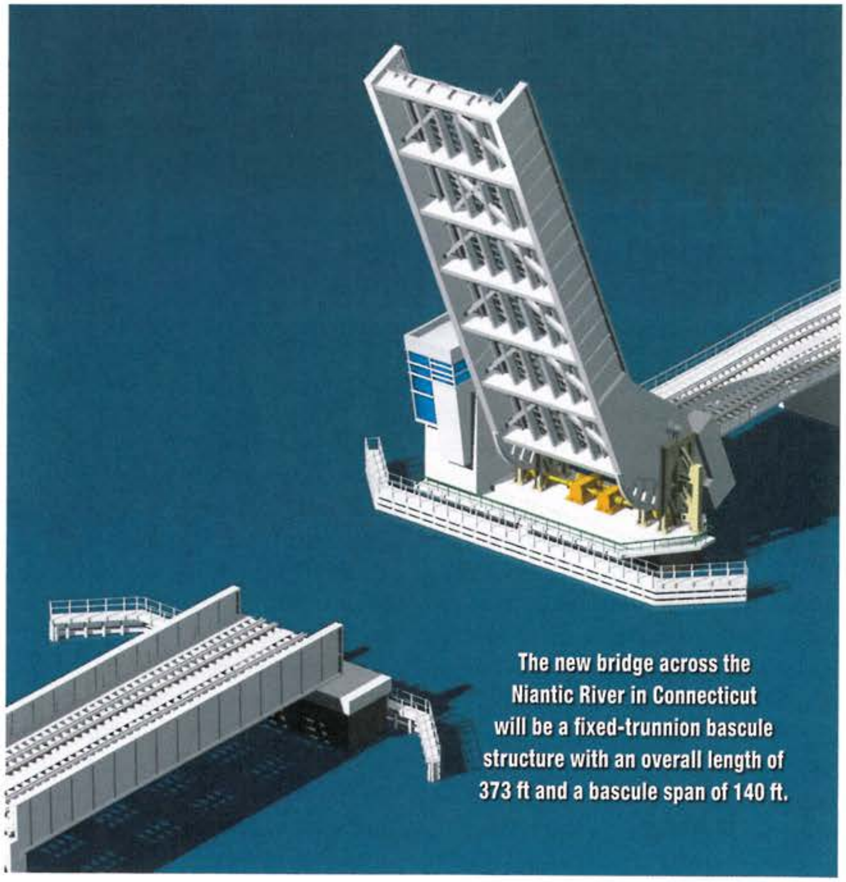
Civil Engineering
NEWS

RAIL INFRASTRUCTURE

Amtrak Replacing 103-Year-Old Bascule Bridge in Connecticut



The new bridge across the Niantic River in Connecticut will be a fixed-trunnion bascule structure with an overall length of 373 ft and a bascule span of 140 ft.

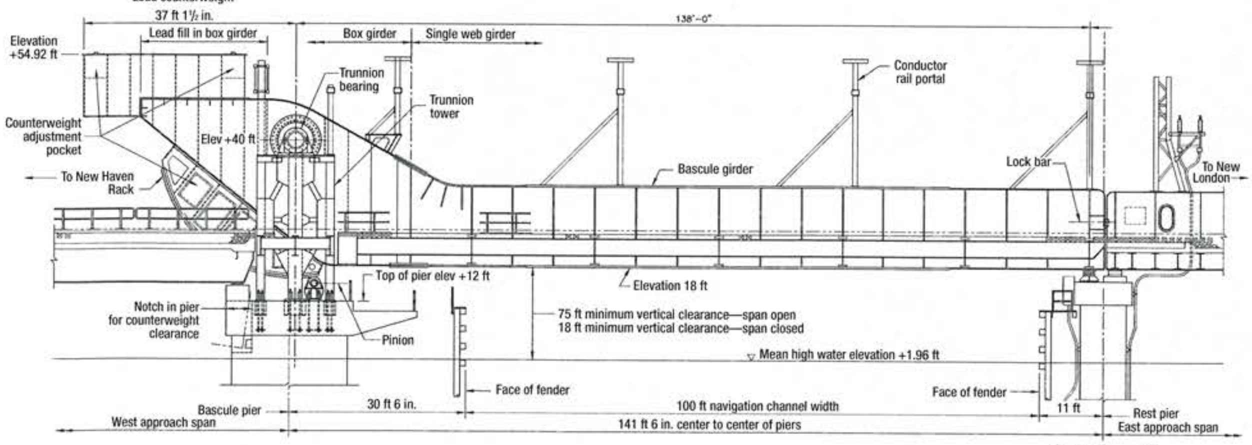
Amtrak is replacing the 103-year-old bascule bridge that in crossing the Niantic River in Connecticut links East Lyme and Waterford. A new two-track, electrified bascule bridge will be constructed in a roughly east–west alignment 58 ft south of the original structure, which has reached the end of its service life and in recent years has required an undue amount of maintenance, explains Craig Rolwood, p.e., m.asce, a principal associate in the Trenton, New Jersey, office of Hardesty & Hanover, the design engineers of the project.

