

Repurposing Industrial Railroad Bridges:  
Linking the Past to the Present

by

Kathleen C. Carver

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Linking the Past to the Present

Kathleen C. Carver

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Signature:

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*Kathleen C. Carver*, Student

Date

Approvals:

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*Dr. Thomas Leary*, Thesis Advisor

Date

---

*Dr. Donna DeBlasio*, Committee Member

Date

---

*Dr. Brian Bonhomme*, Committee Member

Date

---

Dr. Salvatore A. Sanders, Associate Dean of Graduate Studies

Date

## **Abstract**

Three industrial railroad bridges serve as case studies that demonstrate the challenge for adaptive reuse in rust belt communities in the United States. The legacy of an industrial railroad bridge is far reaching beyond the role that it played in the development of its surrounding communities and industry. These bridges are extant artifacts of progress. Through the lens of history, economics, and adaptive reuse, this thesis reveals the significance of preservation of industrial railroad bridges.

One of the most outstanding examples of an industrial heritage resource that illustrates the connection between steel, railroads and innovative bridge construction is the creation of a hot metal bridge. The hot metal bridge owns a specific place in industrial history, distinguished more by purpose than by design. Often these bridges are designed and built for very heavy loads, making the bridge an ideal candidate for adaptive reuse. Identifying and rehabilitating historic bridges is inevitably a difficult endeavor. The challenge of rehabilitating an industrial railroad bridge presents difficult obstacles and demands innovative solutions.

## **Acknowledgments**

To my thesis advisor, Dr. Leary, thank you for your wisdom, guidance, and kind patience throughout this process. Your exceptional knowledge of industrial and labor history is indispensable. You are generous with not only knowledge, but also with kindness. To my academic advisor and committee member, Dr. DeBlasio, thank you for thoroughly reading my thesis and providing exceptional feedback. I am grateful for your guidance throughout my education; you always lead me in the right direction. A special thank you to two inspirational minds, Dr. Pallante and Dr. Bonhomme.

Thank you to my loving and very supportive family. Without your constant love and support, I would not have the luxury of completing my master's program.

This thesis is dedicated to my grandfather, George Albert Carver III, for his many years of service as a locomotive engineer on the Union Railroad in Pittsburgh.

## Table of Contents

Abstract.....	iii
Acknowledgements.....	iv
Figures and Illustrations.....	vi
Introduction.....	vii
Chapter One.....	1
Chapter Two.....	17
Chapter Three.....	29
Chapter Four.....	42
Chapter Five.....	55
Conclusion.....	63
Bibliography.....	66
Appendix A.....	74

## Figures and Illustrations

1-1.	Truss Poster.....	5-6
2-1.	Jones and Laughlin, c. 1907.....	18
2-2.	Erecting the Monongahela Connecting RR Bridge.....	20
2-3.	South Side Hot Metal Bridge.....	25
3-1.	Union Railroad Rankin Hot Metal Bridge.....	29
3-2.	Carrie Furnace Bridge, c. 1945.....	32
3-3.	Map of Rankin, PA.....	32
4-1.	Erecting the Ohio-West Virginia Bridge, c. 1917.....	47
4-2.	Mountain State Carbon.....	50
5-1.	Bollman Bridge, c. 2007.....	59

## Introduction

Unsung and ignored, invariably black and steel ribbed, Pittsburgh's railroad bridges are the silent industrial workhorses of the three rivers.

-Kevin Patrick, Pittsburgh: City of Bridges<sup>1</sup>

In *Industrial Archaeology: Principals and Practice* by Peter Neaverson and Marilyn Palmer, the authors describe industrial archeology as the study of material evidence associated with the industrial past.<sup>2</sup> Industrial growth following the Civil War (1861-1865) was the impetus for the Second Industrial Revolution when manufacturing surpassed agriculture and workers moved from rural farms to urban factories. Industrialization, including the proliferation of the railroads, ushered in the birth of the modern age and the introduction of new technologies. This, combined with greater access to natural resources, made American industry a leader in world production of goods and scientific innovation.<sup>3</sup> The iron, steel, and railroad industries often worked together to reap the benefits of this changing society through vertical integration. Transportation networks connected new markets for manufactured goods. These businesses and the economy fueled each other throughout the second half of the nineteenth century. The remnants of their partnership can be seen in the miles of railroad tracks that link the land and the industrial railroad bridges that span the rivers in Pennsylvania and Ohio.

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<sup>1</sup>Joseph Scarpaci and Kevin J. Patrick, eds., *Pittsburgh and the Appalachians* (Pittsburgh, PA: University of Pittsburgh Press, 2006) 82-85.

<sup>2</sup>Peter Neaverson and Marilyn Palmer, *Industrial Archaeology: Principles and Practice* (New York, NY: Routledge, 2012) 12-30.

<sup>3</sup>Jefferson Cowie and Joseph Heathcott, eds., *Beyond the Ruins: The Meanings of Deindustrialization* (Ithaca, NY: ILR Press, 2003) 37.

Industrial railroad bridges are prime examples of material evidence left behind from our industrial past. They were often custom designed to meet the need of the industry that they served. Fortunately, these bridges were so well built and structurally sound, that they can be repurposed for use as vehicular and pedestrian bridges.

Three case study bridges serve as a foundation for an historical analysis of industrial railroad metal truss bridges and the effects of deindustrialization and rust belt decay. The first case study, the South Side Hot Metal Bridge in Pittsburgh, Pennsylvania, is a rehabilitation success. The second case study, the Union Railroad Rankin Hot Metal Bridge #35 located in Rankin, Pennsylvania, is an example of an industrial railroad bridge that is currently being reviewed for rehabilitation. Finally, if the current burgeoning economic situation continues in Steubenville, the Ohio-West Virginia Railroad Bridge may be considered for demolition. A unique approach to the study of metal truss bridges is an examination of the history and future of railroad metal truss bridges as an industrial heritage resource.

### *Industrial Heritage Resources*

Industrial archeology includes a broad range of historical study and there are many ways to define and characterize industrial heritage resources. In *The Industrial Heritage: Managing Resources and Uses*, Alfrey and Putnam describe industrial heritage resources as the scrapheap that industry leaves behind, including machinery, building materials, industrial structures, and waste material.<sup>4</sup> Heritage management identifies resources that illustrate a particular theme or idea relevant to a period of history, making the industrial artifact a monument or symbol of technological innovation. Many

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<sup>4</sup> Judith Alfrey and Tim Putnam, *The Industrial Heritage: Managing Resources and Uses* (London, UK: Routledge, 2005) 3-10.



industrial historians attempt to study the material culture of industrial society analyzing the social, political, cultural and economic implications of our industrial past.<sup>5</sup> The study of the material culture of industrial heritage includes ‘history from below’ or the worker experience, small industry, and women and minorities in the workplace.<sup>6</sup> Several fields of study within industrial heritage express different intentions including economic stimulus through heritage tourism or simply as a method to understand our civilization’s past and future. In the nineteenth century, the creation of the railroad launched a chain reaction that prompted industrial innovation leading to the development of industrial railroad bridges. The history of industrial metal truss bridges captures the importance of the connection between innovation of the railroads and their relation to the steel industry. Through the study of industrial metal truss railroad bridges, one does not simply learn about technology, but also the development of institutions and our shared values.

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<sup>5</sup> Melanie K. Smith, *Issues in Cultural Tourism Studies* (New York, NY: Routledge, 2003) 96-101.

<sup>6</sup> *Ibid*, 96-101.

## CHAPTER ONE: IRON, STEEL, AND THE METAL TRUSS BRIDGE

### *Nineteenth Century Development of Industrial Railroad Bridges*

The Federal government was not frequently involved in building transportation networks during the nineteenth century, with the exception of land grants for the transcontinental railroad. Because of the federal government's lack of involvement in financing or managing transportation, there was extreme competition and little cooperation in creating a viable system.<sup>1</sup> As a result, the network of railways was not necessarily rational, especially industrial rail spurs which branched off from a central through route, usually a main line.<sup>2</sup> In the early stages of railway development, local governments often helped finance railways. For example, the state of Maryland contributed to the Baltimore and Ohio Railroad and the city of Philadelphia to the Pennsylvania Railroad.<sup>3</sup> The building of infrastructure was financed by a system unique to America which included public and private capital with both cities and states investing in private companies or establishing public companies with private investments.<sup>4</sup>

Given their complex construction and high cost, bridges offered a source of investment opportunity. Most of the early bridges on the railroad lines were built with untreated wood, quickly, at low cost and were badly decayed and weakened.<sup>5</sup> Wooden bridges were a fire risk to a railroad that operated steam locomotives. By the beginning

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<sup>1</sup> National Cooperative Highway Research Program "Preserving Freight and Passenger Rail Corridors and Service" (2007) <[http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp\\_syn\\_374.pdf](http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_374.pdf)> (accessed January 2014) 10-34.

<sup>2</sup> Ibid, 24.

<sup>3</sup> Charles Sellers, *The Market Revolution: Jacksonian America, 1815-1846* (Oxford: The Oxford University Press, 1992) 51.

<sup>4</sup> Steven W. Usselman, *Regulating Railroad Innovation: Business, Technology, and Politics in America, 1840-1920* (Cambridge: Cambridge University Press, 2002) 57-60.

