Project of the Year Submissions

Date Received 11/30/2021 ☑ Files submitted **Score:** _____

Title: **Rachel Carson (Ninth Street) Bridge Rehabilitation**

Company / Owner: Allegheny County Department of Public Works
542 Forbes Avenue, County Office Building, Room 501
Pittsburgh, PA 15219

Category

☐ Commercial	☐ Education	☐ Energy	☐ Environment
☐ Industrial	☐ Innovation	☐ Medical	☐ Modernization
☐ Sustainable	☑ Transportation	☐ Water / Wastewater	Other:

Lead Agents

Stephen G. Shanley

Submitted by: Geoffrey Holmes, P.E., CBSI
Lead Bridge Engineer
TranSystems (formerly L.R. Kimball)
Frick Building, 437 Grant Street, Suite 812
Pittsburgh, PA 15219

Technical Affiliation:

ENGINEERS' SOCIETY
ESWP
WESTERN PENNSYLVANIA
1880

DESIGNER: TRANSYSTEMS (FORMERLY L.R. KIMBALL)

PROJECT NAME: RACHEL CARSON (NINTH STREET) BRIDGE REHABILITATION

NOMINATION FOR ESWP PROJECT OF THE YEAR – TRANSPORTATION

TranSystems

EXPERIENCE | Transportation

Nominator Information:
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Project Title:
Rachel Carson (Ninth Street) Bridge Rehabilitation
Located over the Allegheny River in Pittsburgh, Allegheny County, Pennsylvania

Owner:
Stephen G. Shanley
Allegheny County Department of Public Works
542 Forbes Avenue
County Office Building, Room 501
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Prime Contractor:
Brayman Construction Corporation

PROJECT DESCRIPTION

The Rachel Carson (Ninth Street) Bridge is an eye-bar-chain, self-anchored suspension bridge carrying Ninth Street over the Allegheny River, the Tenth Street Bypass, and Three Rivers Heritage Trail in downtown Pittsburgh. It is one of the "Three Sisters" bridges constructed from 1924 to 1928 that comprise the only trio of identical, side-by-side bridges in the world and the first self-anchored suspension spans constructed in the United States.

The bridge is 995 feet long and consists of two multi-girder steel approach spans of approximately 75 feet and 60 feet in length and a three-span, self-anchored, steel eye-bar suspension bridge that is 860 feet in length. Rehabilitation was required due to accelerating age-related deterioration. Construction work involved replacement of the bridge deck and sidewalks; total repainting of the superstructure; steel repairs of the stringer connections, floor beam connections, stiffening girder, and sidewalk brackets; replacement of numerous sidewalk brackets and all sidewalk fascia beams; updates to structure drainage and lighting; and upper substructure repairs.

TranSystems (formerly L.R. Kimball) was assigned the Rachel Carson (Ninth Street) Bridge and led and coordinated the efforts of the team to deliver the inspection, design, and construction services. This required close coordination with all project stakeholders, including:

Owner / Oversight

- Allegheny County – Owner, Ninth Street Bridge
- PennDOT, District 11-0 & FHWA – Project Oversight
- City of Pittsburgh – Owner, adjacent streets
- CDR Maguire – Program Manager for Allegheny County
- WSP – Construction Manager

Design Team

- TranSystems (formerly L.R. Kimball) – Lead Consultant for Ninth Street Bridge – Project Management, Inspection, Structural Analysis & Design, Roadway Design & Construction Services
- Michael Baker International – Traffic Control and Signing & Pavement Marking Plans, and Prime Consultant for Rehabilitation of 6th, 7th, & 9th Street Bridges agreement
- Santangelo & Lindsay – Lighting
- KTA-Tator – Coatings

Contractor

- Brayman – Prime
- Advantage Steel – Structural Steel Fabrication & Repair
- Avalotis – Painting

PROJECT ELEMENTS

Complexity

The Three Sisters bridges were the first suspension bridges built by the cantilever method, using temporary truss chords, temporary river bents, and hydraulic jacks to erect the bridge from each shore of the Allegheny. When the structures were erected, they stood in contrast to conventional suspension bridges, which used heavy shore masonry for cable anchorage creating a unique solution to a complex set of design criteria and site constraints.

