

HISTORIC STRUCTURES

significant structures of the past

James River Bridge at Richmond, Virginia

*Mighty Colossus,
Bestriding the
Ancient Powhatan*

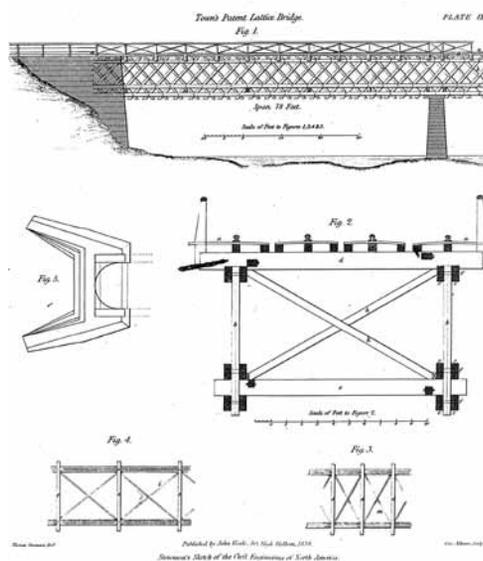
*By Frank Griggs, Jr., Dist.
M. ASCE, D. Eng., P.E., P.L.S.*

Dr. Griggs specializes in the restoration of historic bridges, having restored many 19th Century cast and wrought iron bridges. He was formerly Director of Historic Bridge Programs for Clough, Harbour & Associates LLP in Albany, NY, and is now an independent Consulting Engineer. Dr. Griggs can be reached at fgriggs@nycap.rr.com.



It was early in railroad development in this country when the Richmond & Petersburg Railroad was proposed and chartered in 1836. It ran from just north of Petersburg on the north side of the Appomattox River to just south of Richmond on the James River. The charter stated the line could be extended into both Richmond and Petersburg upon the approval of the Common Council of each city. The line as proposed was only 22 miles long. The B&O Railroad had just reached the Potomac River across from Harper's Ferry, and the railroad and Lewis Wernwag built a wooden deck bridge across the Monocacy River. The Mohawk and Hudson Railroad opened in New York State, connecting Albany and Schenectady, in 1831. The Allegheny Portage Railroad was 36-miles in length, connecting the Hollidaysburg Canal Basin with the basin at Johnstown on the Little Juniata River. It was designed by Moncure Robinson and opened March 18, 1834. Robinson was also working during this time on the construction of the Petersburg and Roanoke Railroad. That line was 59 miles long and ran from Petersburg to Blakely on the Roanoke River. It opened in 1833 and

has also been called the first railroad in Virginia. It was no surprise that Robinson was also selected to design the railroad and the high level bridge connecting it with downtown Richmond. He is another of the early giants in civil engineering of the 19th century that is little known in the present day. At the age of thirteen, he entered William and Mary College graduating with an A.M. degree in 1818. Being interested in Civil engineering, he was a member of a party sent out by the board of public works of Virginia to run a line of levels across the entire state from Richmond to the Ohio

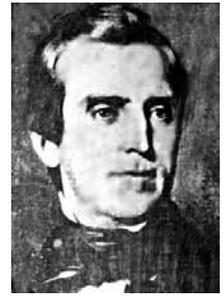


Town Lattice Truss, Philadelphia and Reading Railroad Bridge, by Moncure Robinson from David Stevenson.

River for the James River and Kanawha Canal. In 1822, he visited the Erie Canal, which was under construction, and became convinced that railroads in most cases were, as John Stevens said in 1812, superior to canals. He was one of the first Americans to visit France to study civil engineering and survey the public works of Europe. He arrived in Paris in April 1825 and studied civil engineering at the Sorbonne, founded in 1257. While it primarily stressed the Arts, it was strong in math and science education and was offered free to American students. Why he did not attend the nearby École Polytechnique or the École des Ponts et Chaussées, the finest engineering schools in the world, is not known. Between 1825 and 1827, he also spent a great deal of his time in England meeting George Stephenson, who had just finished the Stockton & Darlington Railway and was beginning work on the Liverpool & Manchester Railway while improving on his steam locomotives. Returning to the United States in the latter part of 1827, Robinson soon became one of the leading railroad engineers in the country. He was first retained by the Canal Commissioners of Pennsylvania to make the survey for a railroad connecting Northumberland on the Susquehanna River with Pottsville on the Schuylkill River, later called the Danville-Pottsville Railway. It was a means to haul anthracite coal from the coal fields to Philadelphia via the Schuylkill Navigation.