<sup>5</sup> Robert W. Jackson, *Rails Across the Mississippi: A History of the St. Louis Bridge* (Urbana: University of Illinois Press, 2001), 109-112.

of the Civil War, many smaller wooden railroad bridges were lost to fire, despite a precautionary coating of fire proof paint.<sup>6</sup> Powdered lead oxide paint was later used on metal bridges to safeguard against rust, corrosion and chemical deterioration.<sup>7</sup> Although the use of metal in bridge building increased, wooden structures remained an important element in bridge work for more than two decades following the Civil War.<sup>8</sup> Structural metal work in bridges proved to be a daunting task in the early years of railroad bridge building. The use of timber was more widely understood.

Due to the fact that wooden bridges could be expected to last only nine years in normal railroad service, many engineers asserted that railroads needed to invest in more durable iron replacements.<sup>9</sup> Many factors influenced the substitution of cast and wrought iron for wood in bridge construction including; decreased cost of wrought iron and greater availability of rolled products in different shapes and increased lengths, growing scarcity of timber and increase in cost, and greater convenience and lower cost of handling and erecting metal members.<sup>10</sup> Bridge building evolved from a trade in the late eighteenth century, to an elevated art in the early nineteenth century and eventually into a complex science in the late nineteenth century.<sup>11</sup> Almost all major contributions to metal bridge construction in nineteenth century America were associated in one way or another with railroad companies.<sup>12</sup> The increased stress on bridges to carry faster and heavier

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<sup>6</sup> J.A.L. Waddell, *Bridge Engineering* (New York: John Wiley and Sons, Inc., 1916) 10.

<sup>7</sup> J.E. Simons, "Official proceedings of the Railway Club of Pittsburgh " *Railway Club of Pittsburgh* 1 no.1. (November 1901) < <https://archive.org/details/officialproceedi07rail>> (accessed January 2014): 1-30.

<sup>8</sup> Llewellyn Nathaniel Edwards, *A Record of History and Evolution of Early American Bridges* (Orono, Maine: University of Maine Press, 1959) 99.

<sup>9</sup> Waddell, *Bridge Engineering*, 15.

<sup>10</sup> Edwards, *A Record of History and Evolution*, 98.

<sup>11</sup> Richard Kirby, Sidney Withington, Arthur Darling and Frederick Kilgour, *Engineering and History*. (New York: McGraw-Hill, 1990) 199-210.

<sup>12</sup> Victor C. Darnell, *A Directory of American Bridge Building Companies, 1840-1900* (Washington DC: Society for Industrial Archeology, 1984) vii.

trains across rivers and valleys demanded bridge innovation. In a 1924 *Engineering News Record* article, the eminent bridge engineer Gustav Lindental states, “The progress of bridge construction during the last fifty years is best exemplified on the American railroads.”<sup>13</sup>

In the mid to later half of the nineteenth century, railroad bridge builders utilized a variety of wrought iron truss forms that were introduced and patented by their designers. Because cast iron is brittle, it was often paired with wrought iron.<sup>14</sup> The truss bridge, which is the most common type of larger railroad bridge built in North America, is a structure made up of individual members arranged in the form of triangles and may have pinned or riveted connections. The load of the bridge is handled through a network of elements in tension and compression. Because cast iron is brittle but strong in compression, it was often paired with wrought iron which is strong in tension.<sup>15</sup> Eventually, bridge engineers recognized the inadequacy of cast iron and compression members were also constructed of wrought iron.<sup>16</sup>

Patented truss designs were common. Truss designs utilized by the railroad included the Whipple, Howe, Fink, Bollman, Warren and the Pratt. Caleb Pratt, an architect, and Thomas Pratt, an engineer, patented the Pratt Truss in the 1840s.<sup>17</sup> Thomas Pratt, Caleb’s son, studied architecture, building construction, mathematics, and natural science at Rensselaer Polytechnic Institute in Troy, New York and later became an

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<sup>13</sup> Gustav Lindental, “Bridge Engineering” *Engineering News-Record*, April 17 1924, 657.

<sup>14</sup> Emory L. Kemp, “The Introduction of Cast and Wrought Iron in Bridge Building” *IA: The Journal for the Society of Industrial Archeology*, Vol. 19, No. 2, 1993, 5.

<sup>15</sup> *Ibid.*, 8.

<sup>16</sup> Francis C. Robb, “Cast Aside: The First Cast Iron Bridge in the United States” *IA: The Journal of the Society for Industrial Archeology*, Vol. 19, No. 2, 1993, 8.

<sup>17</sup> Richard Cook, *The Beauty of Railroad Bridges in North America: Then and Now* (San Marino, CA: Golden West Books, 1987) 34.

engineer for the United State Army Corps of Engineers.<sup>18</sup> The Pratt truss possessed a rectangular profile with vertical posts, and top and bottom horizontal chords fabricated from timber while the double diagonals were wrought iron.<sup>19</sup> The posts are the compression members and the diagonals are the tension members. The design was considered superior to other truss patents before it simply because the Pratt provided a more functional distribution of tensile and compressive stresses in various members. Tensile strength is defined as the resistance of a material to a force tearing it apart and compressive strength is the capacity of a material or structure to withstand weight.<sup>20</sup> J.A.L. Waddell argues that the simplest truss designs are the longest lasting, noting the Pratt truss is in this group.<sup>21</sup> The first iron Pratt truss was built by the Pennsylvania Railroad in 1850 and became a common feature.<sup>22</sup>

**Figure 1-1:** (Page 5-6) Historic American Engineering Record truss poster depicting the interworking structural members of the truss design and several truss patents.  
*Courtesy of the Historic American Engineering Record (HAER)*

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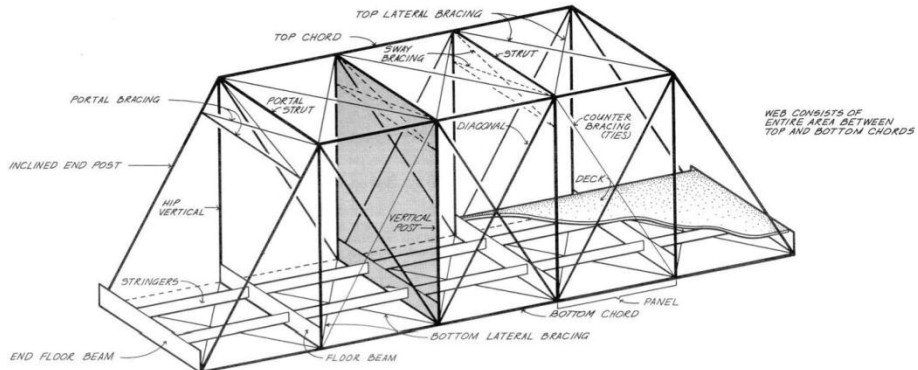
<sup>18</sup> Emory L. Kemp, ed., *American Bridge Patents: The First Century 1790-1890* (Morgantown, West Virginia: West Virginia University Press, 2005) 167.

<sup>19</sup> *Ibid*, 43.

<sup>20</sup> Eda Kranakis, *Constructing a Bridge: An Exploration of Engineering Culture, Design, and Research in Nineteenth Century France and America* (Cambridge, MA: MIT Press, 1997) 32.

<sup>21</sup> Waddell, *Bridge Engineering*, 15.

<sup>22</sup> Albert J. Churella, *The Pennsylvania Railroad, Volume 1: Building an Empire 1846-1917* (University of Pennsylvania Press, 2012) 87.



# TRUSSES

## A STUDY BY THE HISTORIC AMERICAN ENGINEERING RECORD

A TRUSS IS COMPOSED OF STRUCTURAL TRIANGLES JOINED TOGETHER WITH PINNED OR RIVETED CONNECTIONS. THE MAIN PIECES OR MEMBERS MAY BE EITHER STIFF HEAVY STRUTS, RODS OR THIN FLEXIBLE BARS. IT IS THE ARRANGEMENT OF THESE MEMBERS THAT DETERMINES THE SPECIFIC TRUSS TYPE.

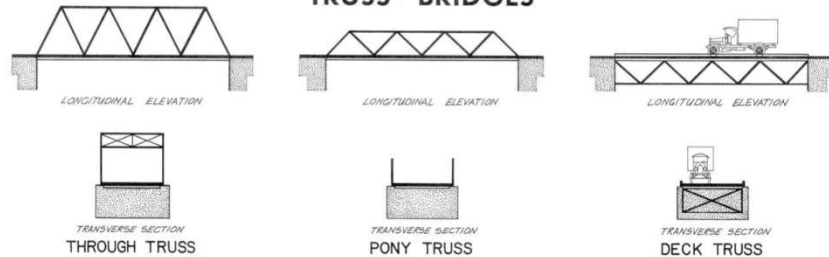
STRUCTURAL MEMBERS RESIST FORCES IN TWO PRIMARY WAYS — COMPRESSION AND TENSION. HEAVY RIGID MEMBERS MAY RESIST BOTH COMPRESSIVE AND TENSILE FORCES BUT THIN RODS CAN ONLY RESIST TENSION AND THESE CHARACTERISTICS ARE MAJOR CLUES IN TRUSS IDENTIFICATION. NOTE THAT THE MAIN STRUCTURAL MEMBERS OF A TRUSS PANEL MAY BE SUPPLEMENTED BY THIN DIAGONAL TIES. BECAUSE TRUSS TYPES ARE DETERMINED BY THEIR MAIN STRUCTURAL MEMBERS THESE COUNTER BRACES (INDICATED BY DASHED LINES) ON THE IDENTIFICATION SHEETS MAY BE IGNORED. AFTER MATCHING THE STRUCTURAL OUTLINE OF THE TRUSS IN QUESTION WITH THE DIAGRAM IT MOST RESEMBLES CHECK TO MAKE SURE THE ARRANGEMENT OF HEAVY COMPRESSION AND LIGHT TENSION MEMBERS IS COMPATIBLE WITH THE DIAGRAM. IF THERE IS AGREEMENT, THEN

THE BASIC TRUSS TYPE IS IDENTIFIED.

