

PHILADELPHIA & READING RAILROAD, SUSQUEHANNA RIVER BRIDGE  
Pennsylvania Historic Railroad Bridges Recording Project  
Spanning Susquehanna River, north of I-83 Bridge  
Harrisburg  
Dauphin County  
Pennsylvania

HAER No. PA-523

HAER  
PA  
22-HARBU,  
30-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD  
National Park Service  
1849 C Street, NW  
Washington, DC 20240

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Location: Spanning Susquehanna River, north of I-83 Bridge, between Harrisburg, Dauphin County, and Lemoyne vicinity, Cumberland County, Pennsylvania.

USGS Quadrangle: Harrisburg West, Pennsylvania (7.5-minute series).

UTM Coordinates: 18/340060/4457240

Dates of Construction: 1920-24.

Basis for Dating: Secondary sources.

Designers: Philadelphia & Reading Railroad: Samuel T. Wagner, Chief Engineer; Percival S. Baker, Engineer of Bridges and Buildings.

Builders: T. L. Eyre (Philadelphia), substructure; James McGraw Co. (Philadelphia), superstructure; Blaw-Knox Co., centering.

Present Owner: Norfolk Southern Railroad.

Present Use: Railroad bridge.

Structure Type: Concrete arch; riveted half-through girder.

Significance: This structure is significant as a late example of a reinforced concrete arch designed by the Philadelphia & Reading Railroad, and perhaps the longest such structure on the former P&R system. Its design, falsework, and construction embody refinements developed during nearly two decades of experience with the material. The P&R's bridge also provides an important contrast to a nearby Pennsylvania Railroad bridge, reflecting the differing design philosophies of competing lines.

Historian: Justin M. Spivey, April 2001.

Project Information: The Historic American Engineering Record (HAER) conducted the Pennsylvania Historic Railroad Bridges Recording Project during 1999 and 2000, under the direction of Eric N. DeLony, Chief. The

project was supported by the Consolidated Rail Corporation (Conrail) and a grant from the Pennsylvania Historical and Museum Commission (PHMC). Justin M. Spivey, HAER engineer, researched and wrote the final reports. Preston M. Thayer, historian, Fredericksburg, Virginia, conducted preliminary research under contract. Jet Lowe, HAER photographer, and Joseph E. B. Elliott, contract photographer, Sellersville, Pennsylvania, produced large-format photographs.

### **Description and History**

The Philadelphia, Harrisburg & Pittsburgh Railroad (PH&P) was a relative latecomer among railroads crossing the Susquehanna River into southwestern Pennsylvania. Until the PH&P opened to traffic in 1891, the Pennsylvania Railroad (PRR) controlled every bridge from Selinsgrove to the Maryland state line. The first serious challenge to PRR's dominance came in 1884, when the South Pennsylvania Railroad began construction on a parallel crossing at Harrisburg. The joint vision of steel magnate Andrew Carnegie and New York Central Railroad director William H. Vanderbilt, the South Penn would have broken PRR's virtual monopoly on the Pittsburgh region. Construction halted in 1885 as part of a deal brokered by financier J. P. Morgan, leaving an incomplete set of bridge piers standing in the Susquehanna River.<sup>1</sup> At Harrisburg, the South Penn would have connected with the Philadelphia & Reading Railroad (P&R), another PRR rival. It is therefore not surprising that P&R was not only involved in the South Penn project, but also backing the PH&P in 1889. The PH&P was not as long as its name might imply. It ran only about six miles from Harrisburg to Bowmansdale, giving P&R a direct connection to the Western Maryland Railway at Shippensburg and a shorter route to Pittsburgh.<sup>2</sup>

P&R subsequently acquired the PH&P and its Susquehanna River bridge. This structure, located just downstream from the aborted South Penn bridge piers, consisted of twenty-three Pratt deck truss spans each 149'-4" long. Nolan Brothers of Reading constructed the original Clearfield County sandstone piers, which were wide enough to support a two-track superstructure. PH&P engaged Cofrode & Saylor of Philadelphia to erect only two lines of trusses supporting a single track, leaving room for a third line of trusses under a future second track.<sup>3</sup> The off-center placement of trusses imposed an eccentric loading on the piers, causing rapid deterioration of the masonry. Around 1914, P&R began an arduous three-year process of building falsework around each pier and replacing weak material with reinforced concrete.<sup>4</sup> Despite the complexity of this effort, it extended the bridge's life by less than a decade.