He also designed the Winchester and Potomac Railroad that ran from Winchester, Virginia along the west bank of the Shenandoah River to Harper's Ferry. It was completed in 1836. It was connected with the Baltimore & Ohio Railroad by a railroad bridge built in 1837 by Wernwag across the Potomac River at Harper's Ferry.

In 1834, Moncure began work on what many called the greatest work of his career, the Philadelphia and Reading Railroad. This line was built on the west bank of the river parallel to the Schuylkill Navigation, which reached Reading in 1825. It was a twin track line built originally to carry coal from the anthracite fields north of Reading to Philadelphia. His design included three tunnels (Black Rock, Flat Rock and Pulpit Rock) and nine bridges across the river. The wooden bridges he built were all Town Lattice Truss bridges. Town had patented his truss in 1820 and updated it in 1835. It was commonly built for roadways, but Robinson was one of the first to use it for railroad purposes even though the Rensselaer & Saratoga Railroad built several across the Hudson and Mohawk Rivers near Troy, New York. Wernwag's B&O Bridge across the Monocacy relied on a trussed arch, and his bridge across the Potomac



Moncure Robinson.

at Harpers Ferry (STRUCTURE, July 2014), designed with Benjamin Latrobe, was a variation of a Grubenmann design from the later 18th Century.

The laying out of the railroad was straight forward, but the bridge across the James River was not. The James River carved out a deep channel over time, and the City of Richmond was about 60 feet above the river, with a similar difference of elevation on the south side. The river channel was of rock and was tidal up to the falls at Richmond. A portion of the James River & Kanawha Canal was built by Charles Ellet, Jr. and ran along the north side of the river. A low level wooden wagon bridge had crossed the river for some time, but the railroad needed a high level bridge.

Robinson patterned his bridge on the ten span bridge he built on the Philadelphia and Reading Railroad. David Stevenson in his *Sketch of the Civil Engineering of North America* gave plans of this bridge, showing not only the truss pattern but the deck framing. Stevenson noted that he observed this bridge, with total length of 1,100 feet, during and after construction.

The structure Robinson designed “was 2,844 feet in length, 60 feet above the water, and composed of nineteen spans, varying from 140 to 153 feet in the clear.” The



James River Bridge looking towards Richmond.

superstructure was lattice, chiefly composed of two-inch pine plank, and contained only 1,500 pounds of iron. Its cost was \$117,200, or \$41 per foot lineal, including masonry – a limit Mr. Robinson found to be necessary to suit the means of the company. The low cost of such a structure for railroad use was commented on by foreign engineers, to whom it was little short of an enigma. It was Mr. Robinson’s forte to “cut his coat according to his cloth,” and he acquired an enviable reputation for his ability to adapt his expenditures to the means at his command... Had the Richmond & Petersburg Company been able to supply their engineer with means to build this bridge of iron, it would be doing duty today.” (*Illustrated American*, December 5, 1891)

The *Richmond Whig* in an article entitled *The Railroad Bridge Across James River* wrote in the flowery language of the time,

What is there yet to be done upon the face of the earth that cannot be effected by the powers of the human mind, connected with the ingenuity of the human hand? The great elementary principles of nature have long ago been mastered by the skill of man, and rendered subservient to his wants and happiness. The bowels of the earth and the fathomless ocean, have alike been made to pour forth their treasures at his bidding. He has navigated the sea and the air, and made the inanimate objects of nature perform the labor that would have otherwise devolved upon his own hands. He has even, by his inventions, condemned the drudgery of personal locomotion, and caused himself to be carried, from point to point, upon the face of the earth and the waters, by inanimate agents, ‘with the rapidity of the wind; while he, luxuriously reclining, as though quiescent, drinks in new draughts of knowledge from the great fountain’ and all nature, as though daily more sensible of the conquest, is progressively making less and less resistance to his dominion.

continue on next page

ADVERTISEMENT—For Advertiser Information, visit www.STRUCTUREmag.org

Williams Geo-Drill Hollow Bar Anchor System

The Williams Geo-Drill Injection Anchor System is today’s solution for a fast and efficient anchoring system into virtually any type of soil. The hollow, fully-threaded bar serves as both the drill string and the grouted anchor, thus installation is efficiently performed in a single operation. The sacrificial drill bit is threaded onto the end of the Geo-Drill bar and left in place following drilling.