The rehabilitation required numerous materials not normally used in modern bridges resulting in special construction procedures and special provisions to standard specifications. These included tie-down anchorages using high-strength post-tensioning bar and high-early-strength cement grouts; forged bridge pins and nuts; permanently lubricated bronze bushings and washers; lubricants to fill the roller "nests" at the expansion towers; and bronze dedication plaques cast to replace missing plaques. Thousands of rivets were replaced with high-strength bolts with button heads to mimic the look of rivets, improving structural capacity while being sensitive to appearance. Fracture-critical tie-downs were replaced and include redundant components.

Innovative Technical Features

The bridge was analyzed for the first time using a fully three-dimensional finite element analysis method developed during the recent rehabilitation of the adjacent Seventh Street Bridge. TranSystems also performed the first Load and Resistance Factor Design analysis of the bridge including the suspension system. This advanced analysis indicates that uplift is present in the tie-downs at the ends of the main spans under dead load which was not predicted in the original calculations. The existing tiedown was reconfigured and replaced with higher strength materials, and rock anchors were added to strengthen the tie-down and provide redundancy.

Benefit to Society

Replacement of both the deck and sidewalks eliminates the need for a separate sidewalk replacement project within the next 15 years due to out of phase deterioration and will reduce the chance of significant bridge closures prior to the next deck replacement. Similarly, complete replacement of the fascia stringers and many sidewalk brackets in the scope of this project accomplishes the same goal.

The project includes upgrades to the electrical and gas utilities that will reduce the chance of future outages, inconveniences to the community and loss of revenue to the surrounding businesses. Peoples approached the County during project bidding to request a change to their previously filed plan which called for no changes to their 95-year-old facility. Instead they requested to coordinate replacement of their 16" gas main with construction. The team was able to find a course to perform the replacement with no cost to the County and no adverse impact to the public or the construction schedule.

The bridge's social value goes beyond traffic, as it also hosts some of the community's more well-attended pedestrian events, such as Picklesburgh. The refurbished structure enhances the bridge's appeal as a premier location for future events.

Public Relations Activities Associated with the Project

A well-organized traffic control plan during construction facilitated stadium events, maintained pedestrian crossings, and sustained access to riverside trails and adjacent businesses throughout the two-year duration of construction. Additionally, coordination with various public event requests during construction provided for the temporary suspension of all work and/or specific tasks to allow for the events to go on adjacent to the site without interference from the noise or the physical activity of the project.

Safety

The traffic lanes were reconfigured from four to three lanes to improve traffic flow. The center lane changes direction near the center of the bridge, better accommodating rush hour traffic and turning movements onto the adjacent roadways helping to reduce backups and potential traffic accidents.

The signage has been updated and the lighting has been improved on the bridge as well as along the pedestrian trails resulting in better security. Replacement of the sidewalks and curbs on the approach roadways removed numerous tripping hazards due to deterioration and heaving.

During construction, underdeck shielding contained construction debris, protecting river traffic and the walking trails, and served as an access platform to perform the work. An engineered containment and monitoring system prevented lead paint from escaping into the environment.

Technical

Listed on the National Register of Historic Places, the Three Sisters Bridges are virtually identical in appearance and feature unique aesthetic characteristics that were carefully considered.

The original pylons and dedication plaques had been designed by Stanley Roush (architect of most county/city buildings and bridges in the early 1900s). The project called for rehabilitation of the pylon doors and large bronze dedication plaques. The project also refurbished and replaced decorative window grilles in pylon rooms and replaced broken glass windows with new weathertight plexiglass windows with bird screens.

The bridge lighting provided on sidewalks and the stair tower was selected to replicate the original bridge lighting. Similarly, the lights on the pylons were specifically designed for this project and replicate the original fixtures. The new fixtures utilize modern LED technology, and can be controlled remotely by the County as part of a system linking each of the Three Sisters Bridges.

New sloped curbs along the roadway replaced the original flat curbs to prevent salt and debris from accumulating on top of the curb and entering the stiffening girders. The curbs were designed to be unobtrusive while providing the benefit of draining water. They included hatch covers allowing inspection access to the interior of the stiffening girders and large flat faces to decrease the risk of vehicles mounting the curb and striking the stiffening girder. Further improvements were made to the hatch designs from the previous 7th Street Rehabilitation to increase accessibility, decrease debris accumulation, and prevent water drainage into the stiffening girder. Cored holes in the bottom flange of the stiffening girder prevent water from collecting and promote drying inside the stiffening girder.