The present structure is a reinforced concrete arch bridge constructed between 1920 and 1924. It is perhaps the longest such structure on the former P&R system with 3,507'-9" in the original concrete portion; several more arch spans were added to the east end at a later, unknown date. After taking a pounding from war-related traffic, the truss bridge and its approaches were too weak to carry modern train loads. A second track was also needed. Were the piers in better condition, P&R could have replaced the existing trusses with heavier two-track spans. Like

many of their counterparts nationwide, however, P&R bridge engineers were fascinated with reinforced concrete as a "permanent" material for main-line structures. The railroad began experimenting with the material in bridge construction as early as 1904, and rebuilt a number of major structures including the Delaware River bridge at Yardley in 1913.<sup>5</sup> The Susquehanna River crossing formed a similarly important link in the P&R system. Furthermore, additional piers would be easy to construct in the shallow water with bedrock close to the surface. Forms could be reused repeatedly on the large number of similar spans. In short, conditions at the Susquehanna bridge were extremely favorable for reconstruction in concrete.

By the time that design work began in 1918, P&R bridge engineers had refined the process of designing and constructing reinforced concrete structures through fifteen years' experience. The Susquehanna bridge reflects this in its simple, if not austere, design. A single rectangular panel is the only ornamentation on the piers. A solid concrete panel railing (found only on the south side) is totally devoid of surface texture except for "THE READING" incised in pilasters near the ends. Whereas the Yardley Bridge has arch rings incised at intervals resembling stone voussoirs, the Susquehanna bridge's rings have only six radial lines marking the joints between concrete pours. In one article describing the bridge, P&R Assistant Engineer Edwin Chamberlain referred to arch rings "poured in sections in the usual manner," assuming that readers shared his familiarity with the procedure.<sup>6</sup> "The usual manner" likely meant sections poured symmetrically from the piers inward, with the center section used to pre-compress the arch against cracking, a method that would have been common knowledge among bridge engineers in the 1920s. The Susquehanna River bridge's significance lies not in any particularly innovative aspect of reinforced concrete design, but in its repeated application to an exceptionally long structure.

It is probably no coincidence that the design and construction sequence of the P&R bridge closely resemble those of the nearby PRR (née Cumberland Valley Railroad) bridge, which was rebuilt between 1914 and 1916. The two structures are similar solutions to similar problems. Both railroads began with single-track trusses on masonry piers intended for two tracks. Their contractors built two-track reinforced concrete arch spans, completing one track at a time. Both structures encase the existing masonry piers and have new intermediate piers cutting each span in half. A subtle visual rhythm is created by the stocky encased piers (11'-6" wide on P&R's bridge, 13'-0" on PRR's) alternating with more slender intermediate piers (9'-0" on both bridges). If PRR had not substituted a plate-girder span for a diverging track on the west shore, both structures would have forty-six closed-spandrel arches.<sup>7</sup>

Differences between the two bridges, however, tell something about the competitors' bridge engineering departments. The PRR bridge has 77'-0" segmental arch spans and a crown-to-coping depth of 6'-6", with an open pipe railing. This appears much lighter alongside the P&R bridge with its 66'-0" semi-circular arch spans and crown-to-coping depth of 7'-0", capped with a 4'-0"-high solid railing. While P&R's design is more conservative, its more inventive construction procedure avoided all but a small amount of falsework in the river. This may represent a lesson learned from the PRR bridge, where an unusual summer flood in 1916 destroyed a low-level construction trestle.<sup>8</sup> P&R's construction procedure also used significantly

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less material in temporary structures, but contemporary articles do not provide cost data to reveal whether this achieved a cost savings over PRR's bridge.