The Geo-Drill System is particularly suitable for soils that do not allow for open-hole drilling (i.e. granular soils that are collapsible in nature). In such cases, drilling with a grout fluid serves the purpose of flushing spoils from the borehole and prevents looser, surrounding material from collapsing due to the higher relative density of the grout.

Fully
Domestic
System
Available



8165 Grapic Dr.
Belmont, MI 49306
Phone: (616) 866-0815
Fax: (616) 866-1890
williams@williamsform.com
www.williamsform.com

The great bridge across James River at Richmond, for the accommodation of the Richmond and Petersburg Railroad, may justly be considered as one of the greatest works of its kind in this country, or perhaps in the world. There are longer bridges of less altitude, and higher bridges of shorter span; but when the altitude and length of span of this bridge are taken collectively, there is, perhaps, not its equal in the world. For the gratification of the universal interest that at this time pervades the country, on the subject of Internal Improvements, I design to give

the public a short, but imperfect account of this gigantic, and in every point of view, interesting and splendid structure.

The location of the bridge is across the falls of the James River, a few hundred yards above tide water, where the velocity of the current is exceedingly great. It is constructed of substantial lattices, upon lofty granite piers, with a floor upon the summit of the lattice frame. The stoutness of the flooring corresponds with the general strength of the decision, and it is rendered water and fire proof, by a strong coat of pitch and sand.

The entire length of the span of the bridge is 2,900 feet, and the span between the piers 160 feet. The entire width of the floor is 22½ feet, (wide enough for a double railroad track,) being wider than, and projecting over the lattice frame, 2½ feet on each side; the frame work is, therefore 17 feet wide, on the top of the piers. The piers are 18 in number, founded in the rapids, upon the solid bed of granite rock that lies beneath. The elevation of the piers above common water is 40 feet, and their dimensions 4 by 18 feet at the top increasing one foot in width and one foot in thickness, for every 12 feet in the descending scale... The entire elevation of the wooden superstructure above the piers is 20 feet; so that the floor, which is on top, is 60 feet above the surface of the water...

The floor, upon which the traverse rails lie, rises five inches from each side to the centre, in order that the rain water may freely pass off. Guard rails are laid parallel to the traverse rails on each track, to prevent the possibility of either engine or cars running off. In addition to the precaution of covering the floor with a coat of pitch and sand, a gallery or walk is constructed throughout the whole length of the bridge, underneath the main floor, having a hand railing, upon which numerous buckets of water are to be kept hanging, ready for extinguishing fire, in case such an accident should call for their use... The frame work is preserved by a painted weather coating.

The whole structure was designed with a view to as much economy as was thought consistent with a just regard to strength and durability... The work itself stands like a mighty Colossus, bestriding the ancient Powhatan, destined to hand down to posterity both itself and its authors; and those piers of imperishable granite will remain as proud monuments, to remote generations of the present State of Virginia, and her sons, as connected with the Sciences and the Mechanic Arts.

During the Civil War it served as the main supply line between Richmond and Petersburg that was under siege for nine months by General Grant and the Northern Armies. The bridge lasted until April 1865 when it was burned when the CSA evacuated Richmond after the fall of Petersburg. It was rebuilt and opened again on May 25, 1866. A steel bridge was erected on the stone piers when sparks from a passing locomotive caused the rebuilt bridge deck to burn in 1882. In the early 1900s, a fourth bridge was built on the smaller concrete pilings beside the original stone piers. ■

The Industry Leader in Seismic And Wind Solutions.

**HF HARDY
FRAME**
SHEAR WALL SYSTEM

USP
STRUCTURAL CONNECTORS

**TIE-DOWN
SYSTEMS**



hardyframe.com 800 754.3030 • uspconnectors.com 800 328.5934

MiTek
BUILDER PRODUCTS

©2014 MiTek, All Rights Reserved

ADVERTISEMENT—For Advertiser Information, visit www.STRUCTUREmag.org