The button head bolts, which are mechanically and chemically identical to high-strength bolts, strengthen connections and fasten new steel while being sensitive to the appearance of the bridge. They have similar proportions to button head rivets and face traffic or pedestrians wherever possible. The rehabilitated bridge was repainted with a three-coat, organic zinc-rich paint system with an Aztec Gold finish coat, the iconic color of most river crossings in downtown Pittsburgh.

Commercial

As the project progressed, engineers identified items of work that could be deleted or modified to provide the client with the best possible solution for the best possible price. For example, cleaning of the masonry substructure units will be performed on all three bridges together so they will weather at the same rate, and the County will realize cost savings of securing one permit for entrance into the river and by performing the work at one time. Similarly, other work that requires river access such as pier repairs and placement of scour protection will be performed as part of the Roberto Clemente (6th Street) Bridge rehabilitation.

Unique Contractual Conditions

Bi-weekly progress meetings kept the project on schedule and promoted communication to make quick adjustments based on actual conditions. Through cooperation and collaboration of the project team, replacement of Peoples 16" gas main was added to the contract after bidding with no additional cost to the County or negative impact to the project schedule. Regularly scheduled meetings with Peoples and Duquesne Light helped minimize the schedule impact of the coordinated utility work. The final year of construction was impacted by the COVID pandemic and resulting protocols. Through the determination and effort of the entire team, the structure was opened to traffic on time. The rehabilitated structure maintains the prior level of service for average daily traffic, and the wider lanes and new lane configuration have proven successful in alleviating traffic congestion and have met client and stakeholder satisfaction.

Awards, Patents, Licenses

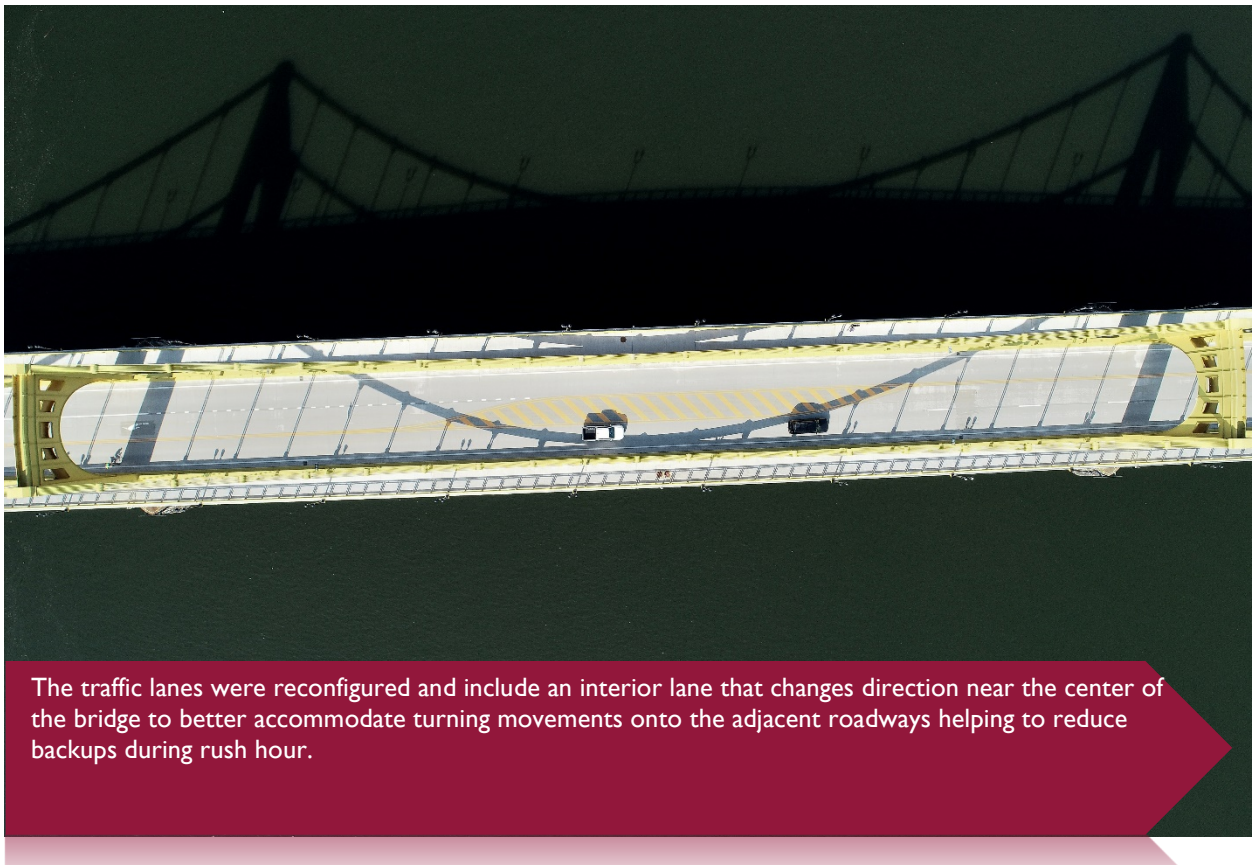
The Ninth Street Bridge received the ASHE Pittsburgh Outstanding Highway Engineering Award – Category C, greater than $20 million construction cost.

