KITTERY, ME/PORTSMOUTH, NH

Photo Courtesy of FIGG

Sarah Mildred Long Bridge

Category: Mass Transit/Rail Bridges

This project centered around the community's theme: "Local Simplicity of the Working Waterway," features over 2,803 ft of precast segmental bridge for vehicles above a 1,795 ft precast segmental heavy rail bridge. Design was performed by the FIGG/Hardesty & Hanover Joint Venture, with FIGG accomplishing the segmental approach bridge spans and Hardesty & Hanover designing the segmental lift towers.

The project is the result of a partnership between Maine and New Hampshire's Departments of Transportation; the two states equally shared the costs of replacing the bridge. MaineDOT led the project on behalf of both states, with support from the Federal Highway Administration. The bridge is the largest project in Maine's history.

Long open span lengths of 320 ft for the vehicle bridge were built in balanced cantilever construction. The heavy rail spans of 160 ft tie with the columns of the vehicle bridge and have interim foundations. These spans were also built using the balanced cantilever method. The lift span towers are made of precast concrete segments with hollow sections shaped to accommodate the lift span counterweight and maintenance access stairs.

The 2,434 ft precast segmental vehicular bridge provides two 12 ft lanes (one in each direction) with 5 ft shoulders and bridge railings for cyclists. The Portsmouth approach consists of a 1,552 ft, six span bridge unit, and the Kittery approach consists of an 882 ft, four span bridge unit. Span lengths for the 37 ft wide bridge vary from a 132 ft end span to a 320 ft interior span.

The 1,437 ft precast segmental railroad bridge provides a heavy rail line that serves the Portsmouth Naval Shipyard. The rail system is supported by stone ballast on the precast segmental superstructure. The Portsmouth approach consists of a 786 ft, six span bridge unit, and the Kittery approach consists of a 651 ft, five span bridge unit. Span lengths vary from 69 ft end spans to 160 ft typical interior spans.

The New Sarah Mildred Long Bridge was opened to traffic on March 30, 2018. It links Kittery, Maine, and Portsmouth, New Hampshire ,and provides a critical back-up route in case of disruption on the nearby Interstate 95 High-Level Bridge or Memorial Bridge lift-span in downtown Portsmouth. It is a significant transportation link to the Port of New Hampshire, Portsmouth Naval Shipyard, and roadway networks. The bridge crosses the challenging Piscataqua River, with tidal waters that vary by 8 ft and have tidal flows that rank within the top six highest velocities in the United States.

Innovation of Design and/or Construction

Coined "three bridges in one," this ingenious vertical lift bridge solution serves two modes of transport (rail and roadway) that approach the moveable span with double-decker spans. The moveable span lifts from the normal roadway position to allow passage of tall vessels underneath and lowers to railroad track level, allowing trains to pass on the rail in the roadway median of the lift span. A benefit of this innovative double stacked new bridge is the drastic reduction in the number of bridge openings needed for ships. Since the new bridge has a 56 ft vertical clearance when in its "resting" position at the vehicular level, there will be 68% fewer bridge openings compared to the previous bridge. This significantly reduces the number of traffic delays due to stopped traffic.

Railroad live loads were quite different than the live loads used to design the vehicular bridge due to the Cooper E80 loading and Alternate Navy Load requirements. For efficiency, the reinforced concrete shaft railroad piers were spaced approximately one-half that of the vehicular bridge piers to keep the railroad bridge superstructure elements the same size as the vehicular bridge superstructure elements.

A total of 355 precast concrete superstructure segments were cast off-site and transported 174 miles by tractor-trailer to the bridge site. Once on-site, the segments were erected by the balanced cantilever construction method. The precast segmental design allowed for segments to be erected at multiple locations simultaneously with land-based cranes and

Jury Comments

This ingenious design serves three modes of transportation; vehicular, train, and water-born vehicles. An outstanding example of integrated design with shared use of lift span for this unique location. An engineering marvel of technology and practical application. This is an exciting new use of segmental construction, with an interesting and well-conceived concept for harmonious approaches to the functional lift span. The new bridge creates an aesthetically pleasing solution using segmental technology.

a barge-mounted ringer crane. Erecting the railroad bridge first provided access and support for construction of the vehicular bridge directly above.

Construction challenges included the Piscataqua River itself, which is one of the fastest flowing tidal rivers in the United States. Tidal swings of up to 8 ft and a river flow velocity of up to 4.5 miles per hour were routinely encountered. River depths at the main channel are over 70 ft. Due to these river characteristics, temporary trestle bridges were used to access and construct the river piers.

Rapid Construction

MaineDOT's project goal of completing the new Sarah Mildred Long Bridge as expeditiously as possible was accomplished with a concrete segmental bridge, multi-directional construction, and overlapping design and construction through CM/GC project delivery. Construction began in the Winter of 2015 and was completed in the Spring of 2018. The precast segmental design allowed for segments to be erected at multiple locations simultaneously with land-based cranes and a barge-mounted crane. The approach pier footing tubs, lift towers, lift tower footings, vehicular approach superstructure, and railroad approach superstructure were all built using precast elements.

Photo Courtesy of FIGG

Aesthetics and/or Harmony with Environment

Carefully engineered and aesthetically pleasing, the 200 ft tall lift towers fully encase the counterweights and related lift mechanisms to provide both function and beauty. The top circular sheaves rotate as the span moves. The glass along the vertical towers provides natural light in the tower by day and accent lighting from inside by night. The dark gray stains on the precast concrete towers reflect the sails of large ships and symbolically point to the navigational channel.

The new bridge's concrete segmental vehicular structure is stacked over its concrete segmental railroad structure. The bridge has long open spans and 11 fewer piers than the previous bridge to provide enhanced vistas for residents and motorists and minimize impact on the river and surrounding environment.

Minimization of Construction Impact on the Traveling Public

The new concrete segmental approach bridges are located northwest of the previous crossing and provide an improved approach to the navigational channel. The new alignment also allowed a more direct flow of vehicular traffic to the existing bridge during construction, reducing local congestion, minimizing retaining walls, and increasing residential privacy during construction. The new span layout not only enhanced vistas for residents and motorists, but it also enabled the new bridge to cross Market Street without a pier in the median and serve as a gateway entrance into the historic downtown Portsmouth, New Hampshire.

The selected foundation types were drilled shafts for piers in the water and spread footings for substructure on land.

CREDITS

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Maine DOT
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