

Merit Award: Reconstructed

Merritt Parkway over Route 123

Norwalk, Connecticut



The Merritt Parkway was originally constructed between 1934 and 1940. The design of the parkway included more than 70 bridges. The Merritt Parkway got its name from Congressman Schuyler Merritt, who was one of the highway's earliest and most persistent advocates. The intent of this parkway was to provide a clear and unobstructed drive in a "park-like" setting from the Housatonic River in Stratford, Connecticut to the New York state line that was free of heavy commercial trucks.

To go along with the parkway theme, a Highway Department staff architect named George Dunkelburger designed the facade of each bridge. The designs range from Neoclassical to Art Deco. No two bridges along the parkway have the same design, but many features such as the State Seal are duplicated. Most of the bridges are rigid frame structures that were designed to provide slender lines meant to prevent the steel frame from competing with the architectural features of each design. These bridges are a monument to the art of combining form and function.

The bridges of the Merritt Parkway have been celebrated for many years by the citizens of Connecticut. They have also been awarded the status of being listed on the National Register of Historic Places. At this time, many of the bridges are reaching the end of their service life. This has brought about a need for rehabilitation of these beautiful structures.

Rehabilitation Need

The condition of the 65 year old bridge had become a concern, although the real driving force behind the project was the need for acceleration and deceleration lanes on the parkway. This required the widening of the bridge on each side in order to accommodate the new lanes. The widening consisted of 17.75' extensions of the original bridge. The original bridge framing was salvaged and re-painted and the original abutments were also rehabilitated. The new bridge extensions would cover all of the

original architectural features of the bridge, therefore it was decided to replicate the features of the original bridge with modern building material such as welded steel.

Some thought was given to re-creating riveted steel frames to exactly match the original, but it was felt by the design team that if George Dunkelburger had the use of modern welded steel he would have used it.

Bridge Information

The Route 123 Bridge is a single span rigid frame structure with a reinforced concrete deck. The approximate dimensions and information about the bridge are as follows:

- steel rigid frame with integral abutments;
- span: 66'; skew: 38 degrees;
- six original riveted steel frames spaced at 11';
- four new welded steel frames spaced at 9';
- frame web depth at abutments: 3.5'; and
- frame web depth at mid-span: 1.5'.

Innovative Design Features

The Route 123 Bridge is not a typical highway structure. In a day where stringer span bridges are the norm, this bridge stands out as a unique and sophisticated structure. The original bridge was constructed in the 1930s. It has many unique features that had been lost over the years where lowest possible cost designs won out over more innovative and more visually appealing designs.

Integral Abutments: Many states are moving in the direction of jointless bridge design using integral abutments. Recent articles have stated that jointless bridge technology was pioneered in the 1950 in several states. The Route 123 Bridge was designed and built almost twenty years before these more modern jointless designs. The bridge has functioned well for over 65 years, which is the greatest test to this technology.

Rigid Frame Design: The structural system of the Route 123 Bridge consists of a single span steel rigid frame. There are many advantages to this type of design. The foremost advantage is the ability to produce very elegant slender structural members over the span. The Route 123 Bridge has a mid-span frame web depth of only 18". This is remarkable considering the span is over 66' and the frame spacing is 9' on center.

Haunched Web Profile: The original



riveted frame was constructed with a haunched section. This not only provided a slender flowing profile, but it also mimicked the moment diagram of the bridge. This variable haunch allowed the design of the new frame to include a constant flange cross section over the entire length of the frame (including the vertical legs). This greatly reduced fabrication expenses by eliminating flange transition splices.

Hidden Bolted Field Splices: The original design of the Route 123 Bridge included field splices located near the inflection points along the span. This was not a visual problem since the splice rivets were visually lost in the continuous riveting of the structure. The new structure is a welded steel frame that is very clean in profile. The design was modified from the original by shifting the bolted splices down into the column legs that are cast integral with the abutments. This provided a clean bolt free look to the fascia frame. The designers feel that had the engineers of the 1930s had modern welding technology available to them they would have opted for this type of clean design.

Welding Details: The design of a rigid frame requires the development of details that are not common to conventional modern stringer bridges. The elbow and base plate details carry significant moments. The design team wanted to avoid sharp angle point connections at the elbows in order to limit the possibility of stress concentrations. The resulting curved flange elbow joint has a combination of ring compression and ring tension that induces compression forces in the web. Diagonal stiffeners were designed to carry these forces between the flanges. The base plate moments had to be transferred from the relatively small flanges

into a large base plate. A design welding a simple base plate on the end of the frame would require a very thick plate in order to accommodate the large bending stresses in the base plate. By designing a stiffened base plate the anchor bolt forces are transferred to the flanges through vertical fillet welds in place of trying to transfer force through the base plate. The design of the elbow and base plate was based on information published in Omer W. Blodgett's book, *Design of Welded Structures*.

Aesthetic Considerations

The Route 123 Bridge, as well as the entire Merritt Parkway, is listed on the National Register of Historic Places. The Connecticut DOT has made an effort in the last ten years to maintain, restore and preserve the historic character of the landscape and bridges. Many citizens of the area are familiar with each individual bridge along the parkway with their unique features ranging from ornamental ironwork of fig leaves, to castings of Pilgrims and Indians, all of which provide a whimsical experience while driving the parkway. The design of the Route 123 Bridge frame provides slender lines that are inconspicuous and unobtrusive. It is well known among architects that dimensional scale of structural elements is a key feature as to how a structure is interpreted.

The structural frame with the haunched webs is an important part of the aesthetics on the Route 123 Bridge. The Maryland DOT *Aesthetic Bridges User Guide* states that, "Haunches are important visually because they make the bridge seem thinner by reducing the average depth while leaving the length

the same. Haunches visually demonstrate the flow of forces in the bridge.” The steel frame on the Route 123 Bridge achieves this aesthetic standard. The steel frame is clean and simple and it does not try to compete with the architectural finishes on the parapets and wing walls.

Summary

The following items summarize the design of the Route 123 Bridge:

- The design includes a steel rigid frame structure that is cast integral with the abutments.
- The frame design with the haunched web produces a constant flange size and a mid-span depth of only 18” for a 66’ span.
- The bolted splices are concealed within the integral abutments.
- Unique stiffening details were developed at the frame elbows and base plate.
- The bridge was designed to replicate the original historic structure using modern steel fabrication techniques.

Project Team

Owner

Connecticut Department of
Transportation

Designer

Connecticut Department of
Transportation

Steel Detailer

John Metcalfe Company

General Contractor

Watertown Construction
Company