Project Cost/Schedule

Item	Budgeted	Actual
Total Project	$23,309,660	$23,714,576
Scheduled Completion	November 23, 2020	November 23, 2020

PROJECT PHOTOS

Constructed from 1924 to 1928, rehabilitation was required due to accelerating age-related deterioration. This required numerous materials not normally used in modern bridges.

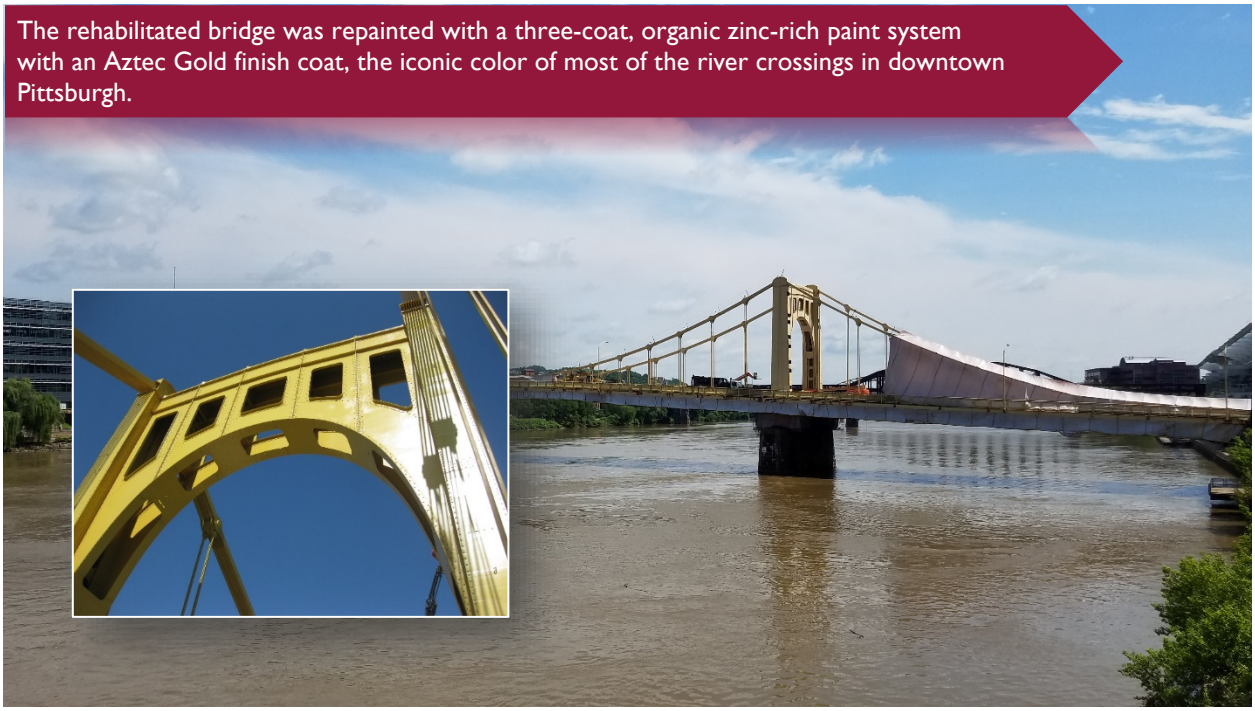


The traffic lanes were reconfigured and include an interior lane that changes direction near the center of the bridge to better accommodate turning movements onto the adjacent roadways helping to reduce backups during rush hour.