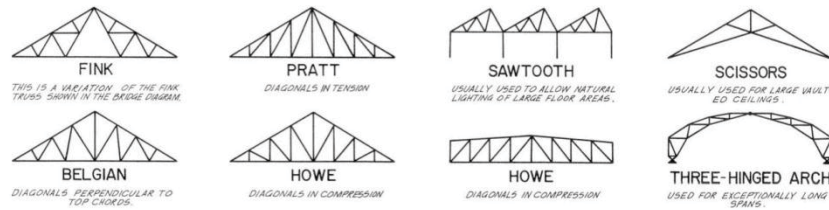
THE SHEET OF TRUSS DIAGRAMS PRESENTS ONLY THE STANDARD TYPES OF THE MOST COMMON TRUSSES. THERE ARE ALSO MANY UNUSUAL TRUSSES THAT DO NOT FALL INTO EASILY-DEFINED CATEGORIES. IN SUCH CASES IDENTIFICATION SHOULD BE MADE AS CLOSELY AS POSSIBLE IN TERMS OF THE STANDARD DESIGNS. ADDITIONALLY, TRUSSES OFTEN ARE INVERTED, CREATING OUTLINES QUITE DIFFERENT FROM THE ORIGINAL — TENSION MEMBERS BELONGING TO COMPRESSION MEMBERS AND VICE VERSA. BEFORE ASSUMING A TRUSS IS NOT REPRESENTED ON THE DIAGRAM, CHECK TO SEE IF IT IS AN INVERTED FORM.

MOST BRIDGE TRUSSES ARE OF THREE BASIC TYPES. IF THE DECK AND JOIST RAILS ARE LEVEL WITH THE BOTTOM CHORDS, IT IS A THROUGH TRUSS. A PONY TRUSS IS A THROUGH TRUSS WITH NO LATERAL BRACING BETWEEN TOP CHORDS. A DECK TRUSS CARRIES ITS TRAFFIC LOAD LEVEL WITH THE TOP CHORDS.

### TRUSS BRIDGES



### ROOF TRUSSES


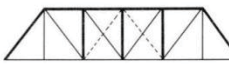
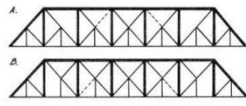






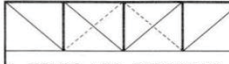




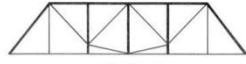



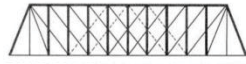




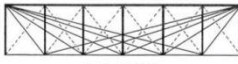





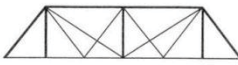


### STRUCTURAL CONNECTIONS



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 <p><b>KING POST</b> (WOOD) A TRADITIONAL TRUSS TYPE WITH ITS ORIGINS IN THE MIDDLE AGES. LENGTH: 20-60 FEET 6-18 METERS</p>	 <p><b>PRATT</b> 1844 - 20TH CENTURY DIAGONALS IN TENSION, VERTICALS IN COMPRESSION (EXCEPT FOR HIP VERTICALS ADJACENT TO INCLINED END POSTS). LENGTH: 30-250 FEET 9-75 METERS</p>	 <p><b>BALTIMORE (PETIT)</b> 1871 - EARLY 20TH CENTURY A. A PRATT WITH 5/8" STRUTS. B. A PRATT WITH 5/8" TIES. LENGTH: 75-600 FEET 23-180 METERS</p>	 <p><b>WARREN</b> 1840 - 20TH CENTURY TRIANGULAR IN OUTLINE, THE DIAGONALS CARRY BOTH COMPRESSIVE AND TENSILE FORCES. A TRUE WARREN TRUSS HAS EQUILATERAL TRIANGLES. LENGTH: 50-400 FEET 15-120 METERS</p>
 <p><b>QUEEN POST</b> (WOOD) A LENGTHENED VERSION OF THE KING POST. LENGTH: 20-50 FEET 6-24 METERS</p>	 <p><b>PRATT HALF-HIP</b> LATE 19TH - EARLY 20TH CENTURY A PRATT WITH INCLINED END POSTS THAT DO NOT HORIZONTALLY EXTEND THE LENGTH OF A FULL PANEL. LENGTH: 30-150 FEET 9-45 METERS</p>	 <p><b>PENNSYLVANIA (PETIT)</b> 1875 - EARLY 20TH CENTURY A. A PRATT WITH 5/8" STRUTS. B. A PRATT WITH 5/8" TIES. LENGTH: 250-600 FEET 75-180 METERS</p>	 <p><b>WARREN WITH VERTICALS</b> MID 19TH - 20TH CENTURY DIAGONALS CARRY BOTH COMPRESSIVE AND TENSILE FORCES. VERTICALS SERVE AS BRACING FOR TRIANGULAR WEB SYSTEM. LENGTH: 50-400 FEET 15-120 METERS</p>
 <p><b>BURR ARCH TRUSS</b> 1804 - LATE 19TH CENTURY (WOOD) COMBINATION OF A WOODEN ARCH WITH A MULTIPLE KING POST ARCH ALSO COMBINED WITH LATER WOODEN TRUSSES. LENGTH: 80-175 FEET 25-50 METERS</p>	 <p><b>TRUSS LEG BEDSTEAD</b> LATE 19TH - EARLY 20TH CENTURY A PRATT WITH VERTICAL END POSTS IMBEDDED IN THEIR FOUNDATIONS. LENGTH: 30-100 FEET 9-30 METERS</p>	 <p><b>LENTICULAR (PARABOLIC)</b> 1870 - EARLY 20TH CENTURY A PRATT WITH BOTH TOP AND BOTTOM CHORDS PARABOLICALLY CURVED OVER THEIR ENTIRE LENGTH. LENGTH: 50-360 FEET 15-110 METERS</p>	 <p><b>DOUBLE INTERSECTION WARREN (LATTICE)</b> MID 19TH - 20TH CENTURY STRUCTURE IS INDETERMINATE. MEMBERS ACT IN BOTH COMPRESSION AND TENSION. TWO TRIANGULAR WEB SYSTEMS ARE SUPERIMPOSED UPON EACH OTHER WITH OR WITHOUT VERTICALS. LENGTH: 75-400 FEET 23-120 METERS</p>
 <p><b>TOWN LATTICE</b> 1820 - LATE 19TH CENTURY (WOOD) A SYSTEM OF WOODEN DIAGONALS WITH NO VERTICALS. MEMBERS TAKE BOTH COMPRESSION AND TENSION. LENGTH: 50-220 FEET 15-66 METERS</p>	 <p><b>PARKER</b> MID-LATE 19TH - 20TH CENTURY A PRATT WITH A POLYGONAL TOP CHORD. LENGTH: 40-250 FEET 12-75 METERS</p>	 <p><b>GREINER</b> 1894 - EARLY 20TH CENTURY PRATT TRUSS WITH THE DIAGONALS REPLACED BY AN INVERTED BOWSTRING TRUSS. LENGTH: 75-250 FEET 23-75 METERS</p>	 <p><b>PEGRAM</b> 1867 - EARLY 20TH CENTURY A HYBRID BETWEEN THE WARREN AND PARKER TRUSSES, UPPER CHORDS ARE ALL OF EQUAL LENGTH. LENGTH: 150-450 FEET 45-135 METERS</p>
 <p><b>HOWE</b> 1840 - 20TH CENTURY (WOOD, VERTICALS OF METAL) DIAGONALS IN COMPRESSION, VERTICALS IN TENSION. LENGTH: 30-150 FEET 9-45 METERS</p>	 <p><b>CAMELBACK</b> LATE 19TH - 20TH CENTURY A PARKER WITH A POLYGONAL TOP CHORD OF EXACTLY FIVE SLOPES. LENGTH: 100-300 FEET 30-90 METERS</p>	 <p><b>DOUBLE INTERSECTION PRATT</b> 1847 - 20TH CENTURY (WHIPPLE, WHIPPLE-MURPHY, LINVILLE) AN INCLINED END POST PRATT WITH DIAGONALS THAT EXTEND ACROSS TWO PANELS. LENGTH: 20-300 FEET 7-90 METERS</p>	 <p><b>POST</b> 1865 - LATE 19TH CENTURY A HYBRID BETWEEN THE WARREN AND THE DOUBLE INTERSECTION PRATT. LENGTH: 100-300 FEET 30-90 METERS</p>
 <p><b>BOWSTRING ARCH-TRUSS</b> 1840 - LATE 19TH CENTURY A TIED ARCH WITH THE DIAGONALS SERVING AS BRACING AND THE VERTICALS SUPPORTING THE DECK. LENGTH: 50-130 FEET 15-40 METERS</p>	 <p><b>CAMELBACK WITH SUBDIVIDED PANELS</b> LATE 19TH - EARLY 20TH CENTURY A. A PENNSYLVANIA TRUSS WITH A POLYGONAL TOP CHORD OF EXACTLY FIVE SLOPES. B. SAME AS A. WITH HORIZONTAL STRUTS. LENGTH: 100-300 FEET 30-90 METERS</p>	 <p><b>SCHWEDLER</b> LATE 19TH CENTURY A DOUBLE INTERSECTION PRATT POSITIONED IN THE CENTER OF A PARKER. LENGTH: 100-300 FEET 30-90 METERS</p>	 <p><b>BOLLMAN</b> 1852 - MID-LATE 19TH CENTURY (RARE) VERTICALS IN COMPRESSION, DIAGONALS IN TENSION. DIAGONALS RUN FROM END POSTS TO EVERY PANEL POINT. LENGTH: 75-100 FEET 23-30 METERS</p>
 <p><b>WADDELL "A" TRUSS</b> LATE 19TH - EARLY 20TH CENTURY EXPANDED VERSION OF THE KING POST TRUSS. USUALLY MADE OF METAL. LENGTH: 25-75 FEET 8-23 METERS</p>	 <p><b>KELLOGG</b> LATE 19TH CENTURY A VARIATION ON THE PRATT WITH ADDITIONAL DIAGONALS RUNNING FROM UPPER CHORD PANEL POINTS TO THE CENTER OF THE LOWER CHORDS. LENGTH: 75-150 FEET 23-45 METERS</p>	 <p><b>K-TRUSS</b> EARLY 20TH CENTURY SO CALLED BECAUSE OF THE DISTINCTIVE OUTLINE OF THE STRUCTURAL MEMBERS. LENGTH: 200-800 FEET 60-240 METERS</p>	 <p><b>FINK</b> 1851 - MID-LATE 19TH CENTURY (RARE) VERTICALS IN COMPRESSION, DIAGONALS IN TENSION. LONGEST DIAGONALS RUN FROM END POSTS TO CENTER PANEL POINTS. LENGTH: 75-100 FEET 23-30 METERS</p>
 <p><b>WICHERT</b> 1730 - MID-LATE 20TH CENTURY IDENTIFIED BY A CHARACTERISTIC PIN-CONNECTED SUPPORT SYSTEM OVER THE PIERS. TRUSS IS CONTINUOUS OVER PIERS. LENGTH: 400-1000 FEET 122-305 METERS</p>	<h2>TRUSSES</h2> <p>A STUDY BY THE <b>HISTORIC AMERICAN ENGINEERING RECORD</b></p> <ul style="list-style-type: none"> <li>GOLLER, ALFRED P. PRACTICAL TREATISE... COOPER, THOMAS, AMERICAN RAILROAD BRIDGES... BRIDGES' ASSESSMENT, TRANSACTIONS NO. 44... BRIDGES, NEW YORK - JOHN WILEY &amp; SONS, INC., VOL. 21 (JULY 1887), 17-28.</li> <li>BONHAM, W.L. AND BUTLAND, WALS STRENGTH OF TRUSS BRIDGES, JOHN WILEY &amp; SONS, INC., NEW YORK, 1916.</li> <li>COMMITTEE ON HISTORY AND HERITAGE OF AMERICAN CIVIL ENGINEERING, BRIDGES AND TRUSSES, AMERICAN SOCIETY OF CIVIL ENGINEERS, NEW YORK, 1974.</li> <li>CONDIT, CARL W. AMERICAN BRIDGES, 1870-1910, NEW YORK: OXFORD UNIVERSITY PRESS, 1984.</li> <li>DEVELOPED BY: ALLAN COMP - DONALD C. JACKSON - ARNOLD DAVID - JAMES HENRY S. AND MEREDITH MANLY.</li> <li>FIELD A TEST BOOK ON BRIDGES AND BRIDGE PARTS, GERRARD SMITH, NEW YORK - JOHN WILEY &amp; SONS, INC., 1910.</li> <li>HENNING, JOHN, BRIDGES, JOHN WILEY &amp; SONS, INC., NEW YORK, 1910.</li> <li>HOWLAND, H. J. SPAN AND BRIDGES, NEW YORK: PRANG PUBLISHERS, 1910.</li> <li>JACOBS, HENRY S. AND MEREDITH MANLY, NEW YORK: JOHN WILEY &amp; SONS, INC., 1914.</li> <li>WADDELL, J.A.L. BRIDGE ENGINEERING, VOL. 1, NEW YORK: JOHN WILEY &amp; SONS, INC., 1914.</li> </ul>		 <p><b>STEARNS</b> 1890 - EARLY 20TH CENTURY SIMPLIFICATION OF FINK TRUSS WITH VERTICALS OMITTED AT ALTERNATE PANEL POINTS. LENGTH: 50-200 FEET 15-60 METERS</p>
<p>OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION TECHNICAL INFORMATION PROJECT UNDER DIRECTION OF THE NATIONAL PARK SERVICE UNITED STATES DEPARTMENT OF THE INTERIOR</p> <p><b>TRUSS IDENTIFICATION: BRIDGE TYPES</b></p> <p>IF REPRODUCED, PLEASE CREDIT: HISTORIC AMERICAN ENGINEERING RECORD, NATIONAL PARK SERVICE, NAME OF DELINEATOR, DATE OF THE DRAWING</p> <p>PRINTED BY THE NATIONAL SOCIETY OF ARCHITECTS ORIGINAL CHAPTER OF THE SOCIETY FOR INDUSTRIAL ARCHEOLOGY FROM THE NATIONAL MUSEUM OF HISTORY AND TECHNOLOGY, SMITHSONIAN INSTITUTION, WASHINGTON, D.C., 20540</p>			