The existing Niantic River Bridge, a rolling lift structure that was constructed in 1907, will remain in operation while the new bridge is being constructed and will be demolished once the latter is in operation, says Peter Finch, the Amtrak project manager for the replacement. The new Niantic River Bridge will be a fixed-trunnion bascule structure with an overall length of 373 ft and a bascule span of 140 ft—a distance that approaches the "limits of practicality and economy for this type of framing," says Rolwood. A fixed-trunnion bridge pivots on steel pins approximately 30 in. in diameter located above the track level that are supported on twin steel box column towers. The new bridge will cost approximately $125 million and is scheduled for completion by May 31, 2013.

Although the design team considered other movable bridge styles, including vertical lift and rolling lift bridges, the fixed-trunnion style was selected in part because it eliminates the need for a movable catenary unit. Such a unit has been used on the existing bridge since the line was electrified, about 10 years ago, says Rolwood. The existing movable catenary is a massive device that has been prone to trouble, Rolwood explains. Eliminating this technology will lower the costs of constructing, operating, and maintaining the new bridge and will also reduce the amount of time required to open and close the bridge by approximately one minute in each direction, Rolwood notes.

On the basis of the site conditions, however, it was determined that a fixed-trunnion bascule bridge would be viable only if the movable structure used a smaller counterweight than

Elevation View, New Niantic River Bridge



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the steel and concrete counterweight used by the existing bridge. The solution was to design a counterweight made of encapsulated lead, which at about 750 lb/cu ft is much denser than steel and concrete, which have densities of respectively about 490 and 150 lb/cu ft. The choice of lead thus achieves the same results with a smaller volume, Rolwood explains.

Although the existing bridge operates with a chain system that is exposed to the weather, the operating works of the new bridge will be contained within protective housings. The operator's station also will be housed within a protective structure and will feature a programmable logic control system. The design of the new bridge also takes into consideration the service experience of the existing bridge over the past century, including vibration issues and long-term maintenance concerns, notes Finch.

The Niantic crossing is located along Amtrak's heavily traveled Northeast Corridor, where trains can reach speeds of 150 mph. But because trains typically cannot cross movable spans at such high speeds, those operating on the new bridge will probably be initially limited to roughly 60 mph. The speeds can then be increased gradually depending on how the movable span performs, notes Jim Richter, p.e., m.asce, the deputy chief engineer of structures in Amtrak's Philadelphia office.

The bascule span section will feature steel framing and an open-timber deck. The approach spans will feature reinforced-concrete pans, steel framing, and ballasted tracks. The western approach span will be 91 ft and the eastern approach span, 126 ft. The approach spans have been designed to provide adequate clearances for pedestrians and emergency vehicles beneath them adjacent to the bridge abutments, Rolwood says. The eastern approach span has also been designed to eliminate the need for a short-span access structure similar to the one beneath the existing bridge.

The stationary portion of the bridge will be founded on spread footings constructed in the river within cofferdams of steel sheeting constructed with a concrete tremie seal. The footings will bear on rock or weathered rock. Although drilled shafts were considered during design, the cofferdam method was chosen because of site and cost considerations, says Rolwood. The abutments will be founded on concrete pilings, and sheet piles of precast, prestressed concrete will be used to support the approaches.

Two massive piers of reinforced-concrete in the river will support the bascule span. The larger will have a cofferdam footprint of 88 by 36 ft; the other will have a footprint of roughly one-third that size, Rolwood notes. A composite plastic fender system will protect the piers from ship impacts and delineate the navigable channel for boaters.

The new bridge will increase the vertical clearance above the water from 11.5 ft to 16 ft; the width of the navigation channel will be expanded from 45 ft to 100 ft, matching the channel widths that exist both upstream and downstream of the crossing. The width and depth of the navigation channel will probably be maintained primarily through the flushing action of the tidal flow once the existing bridge has been demolished and various obstructions have been removed, Rolwood says. Among these obstacles are the abandoned piers from a 19th-century swing bridge that once served as the Niantic crossing.

Like the existing bridge, the new bridge will operate seasonally and will be mainly in the open position from May 15 to October 15, closing only when trains need to cross. It will remain mostly in the closed position during the rest of the year, except when it needs to open for boats, Finch says. The bridge opens between 3,800 and 4,000 times a year. On average, 50 passenger trains, including local commuter trains and 2 freight trains, use the existing bridge each day.

Once the new bridge is completed, the approach tracks will be connected in a two-step process. First, one set of approach tracks will be aligned to one set of bridge tracks and the traffic will run on a single track for a week or so. Next, the second set of approach tracks will be aligned to the second set of bridge tracks, explains Finch.

Although construction work on the new bridge began earlier this year, the origins of the project date to 2000, when Amtrak conducted an environmental assessment of plans to replace the crossing. The design of the new bridge was completed between 2004 and 2006, but the project then stalled over lack of funding. Work restarted early this year thanks to an influx of money from the American Recovery and Reinvestment Act of 2009, the so-called stimulus program, which is providing slightly more than half the funding. "Without the stimulus program, we'd probably still be waiting to get started on this project," says Richter.

The project also had to contend with local permitting approval processes that were made difficult by several changes over the years in the leadership of the communities that surround the construction site. To assuage local concerns, the project includes the design and construction of a more robust beachfront boardwalk. The existing boardwalk will be demolished, and a beach restoration and armoring plan will be implemented. The latter includes a new jetty-like stone groin for the popular tourist areas that stretch for roughly half a mile along the western section of the project, Rolwood says. —Robert L. Reid