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NEW ENGLAND CONSTRUCTION

Signature Bridge Rises Over Historic Water Power Canal in Lowell

ALGAR Construction workers place concrete into form for pile caps at new bridge's north abutment.

LANDMARK BRIDGE AIDS LOWELL TRANSFORMATION

New Span Over Pawtucket Canal Will Unify HCID Development as Six Other Spans are Reconstructed Under Federal TIGER Program

By Paul Fournier

The City of Lowell, Massachusetts, is constructing a "Signature Bridge" over its oldest water power canal to unite north and south halves of a massive mixed-use redevelopment, while simultaneously rehabilitating or replacing several other historic canal bridges under a separate federally funded program.

Under a $7.6 million contract with the city, Newport Construction of Nashua, New Hampshire, is building the new landmark bridge over the lower Pawtucket Canal as part of the Master Plan for the Hamilton Canal Innovation District (HCID).

The $800 million HCID is the city's largest single project of an even larger development, the Jackson/Appleton/Middlesex (JAM) Urban Revitalization Plan. JAM was created to inject life into the redevelopment of the neighborhood, which borders downtown Lowell. The goal of the Hamilton Canal project is to transform about 15 acres of run-down neighborhoods into 425,000 square feet of office and commercial space, 55,000 square feet of retail space and up to 725 housing units.

200-Year-Old Canal System

Pawtucket Canal is the oldest waterway of the city's 5.6-mile manmade power canal system, a 19th century engineering achievement that gave birth to the City of Lowell and created the country's largest textile center. Constructed in the late 1790s, Pawtucket Canal was originally intended to be a means of transportation. It allowed New Hampshire lumbermen who were driving logs on the Merrimack River to Newburyport, Massachusetts, to avoid Pawtucket Falls, a mile-long series of rapids and falls that lower the river level by 32 feet. But in the early 1800s, the Pawtucket Canal became the main water feeder for a system of canals that provided power for textile mills in Lowell. Eventually, six major granite block-wall-lined canals were built between 1796 and 1847, including Pawtucket Canal, Hamilton Canal, Lowell Canal, Lawrence Canal (Western Canal), Eastern Canal, and Northern Canal. Taken together, the canals provided a water power capacity of 10,000 horsepower.

Father/Son Team Run Project

Newport Construction's contract, entitled HCID North Infrastructure – Streets F & G and Signature Bridge, is being financed with the help of a $4.9 million grant from MassWorks and $2.5 million from the federal Economic Development Administration. Work includes building not only the new bridge over the lower Pawtucket Canal but two new streets and new utility infrastructure in the northern section of the HCID as well. The contract also entails making major pedestrian and traffic improvements to a second bridge, located near the intersection of local streets Dutton and Broadway.

Cut-off HP14X73 piles backfilled with stone await placement of ready mix for concrete pile cap.

Key personnel for Newport Construction include father and son, Al Maimone, Project Superintendent, and Tom Maimone, Estimator/Project Manager.

According to the senior Maimone, Newport Construction typically self-performs an entire project; however in this case there are two subcontractors: Atlantic Bridge & Engineering of Hampton, New Hampshire, is assembling and erecting the prefabricated bridge, while ALGAR Construction Corporation of Brockton, Massachusetts, is responsible for concrete construction.

Maimone said that during site excavation, Newport Construction crews ran into uncharted metal items, cobbles, bricks and pieces of concrete foundations from old mill buildings – even the remnants of a blacksmith shop – but in general the site work was not overly challenging.

A Striking Design

The new Signature Bridge, which city officials say is critical to the success of the HCID, has an aesthetic blue finish and a striking Pratt bowstring truss design. This design is distinguished by a continuously curved top chord and diagonal web members that form V-shapes. It also has a "Pony Bridge" classification since the travel deck passes between parallel trusses that are not interconnected with cross-bracing at the top.

The steel bridge measures 87 feet, 6-inches-long and has a 38-foot width that allows for two 11-foot roadway travel lanes and two 5-foot wide sidewalks cantilevered from the outside face of the trusses. Shop drawings indicate trusses have a maximum height of 11 feet. Top chords are fabricated from continuously arched W10X88 shapes, vertical members from W10X33 shapes, diagonals from W10X26 shapes and bottom chords from miscellaneous channel shapes. Bridge floor beams are W27X84s and support W12X26 stringers.