P&R and its contractors took unusual steps to avoid placing falsework in the river. Instead of building a temporary construction trestle, P&R shifted its tracks northward on the existing trusses and cantilevered a narrow-gauge track off the south side. Philadelphia-based foundation contractor T. L. Eyre used this track to build new pier foundations and encase the old ones in concrete. Superstructure contractor James McGraw, also of Philadelphia, then took over and built up the south half of the new concrete arches. Like the contractor on PRR's bridge, McGraw used steel truss centering seated in pockets on the piers to form the arches. Both re-used a small number of trusses for all of the spans. But whereas PRR's contractor had to shuffle the centering along its low-level trestle, McGraw used a pontoon-based traveling crane to move centering between pours. Blaw-Knox Co. provided both the steel trusses and the traveling crane as a subcontractor on the P&R project. After P&R shifted traffic to the completed south half of the bridge in July 1922, McGraw began constructing the north half, again keeping falsework to a minimum. As the low bidder for demolishing the old trusses, McGraw was able to continue using them as a working platform, removing member by member as the arches rose beneath. Published construction photographs show only a few short segments of falsework installed as temporary support for the old trusses.<sup>9</sup> The structure seems to have been completed in 1924.

Both PRR and P&R bridges came under Conrail ownership in 1976 after their owners declared bankruptcy.<sup>10</sup> In the interest of eliminating duplicate routes, Conrail removed tracks from the former PRR bridge. The P&R's bridge, however, continues to carry freight trains to and from the Western Maryland interchange at Shippensburg. It serves as a visual landmark in downtown Harrisburg, and is seen by tens of thousands of motorists each day on I-83.

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**Notes**

1. Thomas J. Misa, *A Nation of Steel: The Making of Modern America, 1865-1925* (Baltimore: Johns Hopkins Univ. Press, 1995), 134-37.
2. See route map in Jay V. Hare, *History of the Reading* (Philadelphia: ABC Duplicator Co., 1966), vi-vii.
3. Edwin Chamberlain, "The New Susquehanna River Bridge at Harrisburg, Pa.," *Railroad Gazette* 23, No. 7 (13 Feb. 1891): 108-09.
4. "Capping Old Bridge Piers under Railway Traffic," *Engineering News* 76, No. 15 (12 Oct. 1916): 703-04.
5. "Double-Track and Four-Track Concrete Bridges on the Philadelphia & Reading Railroad Lines," *Engineering Record* 54, No. 15 (13 Oct. 1906): 396-400; U.S. Department of the Interior, Historic American Engineering Record (HAER) No. PA-513, "Philadelphia & Reading Railroad, Delaware River Bridge," 2001, Prints and Photographs Division, Library of Congress, Washington, D.C.
6. Edwin Chamberlain, "Philadelphia & Reading to Build 46-Arch Bridge," *Railway Age* 69, No. 21 (19 Nov. 1920): 870.
7. On the Cumberland Valley Railroad bridge, see "New Susquehanna River Bridge at Harrisburg," *Railway Age Gazette* 60, No. 11 (17 Mar. 1916): 501-03; "Susquehanna Concrete Viaduct Built in Halves," *Engineering News* 75, No. 12 (23 Mar. 1916): 537-40; and "Building Second Half of the Susquehanna Bridge," *Engineering News* 76, No. 16 (19 Oct. 1916): 764-66.
8. "Straightening 70-Ft. I-Beams Bent by Flood," *Engineering News* 76, No. 9 (31 Aug. 1916): 385-86.
9. Charles H. Hitchcock, "Philadelphia & Reading Builds 46-Arch Bridge," *Railway Age* 73, No. 23 (2 Dec. 1922): 1035.
10. Richard Saunders, "Conrail," in *Encyclopedia of American Business History and Biography: Railroads in the Age of Regulation, 1900-1980*, edited by Keith L. Bryant, Jr. (New York: Facts on File, 1988), 93.

**Additional Source**

1. Philadelphia & Reading Railroad Co., "Rebuilding Bridge No. 8 over the Susquehanna River, Harrisburg, Pa." (11 Oct. 1919), milepost 0.80, region/division/branch 150333, aperture card files, Consolidated Rail Corp., Philadelphia, Pa. [transferred to Norfolk Southern Railway Co., Atlanta, Ga.].