The Baltimore and Ohio Railroad is one of the oldest and most innovative railroads in the United States. It was the first railroad to offer scheduled freight and passenger service to the public, the first to use an American locomotive and the first to cross the Allegheny Mountains in Pennsylvania.<sup>23</sup> The Baltimore and Ohio Railroad was considered America's first school of engineering having sponsored many experiments in motive power, track work, and bridge building.<sup>24</sup> Benjamin Latrobe II, son of the Greek Revival architect and assistant engineer at the Baltimore and Ohio Railroad, began to construct bridges with components fabricated from cast iron and wrought iron for their railroad lines around 1839. Latrobe's assistants, Albert Fink and Wendell Bollman, later patented their designs for railroad trusses. Wendell Bollman began designing bridges in 1840, when there were fewer than ten men in the country designing bridges by proven analytical methods.<sup>25</sup> Most bridge builders utilized intuitive design methods for railroad bridge building. In the mid-nineteenth century, the railroad's major need in truss construction was a design which involved a relatively small number of members substantial enough to withstand the growing vertical and lateral impacts of moving locomotives. Engineers needed to develop a form which could be erected most easily and which was a determinate structure, without any redundant members.<sup>26</sup> As a result, the stress distribution of the bridge required mathematical analysis.

Bollman's first example of his patented truss, built in 1850, was the first bridge in the world to utilize iron in all of its principal structural members used consistently on a

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<sup>23</sup> Martin D. Stevers, *Steel Rails: The Epic of the Railroads* (New York, NY: Minton, Balch and Company, 1933) 26.

<sup>24</sup> Robert M. Vogel, *The Engineering Contributions of Wendell Bollman* (Washington D.C: Smithsonian Institution, 1966) 210.

<sup>25</sup> *Ibid*, 56.

<sup>26</sup> Carl W. Condit, *American Building Art* (New York: Oxford University Press, 1960) 108.



railroad.<sup>27</sup> The Bollman Truss Railroad Bridge located in Savage, Maryland is designated a National Historic Civil Engineering Landmark. This bridge is one of the oldest standing iron railroad bridges in the United States.<sup>28</sup>

Early metal bridge builders were concerned with the fastest means of construction and designed for expansion rather than permanence. Expansion was the prime driver of bridge construction in the United States, more so than aesthetics, because of the vast amount of territory that needed to be spanned. Europeans, however, were more concerned about aesthetics during this time. Return of investment in American railroads depended on how quickly the railway could be extended during the early years of construction. Profits depended on the speed of bridge building among other railroad construction tasks.<sup>29</sup> There were technical defects embedded in the science of bridge construction that hindered their safety.

The Cleveland, Painesville, and Ashtabula Railroad challenged railroad safety standards in 1876 after experiencing the worst bridge disaster of the century.<sup>30</sup> The president of the Cleveland, Painesville, and Ashtabula Railroad, Amasa Stone, authorized the construction of the Ashtabula Railroad Bridge in 1865 and personally approved the design of the prototype. From 1865 until 1876, the bridge carried trains over the river. After a Lake Erie blizzard, an eleven car train with two locomotives crossed the Ashtabula Bridge in December, 1876. When the pilot truck of the first engine reached

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<sup>27</sup> Eric DeLony, ed, "1869 Bollman Bridge at Savage (MD) Restored by County" *Historic Bridge Bulletin Society for Industrial Archeology, No.1* (1984) 2.

<sup>28</sup> *Ibid*, 1.

<sup>29</sup> Albert Churella, *The Pennsylvania Railroad Volume 1: Building an Empire 1846-1917* (Philadelphia: University of Pennsylvania Press, 2012) 61-62.

<sup>30</sup> Condit, *American Building Art*, 108.

the west abutment, the leading engineer felt the bridge sink under him.<sup>31</sup> He sped up and got the engine across, but behind him the entire structure of the bridge collapsed carrying the second locomotive, two tenders, and several cars with it.<sup>32</sup> This disaster resulted in the death of ninety two people. An investigation revealed that the bridge iron itself was defective and that the bridge subjected to heavy snow and wind loads, even before the train's added weight, could not handle the extra stress.

