based on the maximum size member that could be delivered to the site. The tie girder is a bolted steel box so there is redundancy in the tension member. Steel transverse floor beams were used to support the cast in place concrete deck. The continuous concrete deck acts as a horizontal diaphragm, eliminating the need for cross-bracing the floor system. Vierendeel struts were selected to laterally brace the arch while maintaining open views of the surrounding mountains.

The end floor beams were designed with a full moment connection to the arch and tie intersection. This connection reduced the effective length factor to allow a reduction in the number of vierendeel struts required. The interior floor beams had flange connections to stabilize the tie girder and prevent longitudinal movement between the tie girder and floor beam at the top flange.

The bearings were designed to allow for movement during construction so that the tie girder would support the load. After the deck was placed, the bearings were fixed so they would provide lateral support to the drilled shafts. The fixed bearings provided for the longitudinal seismic force to resist the soil at each abutment.

Construction Sequence

The construction sequence identified in the plans allowed erection to take place without impacting the environmentally sensitive north fork of the Skykomish River. A full member lay down was completed at the fabricator before holes were drilled in the cover plates to assure members would fit in the field.

The tie girder was erected first using temporary supports at the edge of the river. Tie-downs at the abutments were used to eliminate supports in the river. Arch sections were erected using falsework supported on the tie girder. A hydraulic jacking system at the top of the falsework towers was used to jack the arch up into final position to install the last arch section. Cable hangers were installed and the arch falsework removed. The hangers were adjusted for final geometry and load by adjusting the bolts at deck level. The construction was completed without requiring falsework in the river, which is habitat for the endangered Chinook salmon and Bull trout.

Pedestrian Elements

The Wes Smith Bridge is located at the edge of the town of Index. It receives frequent use by pedestrians and sightseers. The river is a popular white water rafting destination so river views are important. A combination pedestrian/traffic barrier was placed at the edge of the structure to provide a pedestrian friendly facility with good views both up and down the river. The sidewalk opens between the hanger system and roadway to provide additional width of sidewalk and allow pedestrian to cross from one side of the bridge to the other as river rafters float by.

Coating System

The county had a strong desire to achieve a durable and low maintenance structure. The coating system used on the new bridge is a shop applied thermal spray coating of aluminum and zinc. The splice plates and reinforcing steel were hot-dip galvanized. These coating systems provide both barrier protection and galvanic protection minimizing future maintenance costs and ensuring a long structure life.

Steel Alternative Cost Comparison

A concrete tied arch alternative was designed and competitively bid against the steel tied arch alternative. Six bids were received, with five of the six bidders bidding the steel alternative. The low bid on the steel alternative was $2,562,597, 9% lower than the concrete alternative bid of $2,808,605. All of the five steel bids were at or below the concrete alternative bid. The concrete arch was not cost competitive due to the remote site and requirement for significant shoring to be placed in the river during tie and arch erection.

Project Team

Owner
Snohomish County

Designer
HNTB Corporation

Steel Fabricator
Oregon Iron Works

Steel Detailer
John Newell & Associates

Steel Erector
J & S Construction

General Contractor
Mowat Construction Co.