Heavy Lifting

US Bridge based in Cambridge, Ohio, prefabricated the steel bridge and shipped it to the Lowell jobsite in multiple pieces, with each of the two trusses separated into halves. At the jobsite, the half-trusses were joined together and erected by the Atlantic Bridge & Engineering crew. Key personnel for Atlantic Bridge & Engineering are Dave Blais, P.E., Project Manager, and John Erb, Project Superintendent.

MacLellan Concrete transit mixer feeds ready-mix to ALGAR Construction's Schwing Pump truck at Lowell bridge site.

Father/son team, Al Maimone and Tom Maimone, Newport Construction Project Superintendent and Estimator/Project Manager, oversee Signature Bridge work.

Retaining wall forms for the $7.6 million Signature Bridge are filled with ready-mix concrete.

The heaviest half-truss weighed 13,444 pounds. Factoring in the weight of the crane's block and rigging, the horizontal wind force, and a safety factor of 25 percent, resulted in an estimated design loading for the lift of about 19,300 pounds.

Each fully assembled truss weighed close to 28,000 pounds, but with loads from block and rigging, wind, and safety factor added the estimated design loading for the crane lift was approximately 39,500 pounds.

Blais designed the bridge erection procedure for ironworkers, while Locke Crane Services of Tewksbury, Massachusetts, provided the cranes. Blais said they employed a National Crane boom truck and two Grove hydraulic cranes – a 5-axle, 275-ton capacity GMK5275 and a 4-axle, 100-ton capacity GMK4100.

The lifting and setting of each truss was accomplished using one or both Grove Cranes, depending on the load, site terrain and crane positions. In order to meet the hoisting demands of the job, the Grove GMK 5275 was equipped with 90,300 pounds of counterweights, while the 4100L-1 carried 18,700 pounds. The National Crane boom truck assisted with some of the lifting maneuvers and also aided the erection crew in placing bridge floor beams and stringers between the trusses.

Lean Concrete and Battered Piles

The new bridge is supported on cast-in-place concrete abutments. Before concrete work could begin, however, Newport Construction had to remove a 10-foot deep layer of unsuitable soil at the south abutment site, replace the material with lean concrete (1,000 psi compressive strength), then construct the abutment footing and wall. At the other end of the bridge site, the contractor had to drive 16 steel H-Piles, HP14X73, (eight vertical, eight battered) before casting the concrete footing and north abutment wall.

The roadway deck consists of 8 inches of 4,000 psi cast-in-place concrete on stay-in-place corrugated steel forms. Three inches of hot-mix-asphalt provide the roadway wearing surface. Sidewalk slabs consist of 6 inches of 5,000 psi cast-in-place concrete.

TIGER Canal Bridges Underway

The City of Lowell is also replacing or rehabilitating six additional historic power canal bridges with the help of a $13,389,750 grant from the USDOT Transportation Investment Generating Economic Recovery (TIGER VII) Discretionary Grant Program. The bridges were in various states of disrepair or deterioration, and this project will update them with improvements including the elimination of weight restrictions that currently interfere with transportation circulation and access in the downtown area.

The original project scope includes complete replacement of two bridges: Pawtucket Street over the Pawtucket Canal and Pawtucket Street over the Northern Canal, and superstructure replacement at the Suffolk Street over the Northern Canal bridge. The remaining three bridges to be rehabilitated and preserved include: Central Street over the Lower Pawtucket Canal, Merrimack Street over the Western Canal, and Merrimack Street over the Merrimack Canal.

A 2022 Finish

A $4,366,613 design contract for the bridges was awarded to Kleinfelder Boston, Massachusetts, which completed the design and engineering in 18 months on an accelerated schedule due to a deadline imposed by regulations governing federal TIGER funding.

According to Claire V. Ricker, Head Planner at the City's Planning and Development Department, MAS Building and Bridge, Norfolk, Massachusetts, was awarded the $11,643,260 contract for project construction. She indicated that other project items such as utilities, police details, contingencies, MassDOT administration, among others, have increased the overall price tag.

Currently, officials are using an estimated project cost of $22.9 million. In addition to the federal TIGER grant, the project is being funded by MassDOT, which is contributing $3.9 million, and the City, which is providing $3.6 million in capital funds. The TIGER bridges project is expected to be completed by 2022.

Atlantic Bridge & Engineering uses National Crane boom truck, and Grove GMK5275 and GMK4100L-1 Cranes provided by Locke Crane Services to set Pratt bowstring trusses for the Signature Bridge spanning historic Pawtucket Canal in Lowell, Massachusetts.