The Ashtabula Bridge accident put into motion a program for adequate bridge design that included: comprehensive scientific investigation of all the variables of bridge design; mill and construction worker training and supervision with inspection of their work; and metallurgical analysis and weather condition site analysis. The Ashtabula Bridge accident lead to significant improvements in bridge construction and an acute awareness of safety issues that changed the course of building practices around the world. It was not, however, until the Interstate Commerce Commission passed the Transportation Act in 1920, that railroad safety became federally regulated.<sup>33</sup>

### *Bridge Companies*

Bridge companies developed because of the expanding needs of the railroads. Railroads did not own bridge companies; however, bridge companies did rely on the railroads for a significant amount of their business. For example, the Keystone Bridge Company relied heavily on the Pennsylvania Railroad for investors and consumers.<sup>34</sup> Andrew Carnegie was an important member of the bridge company enterprise due to his position as Vice President and Partner in the Keystone Bridge Company. The Keystone

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<sup>31</sup> Ibid,108.

<sup>32</sup> Ibid,114.

<sup>33</sup> Cynthia Clark Northrup, *The American Economy: A Historical Encyclopedia* (Washington D.C: Library of Congress, 2003) 157.

<sup>34</sup> Joseph Frasier Wall, *Andrew Carnegie* (New York: Oxford University Press, 1970) 307.

Bridge Company was one of two main types of companies involved in production of long-span railroad bridges following the Civil War: the bridge-financing corporation and the bridge building type; some conducted the business of both.<sup>35</sup> The bridge financing corporation's function was to bring together capital, real-estate, labor, and political power to create a functional engineered structure to railroad companies.<sup>36</sup> They secured financing, contracted out the work of construction to specialized bridge-building companies, and then maintained and operated the completed structure as a toll bridge, charging railroads for its use. The Keystone Bridge Company was a company that could finance and build a bridge. During and after the Civil War, from about 1860 to 1870, some bridge engineers began to leave the railroads and form their own companies, contracting to build bridges either directly for the railroads, or for bridge financing firms. They tended to specialize in the manufacture and production of a certain type of bridge that was the patent design of the engineer who formed the company.

Andrew Carnegie, along with Pennsylvania Railroad executives and engineers including J. Edgar Thomson, Thomas Scott, John Piper, Adam Shiffler and Jacob Linville became partners and formed the Keystone Bridge Company in 1862.<sup>37</sup> Carnegie named Keystone Bridge Company after his adopted state of Pennsylvania and advertised its services for building steel, wrought iron, wooden railway and road bridges in 1890.<sup>38</sup> Additionally, it held a patent for wrought iron bridges and also supplied wrought iron columns for buildings.

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<sup>35</sup> Melville Wells, *Steel Bridge Designing*. (Chicago: The Myron C. Clark Publishing Company, 1913) 1-14.

<sup>36</sup> Wall, *Carnegie*, 317.

<sup>37</sup> *Ibid*, 318.

<sup>38</sup> *Ibid*, 317.

Each company had its own territory, or lines of railroad, giving it preference to a particular geographical region. For example, the early Keystone Bridge Company was based in Pittsburgh. The company utilized mostly the Whipple truss. The Berlin Iron Bridge Company of Berlin, Connecticut specialized in the lenticular truss.<sup>39</sup> Bridge companies were equipped to execute a complete construction job. They contracted to build both the substructure and the superstructure.

### *Proliferation of Railroads and Steel*

With the completion of the Eads Bridge in 1874, America saw the first use of steel as a structural component of a bridge. At the time, a railroad bridge crossing the Mississippi River was an extremely profitable endeavor. James Buchanan Eads, an American entrepreneur and former army engineer, obtained financing and created the final design for the bridge. Eads and his associates actively sought advice and assistance from entrepreneurs knowledgeable in railroad financing and operation. After forming the St. Louis and Illinois Bridge Company, Eads and his partners met with J. Edgar Thompson and Thomas Scott of the Pennsylvania Railroad.<sup>40</sup> Thompson and Scott connected Eads with Andrew Carnegie and the Keystone Bridge Company. Carnegie became an investor in the St. Louis and Illinois Bridge Company. The St. Louis and Illinois Bridge Company contracted Keystone Bridge Company to build the bridge superstructure.

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<sup>39</sup> Keystone Bridge Company, *Descriptive catalogue of wrought-iron bridges, fire-proof columns and floor girders, wrought-iron roof trusses, wrought-iron turn tables, pivot bridges, park bridges, suspension bridges, columns, links, and bridge bolts, manufactured by the Keystone Bridge Company.* (Philadelphia: Allen, Lane and Scott, 1874) 3.

<sup>40</sup>Jackson, *Rails Across the Mississippi*, 108.

Construction of the superstructure began in 1873 utilizing chrome steel, an alloy of chromium with steel, for the bridge's tubular arch ribs.<sup>41</sup> Chrome steel is made with a larger amount of carbon and is corrosion-resistant. Eads developed a steel arch using four pairs of steel tubes for each of the three spans with the lower and upper tubes of each pair tied together in a truss-like form using wrought iron bracings supplied by the Keystone Bridge Company.<sup>42</sup> Eads insisted on employing steel members for certain sections of bridge fabrication, which was an extremely time consuming and costly endeavor. Eads had experience working with steel while fabricating armor plated gun boats in the army during the Civil War.<sup>43</sup> Eads argued for the use of steel for major bolts of the piers and the staves that made up the tubes to support the superstructure. It was both time consuming and costly for Carnegie and his business partners to supply steel for bridge members. Wall states in his biography of Andrew Carnegie, "The steel parts that met his (Eads) exacting specifications were finally obtained, and the general agreement among professional engineers throughout the country that Eads had been right in his insistence upon steel may well have been a major factor in convincing Carnegie at this time that the Age of Steel was close at hand and could not be denied."<sup>44</sup> Steel was not readily available and often expensive in large quantities in 1874, when the Eads Bridge was completed.

Production of rails in the early years of the railroad persistently challenged the capabilities of the American iron and steel industries. Railroad expansion initiated a market in the United States for large amounts of affordable and durable steel rails, which

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<sup>41</sup> Wall, *Carnegie*, 275.

<sup>42</sup> Jackson, *Rails Across the Mississippi*, 70.

<sup>43</sup> *Ibid*, 65.

<sup>44</sup> Wall, *Carnegie*, 275.

propelled mass production of steel.<sup>45</sup> Railroads not only provided the essential means of transporting ore and coal from remote locations to the mills, they offered much of the capital for the iron and steel industry and generated enormous demands for finished products.<sup>46</sup> Andrew Carnegie opened the Edgar Thomson Steel Works in Braddock, Pennsylvania, in 1875 and became largely successful because the railroad linked the product directly with raw materials necessary to produce steel.<sup>47</sup> Carnegie's goal was to improve efficiency by making supplies more reliable, controlling the quality of the product at all stages of production, and eliminating middlemen fees.<sup>48</sup> This meant that often the infrastructure of the mill was organized around the railroad. An internal railroad linked stages of production including hauling molten iron.

The rolling of structural steel for general use began around 1884; however, the metal chosen for bridge construction mostly depended on the material available in the bridge company stockyard or readily available from another source.<sup>49</sup> The first American bridge in which steel was used exclusively was the Glasgow Railroad Bridge over the Missouri River on the Chicago and Alton Railroad line in 1879.<sup>50</sup> General Sooy Smith, an engineer from Ohio, was chosen by committee to design the bridge. While attending a meeting for the American Society of Civil Engineers in Chicago, Smith learned about

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<sup>45</sup> "Steel and Iron Rails" *The Railroad Gazette* 8 no. 17 (1876) 1.

<sup>46</sup> Thomas J. Misa, *A Nation of Steel: The Making of Modern America 1865-1925* (Baltimore: The Johns Hopkins University Press, 1995) 34.

<sup>47</sup> Theodore Dreiser, *The Carnegie Works at Pittsburgh* (Printed at Chelsea, New York for private distribution:1929) 15.

<sup>48</sup> Jonathan Rees, *Industrialization and the Transformation of American Life*. (New York: M.E. Sharpe, Inc., 2013), 6-7.

<sup>49</sup> James Cooper, *Iron Monuments to Distant Prosperity, 1870-1930* (Indianapolis, Indiana: Pierson, 1987) 74.

<sup>50</sup> Waddell, *Bridge Engineering*, 28.

difficulties associated with iron bridge construction.<sup>51</sup> Iron bridges usually had a short life span and were highly susceptible to defects.<sup>52</sup> At that meeting, Smith was appointed, along with a group of military engineers to test the qualities of various metals for bridge building. A steel scientist, A.T. Hay joined the committee. Hay successfully tested steel alloys with tensile strengths varying from 70,000 to 90,000 pounds per square inch, and with elastic limits between 48,000 and 90,000 pounds.<sup>53</sup> Hay used an electric furnace for fusing ores. General Smith recommended to the committee that the Glasgow Bridge be built utilizing Hay Steel and received approval. Hay supervised the production of eight hundred tons of Hay steel for bridge construction at the Edgar Thompson Steel Works. Work on the foundations and piers began in 1878 and the Chicago and Alton Railroad Company completed the construction of the bridge in 1879. The bridge had no problems over its twenty years in service until it was replaced in 1899 by the present structure designed to carry heavier loads.

Development of the structural steel industry was slow and wrought iron remained the almost universal bridge metal until 1880.<sup>54</sup> Advances in steel making, specifically blast furnace technology ushered in this change when open hearth steel supplanted wrought iron almost entirely in bridge building due to successful mass production and increased technology.<sup>55</sup> The development of the open-hearth furnace brought about a transition in steelmaking from the Bessemer converter to the open-hearth furnace as the

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<sup>51</sup> H.B Voorhees, "The Alton Railroad Bridge at Glasgow, Missouri 1879" (New York: Newcomen Society, August 5, 1939) 9.