Replacement of both the deck and sidewalk eliminates the need for a separate sidewalk replacement project within the next 15 years.

New signage and lighting are included throughout. Bridge lighting replicating the original lighting features was provided on the sidewalks and pylons.

The rehabilitated bridge was repainted with a three-coat, organic zinc-rich paint system with an Aztec Gold finish coat, the iconic color of most of the river crossings in downtown Pittsburgh.



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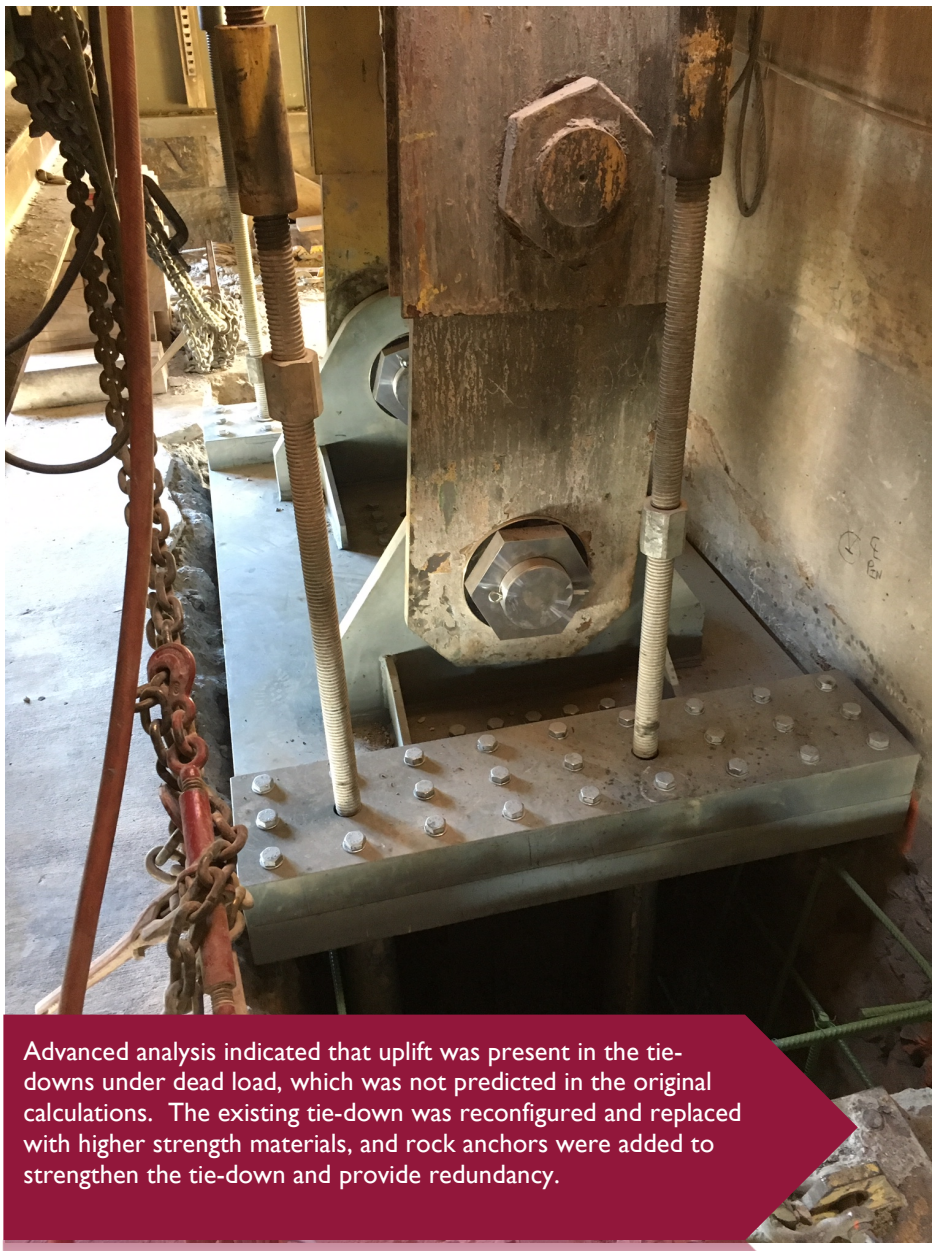
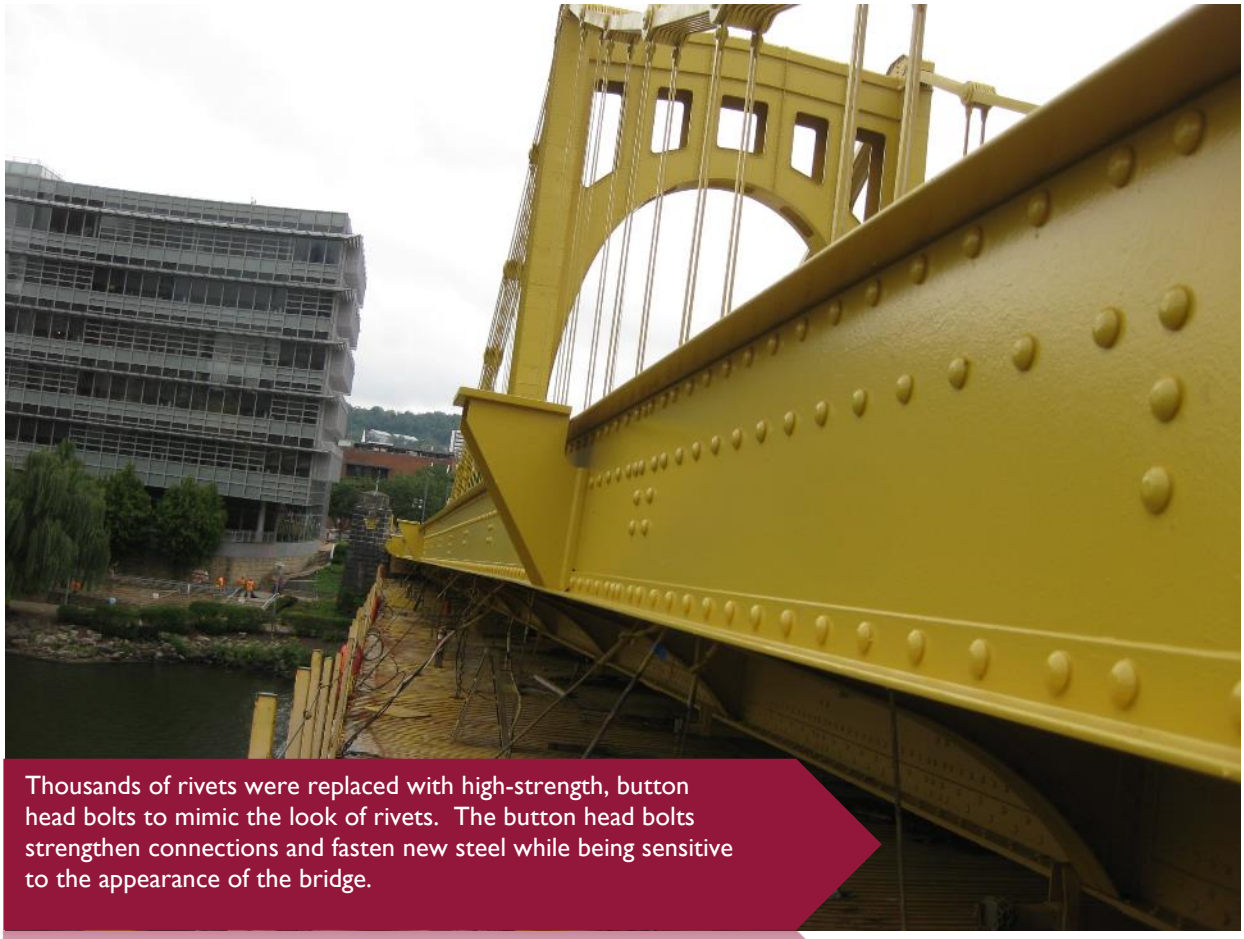


Advanced analysis indicated that uplift was present in the tie-downs under dead load, which was not predicted in the original calculations. The existing tie-down was reconfigured and replaced with higher strength materials, and rock anchors were added to strengthen the tie-down and provide redundancy.



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