<sup>52</sup> Ibid, 12.

<sup>53</sup> Ibid, 14.

<sup>54</sup> Emory L. Kemp and Jet Lowe, "The Fabric of Historic Bridges" *IA: The Journal for the Society of Industrial Archeology Vol.5. No.1* (Summer 1984) 11-12.

<sup>55</sup> Misa, *A Nation of Steel*, 27.

principal means of melting steel. For several years, however, many mills used both technologies.

In 1888, the first commercial open-hearth steel furnace was tapped at the Pittsburgh Homestead Works. The basic reasons for the shift from the Bessemer converter to the open hearth were: the type of iron ore which was found in the United States had an undesirably high amount of phosphorus, the high phosphorus ore made the open hearth furnace with basic refractory lining necessary; scrap metal could be used in the open hearth furnace while scrap metal could not be used in the Bessemer at all; greater uniformity and more exact specifications are available with open hearth steel as opposed to Bessemer steel.<sup>56</sup>

The use of cast iron in railroad bridge construction ended about 1870. The production of steel increased steadily. By 1890, bridge structural shapes such as angles, I-beams, channels, Z-bars and corrugated plates were the same price as wrought iron. By 1895, the use of steel for bridge building was almost universal and large scale production making wrought iron obsolete.

One of the most outstanding industrial heritage resources that illustrates the connection between steel, railroads and innovative bridge construction is the creation of a hot metal bridge. A hot metal bridge is a heavy load bearing bridge built for the transport of molten iron across a significant body of water to steel-making facilities on the opposite bank.<sup>57</sup> Hot metal bridges were designed for specific landscapes. They were built in areas where vast rivers once served to haul raw materials from the mines to the mills.

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<sup>56</sup> William T. Hogan, S. J., *Economic History of the Iron and Steel Industry in the United States Volume 2: Part III* (Lexington, Massachusetts: Heath and Company, 1971) 403.

<sup>57</sup> Ron Baraff, Rivers of Steel (Personal Interview, February 25, 2014) pertaining to history and future of Rankin Hot Metal Bridge.



Iron and steel making facilities were built up on opposite sides of rivers because of the convenience of shipping. Railroads further streamlined the steel-making process when hot metal bridges were invented to safely, quickly and efficiently transport hot metal and connect the mill process.

Typically, a hot metal bridge connected the “hot end” to the “cold end” of the mill complex. The “hot end” of the mill includes the blast furnaces, gas stoves, casting houses, and raw materials pit, the “cold end” usually includes rolling mills and fabricating shops. The rails are guarded on either side by steel plates that are 3/8 inches in thickness and 4 feet high.<sup>58</sup> The plates are clamped to the tracks, lined with refractory brick and covered in sand. The bridge is built with a slight elevation change so that if the car stops unexpectedly, the train will roll back to its original destination. The hot metal design ensures that molten metal does not touch the fabric of the bridge or drip into the river below. If the molten metal did leak through, the pressure from the heat could harm the bridge or cause an explosion.

Hot metal bridges own a specific place in industrial history, distinguished more by purpose than by design. The landscape of industrial river valleys such as the Pennsylvania and Ohio River Valleys, dictated a need to connect two important operations of the steel making process by a uniquely designed bridge. They were innovatively constructed during a time when long span railroad bridges were beginning to be constructed. An important case study that illustrates the changing significance and contribution of these bridges is Hot Metal Bridge on the South Side of Pittsburgh.

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<sup>58</sup> Carnegie Steel Company, Ltd., “Keystone Bridge Works Monongahela River Bridge at Rankin” American Bridge Company Blueprints: March, 1900 Sheet 1 of 4 (Pittsburgh: Rivers of Steel Archive) 1.

## CHAPTER TWO: SOUTH SIDE HOT METAL BRIDGE

The Hot Metal Bridge crosses the Monongahela River just about four miles up-river from downtown Pittsburgh. Two corresponding spans are perched on a solitary set of stone piers. One span is on the upstream side and it was formerly named the Monongahela Connecting Railroad Bridge built in 1900. The other span is on the downstream side and is the former Hot Metal Bridge built in 1904.<sup>1</sup> Because the bridges share piers and have similar truss designs, the pair is usually referred to as The Hot Metal Bridge. The bridge is a Pennsylvania thru-truss with the length of the main span stretching about 321 feet and the height of the deck is about 50 feet.<sup>2</sup> The structure is pin connected with lattice bracing. The vertical posts contain riveted connections. The Monongahela Connecting Railroad Bridge carried standard railway traffic and connected Eliza Furnace to the Jones and Laughlin Works on the South Side. It is not listed on the National Register of Historic Places, but it was designated as a city landmark by the Pittsburgh History and Landmarks Foundation.

The completed rehabilitation of the Hot Metal Bridge in 2007 from a railroad bridge to a vehicular bridge is a victory for the city of Pittsburgh. It is perhaps the most evident in the microcosm that is the South Side Works area of Pittsburgh, with the Hot Metal Bridge as its most palpable talisman. The Hot Metal Bridge located in the South Side district of Pittsburgh, Pennsylvania, is at first glance, a simple industrial truss bridge leftover from Pittsburgh's former "Steel Town" glory. At a closer second look, the Hot

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<sup>1</sup> Richard McCombs, "Monongahela Connecting Railroad Company" Historic American Engineering Record HAER No. PA-277 (Washington, D.C: National Park Service, 1993) 7.

<sup>2</sup> John Coyne, Senior Director Engineering GAI Consultants (Personal Interview February 2014) pertaining to rehabilitation of the Hot Metal Bridge.

Metal Bridge is an example and reminder of what the City of Pittsburgh has achieved in its renaissance over the last 15 years.



**Figure 2-1:** Jones and Laughlin circa 1957. A small section of the Hot Metal Bridge is located directly to the right.

*Courtesy of the Historical Society of Western Pennsylvania*

### *History*

In 1850, Benjamin Jones launched the American Iron Works positioned on the south bank of the Monongahela River.<sup>3</sup> At this time, practically no pig iron was produced in Pittsburgh. Like Andrew Carnegie, Jones began his career in the Pennsylvania Railroad and saw the promise of the iron business early on. An Irish banker, James Laughlin, purchased a significant piece of the business and was made a partner. Jones & Laughlin purchased the Falcon Furnace in Youngstown, Ohio and eventually built the Eliza blast furnaces on the north shore in 1860.<sup>4</sup> A river ferry connected the blast furnaces with the south side mills and transported cold pig iron rather than molten iron.

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<sup>3</sup> John Ingham, *Biographical Dictionary of American Business Leaders Volume 2*. (Washington, D.C: Library of Congress, 1983) 679.

<sup>4</sup> *Ibid*, 679.

The Monongahela Connecting Railroad was chartered with the Interstate Commerce Commission as a common carrier in 1887.<sup>5</sup> It was a subsidiary of Jones and Laughlin, Ltd, later Jones and Laughlin Steel Corporation. The Historic American Engineering Record states that the Monongahela Connecting Railroad Company provided for transportation of inbound raw materials, in-plant service for the production of steel, and the outbound shipment of semi-finished steel products to connecting carriers.<sup>6</sup> The bridge connected the two banks of the outfit in 1887.<sup>7</sup> The upstream side held two tracks for the Monongahela Connecting Railroad (Mon Con). The downstream side had only one track used to transport hot metal back and forth from the furnaces to the Bessemer Steel Plant and rolling mills. The Pittsburgh and Lake Erie Railroad Company linked to the Mon Con network to carry the product to clients.<sup>8</sup> Although many sources list the engineer and architect for the Eliza furnaces and the bridge as “unknown,” William Glyde Wilkins is likely the designer of this bridge. Wilkins was an architect and engineer for the Pennsylvania Railroad early in his career.<sup>9</sup> He later owned his own firm which was known to design and construct industrial railways in the Pittsburgh region.

The Mon Con’s business began to decline with the steel business in the 1970’s. LTV Corporation purchased J&L and merged it with Youngstown Sheet and Tube and Republic Steel.<sup>10</sup> LTV eventually closed, leaving 130 acres demolished.

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<sup>5</sup> McCombs, “Monongahela Connecting Railroad Company”, 6.

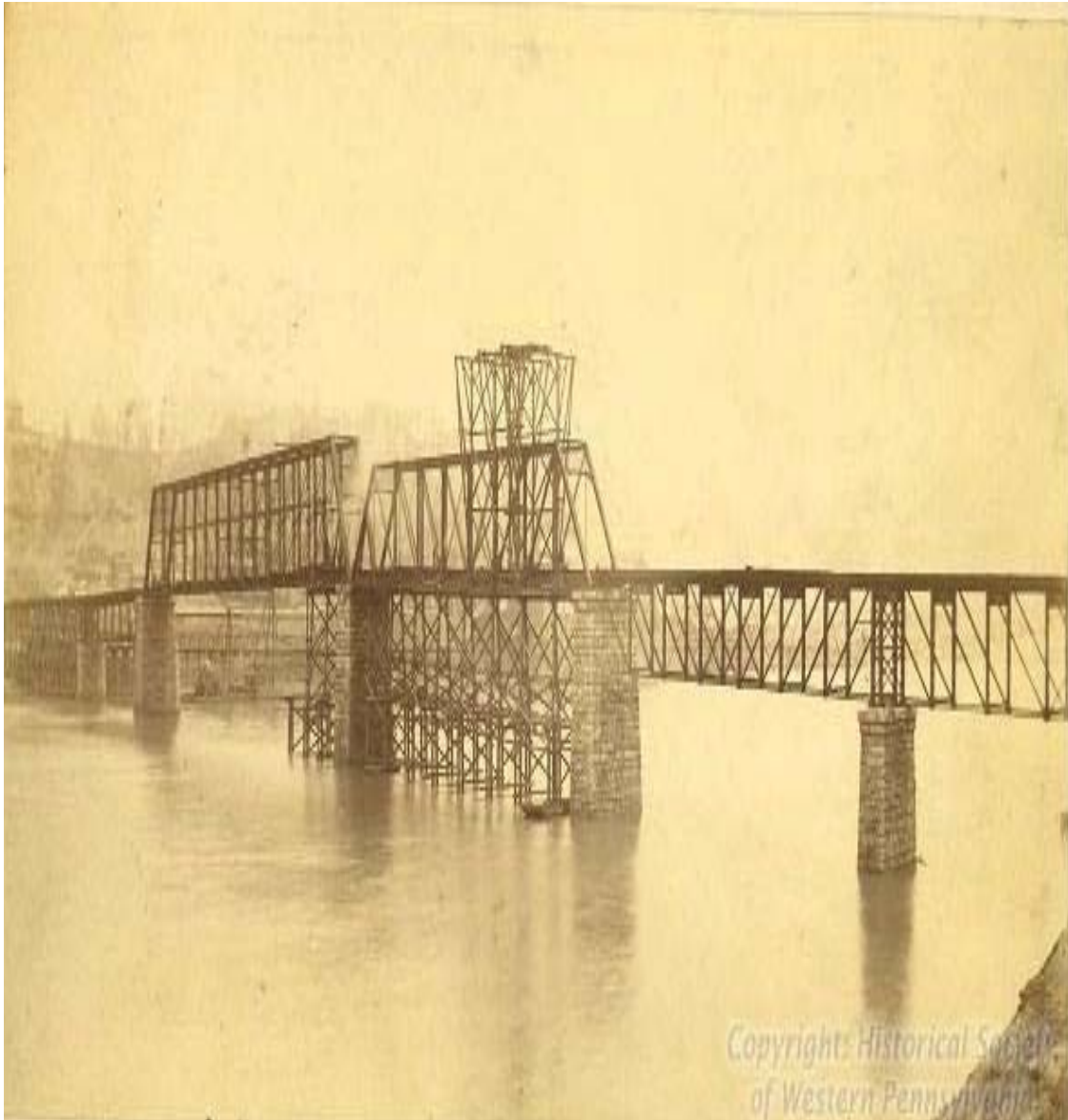
<sup>6</sup> Ibid, 8.

<sup>7</sup> David A. Charters, “Rehabilitation of the Monongahela Connecting Railroad Bridge” *Bridge Management Four: Inspection, Maintenance, Assessment and Repair* (London: Thomas Telford Publishing, 2000) 295-300.

<sup>8</sup> McCombs, “Monongahela Connecting Railroad Company”, 11.

<sup>9</sup> Vernon Sullivan, “Memoir of William Glyde Wilkins” *Transactions of the American Society for Civil Engineers* 85 (1922) 1744.

<sup>10</sup> David H. Wollman and Donald R. Inman, *Portraits in Steel: An Illustrated History of Jones and Laughlin Steel Corporation* (Kent, Ohio: The Kent State University Press, 1990) 179.



**Figure 2-2:** Erecting the Monongahela Connecting Railroad Bridge over the Monongahela River.  
*Courtesy of the Historical Society of Western Pennsylvania*

The Urban Redevelopment Authority of Pittsburgh (URA) developed the north side of the river near the bridge into a technology office park. In the early 1990s, the URA purchased LTV's steel mill property on the south side of the river near the bridge to be developed into a multi-use commercial residential and retail property. This required a

bridge to connect the two new developments. Rehabilitation of the Monongahela Connecting Railroad Bridge proved to be the best solution both economically and aesthetically. By retaining the existing bridge, the community maintained a remnant from their past. A feasibility study conducted by the Redevelopment Authority of Allegheny County confirmed the economic advantage of rehabilitating the bridge.

### *Feasibility Study*

The Urban Redevelopment Authority (URA) initiated a feasibility study on the Monongahela Connecting Railroad Bridge in 1997 and early 1998, while negotiations were ongoing between the URA and LTV Steel regarding the acquisition of the bridge and the South Side property.<sup>11</sup> Engineers from Parson Brinckerhoff (PB) had to factor into their analysis the dead loads of the utilities that LTV had not yet removed such as utility infrastructure including electric, gas and water lines. This complicated the engineers' understanding of the dead loads that would be on the bridge during rehabilitation. So as not to delay the critical analysis and designs for rehabilitation, the URA decided to analyze the bridge by factoring in the existing dead loads from the utilities.

The analysis confirmed that even with some deteriorated members, the superstructure has sufficient capacity to support a new concrete deck and vehicular loads. Based on an analysis, the bridge was deemed in adequate condition for rehabilitation, though significant updates were required. The paint contained asbestos, cadmium, chromium, and lead that was flaking and peeling. A number of I-bars were bent from train derailments and collisions, and some of the members had sustained moderate

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<sup>11</sup>*Draft Report of the Feasibility Study for the Monongahela Connecting Railroad Bridge Rehabilitation* Pittsburgh, PA: Parsons, Brinkerhoff, Quade, and Douglas, Inc., 1998) 1.

corrosion and rust. The most significant aspect of the rehabilitation process was the replacement of the end floor beams. PB found the end floor beams in very poor condition because they were the original bridge members.<sup>12</sup>

The URA conducted another study in 2001 to convert the Hot Metal Bridge. The intention was to renovate the bridge to provide a suitable 14-foot wide pedestrian/bikeway connection across the river and Second Avenue. New ramps were constructed at the ends of the bridges, including a switchback concrete ramp to connect to street level on the south end and a new bridge over Second Avenue to connect to the Eliza Furnace Trail on the north end.<sup>13</sup> The Eliza Trail, also known as the Eliza Furnace Trail, was named after the Eliza Blast Furnaces that once occupied part of the site on the trail. The trail is a paved, two-directional, off-road, multi-use path that follows the former Baltimore & Ohio railroad tracks east of downtown Pittsburgh. The Allegheny Trail Coalition petitioned a trail connecting ramp. Analysis of the connection of the Hot Metal Bridge to the Eliza Trail included parameters such as access, safety, travel time, convenience and cost.

### *Rehabilitation*

The engineers and designers of the Monongahela Connecting Railroad Bridge and the Hot Metal Bridge set out to retain as much of the bridge's historic fabric, look and feel as they possibly could. Since the bridge is of historic significance, the rehabilitation techniques and details had to comply with the requirements of the Pennsylvania Historical and Museum Commission.

The rehabilitation of the Hot Metal Bridge included the addition of a new concrete deck for vehicles and pedestrians. The concrete deck required that the hot metal

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<sup>12</sup> Ibid, 9.

<sup>13</sup> *Draft Report of the Feasibility Study for the Eliza Trail Connection to the Hot Metal Bridge* (Pittsburgh, PA: Parsons, Brinkerhoff, Quade, and Douglas, Inc., 2001) 5.

pan be removed. The weight of the pans along with the superstructure attachments made it unfeasible. The Bureau for Historic Preservation required mitigation for the loss, which included recordation in the form of written analysis and photography. Instead of fitting the bridge with simple neon lights, the design included decorative lamps that appear as though they were originally part of the bridge. Over the cross walk, ornamental railings were added that also look original. The materials and design of the walkway are compatible with the architectural features maintaining the historic integrity of the bridge.

The life of railroad bridges differs from vehicular bridges because railroad bridges are not subject to regular chemical treatments, such as de-icing which accelerates corrosion. However, the Hot Metal Bridge required that the superstructure be protected to mitigate against future rust and corrosion by adding an effective drainage system. Additionally, because the bridge carried very heavy loads the engineers were not required to upsize the bridge.

The Hot Metal Bridge project received three industry awards in 2008 including: The American Society of Civil Engineers' Civil Engineering Achievement Award (ASCE); The American Council of Engineering Companies of Pennsylvania's Diamond Award (ACEC); and The American Society of Highway Engineers' Outstanding Highway Engineering Project for Category A (less than \$15 million.)<sup>14</sup> ASCE's Honors and Awards program recognizes the commendable achievements and remarkable accomplishments of the civil engineering profession. The program distinguishes the unique contributions that engineers make to both industry and society.<sup>15</sup> The ACEC

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<sup>14</sup> Trumbull Construction Management Services (TCMS), "Hot Metal Bridge Pedestrian and Bicycle Trail, Pittsburgh, PA" *Urban Redevelopment Authority* (2007) 1.

<sup>15</sup>"American Society of Civil Engineers" <[www.asce.org/leadership-management/awards/](http://www.asce.org/leadership-management/awards/)> (accessed April 17, 2004)



Pennsylvania is devoted to the promotion and enhancement of the business interests of the consulting engineering industry of Pennsylvania. The Hot Metal Bridge received the ACEC Pennsylvania's most prestigious award, the Diamond Award.<sup>16</sup> Finally, the American Society of Highway Engineers' Outstanding Highway Engineering Project (ASHE) is a highway industry networking organization. Their mission is to provide a forum for members and partners of the highway industry and to promote safe, efficient, and sustainable highway systems through education, innovation and fellowship. The Hot Metal Bridge received their outstanding highway engineering project award for Category A for projects totaling under 15 million dollars.<sup>17</sup>

The rehabilitation of the Hot Metal Bridge created a vital transportation link between 2nd Avenue near South Oakland and 29<sup>th</sup> Street on the South Side of Pittsburgh. The URA converted the upstream span to vehicular use in 2000. The downstream span reopened for pedestrian and bicycle use in late 2007. The rehabilitation of the Hot Metal Bridge was a central force in the creation of the South Side Works providing not only access to the South Side location, but also a sense of history and meaning to that area.

The project required a total of \$9.2 million.<sup>18</sup> The Pittsburgh History and Landmarks Foundation along with other local advocates argued that economically, it was more cost effective to rehabilitate the bridge rather than replace it. A feasibility study made it clear that the cost of demolishing and building a brand new bridge would cost more than rehabilitating the extant Hot Metal Bridge. Public funding sources included;

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<sup>16</sup> "American Council of Engineering Companies of Pennsylvania (ACEC)" <[www.google.com/#q=The+American+Council+Engineering+Companies+of+Pennsylvania](http://www.google.com/#q=The+American+Council+Engineering+Companies+of+Pennsylvania)>(accessed April 17,2004)

<sup>17</sup> "The American Society of Highway Engineers, (ASHE)" <[www.ashe.pro](http://www.ashe.pro)> (accessed April 17, 2014)

<sup>18</sup> Trumbull Construction Management Services (TCMS), "Hot Metal Bridge Pedestrian and Bicycle Trail," 1.

the City of Pittsburgh, U.S. Fish and Boat Commission, HUD Brownfield's Economic Development Initiative, Allegheny County, Pittsburgh Water and Sewer Authority, Urban Redevelopment Authority of Pittsburgh and other private funding sources.



**Figure 2-3:** Vehicular and pedestrian spans of the South Side Hot Metal Bridge.  
*Courtesy of the Urban Redevelopment Authority of Allegheny County*

*Positive Outcome*

The rehabilitation of this 125-year-old bridge symbolically captures Pittsburgh's economic revival built to support the once flourishing steel industry; it will now support our burgeoning knowledge-based economy by linking critical places of economic development to social, research and medical centers.

–Mayor Luke Ravenstahl<sup>19</sup>

The rehabilitation of the Monongahela Connecting Railroad Bridge aided in the development of the South Side Works. The bridge rehabilitation occurred in 2000 and the South Side Works was completed in 2004. The bridge has since served as the main artery in connecting communities from the North Shore and the Technology Park to the South Side. The Hot Metal Bridge connects onto Bates Street as the link to Route 22 to the Eastern Suburbs.

The South Side Works complex mimics the look and feel of the time period of the bridge. The most important principles guiding the resulting design of the South Side Works was the use of building materials that complimented the bridge such as brick and steel. The height of the buildings cannot exceed 10 stories. Community input ensured that the new buildings imitate an existing urban setting by building flush to the sidewalks.

The South Side Works includes the University of Pittsburgh McGowan Institute for Regenerative Medicine, The University of Pittsburgh Medical Center Orthopedic Clinic, the UPMC Sports Training Facility where the Pittsburgh Steelers and Pittsburgh Penguins train and the corporate headquarters for American Eagle Outfitters.<sup>20</sup> Directly across the Hot Metal Bridge is the University of Pittsburgh main campus and the

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<sup>19</sup> Lawrence Walsh, “Put the Pedal to the Hot Metal” *Pittsburgh Post-Gazette* (November 29, 2007) <<http://www.post-gazette.com/local/neighborhoods/2007/11/29/Put-the-pedal-to-the-Hot-Metal-Bridge-across-Mon-opens-at-last/stories/200711290281>>(accessed February 2014).

<sup>20</sup> *Ibid*, 4.

Pittsburgh Technology Center where the Eliza Furnaces once stood. There are many more examples of thriving commerce, creativity, revolutionary research, and quality of life in this impressive piece of Pittsburgh real-estate that is the South Side Works. The industrial heritage significance of the rehabilitation of the Hot Metal Bridge is that the community recognized the inherent history connected to the bridge and built the South Side Works with that history in mind. Various South Side groups were involved in the LTV site since the early 1990s. The Southside Local Development Company was one of these groups. The South Side Local Development Company is a non-profit community development organization with the goal to preserve and develop the South Side. This group in conjunction with the Urban Redevelopment Authority, led in the acquisition of the land and its redevelopment. The URA provided major funding for the development of the South Side. Additionally, Pittsburgh Water and Sewer Authority, the State of Pennsylvania, and Housing and Urban Development (HUD) in partnership with private donors also provided funding.<sup>21</sup>

With economic activity comes jobs and the jobs in the South Side Works are held by neighborhood residents. Employees walk to work over the Hot Metal Bridge and both the bridge and the South Side Works are important to the neighborhood. Employment generated by initial development of the South Side Works amounted to approximately 5,400 jobs.<sup>22</sup> The rehabilitation of the bridge for connection into the South Side Works has made a large economic impact for surrounding residential neighborhoods. Residential sales prices in adjacent neighborhoods have increased between 160% and

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<sup>21</sup> Ibid, 4.

<sup>22</sup> Ibid, 5.

225% from 2000-2007.<sup>23</sup> In addition to job creation and economic stimulus, re-development of the South Side allowed for public access to the riverfront. This access to the riverfront paved the way for riverfront trails and tourism.

Another bridge just down river from the Hot Metal Bridge on the Monongahela River is in the midst of the process for rehabilitation, The Union Rankin Railroad Hot Metal Bridge #35.

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<sup>23</sup> Ibid, 5.

**CHAPTER THREE: UNION RAILROAD RANKIN HOT METAL BRIDGE #35**



**Figure 3-1:** Hot metal track of the Union Railroad Rankin Hot Metal Bridge #35  
*Courtesy of the Redevelopment Authority of Allegheny County*

## *History*

The Union Railroad Rankin Hot Metal Bridge #35, also known as the Carrie Furnace Bridge efficiently integrated Carrie's iron making blast furnaces and Homestead Works steel plant on opposite sides of the Monongahela River in Rankin, Pennsylvania. The Carrie Furnaces located on the north bank of the Monongahela River produced pig iron. The Homestead Works across the Monongahela River was Carrie Furnace's main customer. Andrew Carnegie purchased the Homestead Works in 1883.<sup>1</sup> Shortly after the Homestead Works began using hot metal to charge its open hearth furnace rather than cold pig iron, Carnegie purchased Carrie Furnace with the idea of supplying the Homestead Works with the pig iron being produced there. At the time of purchase, Carrie Furnace produced 18,000 tons of pig iron a month.<sup>2</sup>

Completed in 1901, the bridge was designed by W.H. Smith, chief engineer of the Union Railroad and built by the Keystone Bridge Company.<sup>3</sup> The bridge was built in conjunction with Carnegie Steel's expansion of the Carrie Furnaces and contains two railway lines and a sidewalk. On the upstream side, a standard gauge rail line was built to integrate with the Baltimore and Ohio Railroad to transport ore and other raw materials to the blast furnaces at Carrie Furnace.<sup>4</sup> The other side of the bridge is the hot metal transport line for the Union Railroad between Carrie Furnace and the Homestead Works. Constructed with extremely heavy structural members, the Union Railroad Ranking Hot Metal Bridge #35 was the heaviest span ever built at the time. The bridge weighs

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<sup>1</sup> Joseph Frasier Wall, *Andrew Carnegie* ( New York: Oxford University Press, 1970) 537-547.

<sup>2</sup> Michael G. Bennett, *National Register of Historic Places Registration Form: Carrie Blast Furnaces 6 and 7* (Washington, D.C.: National Park Service, 2000) 7.

<sup>3</sup>“A Bridge For Carrying Molten Iron,” *The Engineering and Mining Journal* 34(November 10, 1900) 517.

<sup>4</sup> Gray Fitzsimons, ed. *Historic American Engineering Record U.S. Steel Homestead Works HAER No. PA-200*. (Washington D.C.: National Park Service, 1990) 3.

approximately 9,000 tons.<sup>5</sup> The Sixteenth Street Bridge, built around the same time across the Allegheny River, was also a thru-truss but weighs only 5,200 tons.<sup>6</sup> The design of the main span is a Pennsylvania (or Petit) thru-truss and the smaller span is a Baltimore thru-truss with open-tie and plate-floor designs. The Pennsylvania thru-truss is pin-connected (rather than using rivets) and is 496 feet in length.<sup>7</sup> The Baltimore thru-truss span is also pin connected and is 248 feet in length.<sup>8</sup> Both thru-truss designs contain diagonal members in tension and vertical members in compression with a polygonal top chord. Each vertical and diagonal post contains lattice bracing.

The original purpose of the Carrie Furnace Bridge was to haul molten iron from the Carrie Furnaces at the Homestead Mills and secondarily to give the Union Railroad a right of way to the Carrie Furnaces.<sup>9</sup> Prior to building the bridge, ore and other materials used at these furnaces came by way of the Baltimore and Ohio (B&O) and the Pennsylvania Railroads, also on the opposite banks of the river. The Carrie Furnace Bridge carried trains and ladle cars. Each train was made up of a steam locomotive and two ladles each weighing 87 tons and carrying 90 tons of metal, and a caboose.<sup>10</sup>

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<sup>5</sup> "Hot Metal from Rankin to Homestead" *The Iron Trade Review* 33 (October 25, 1900) 33-34.

<sup>6</sup> *Ibid*, 34.

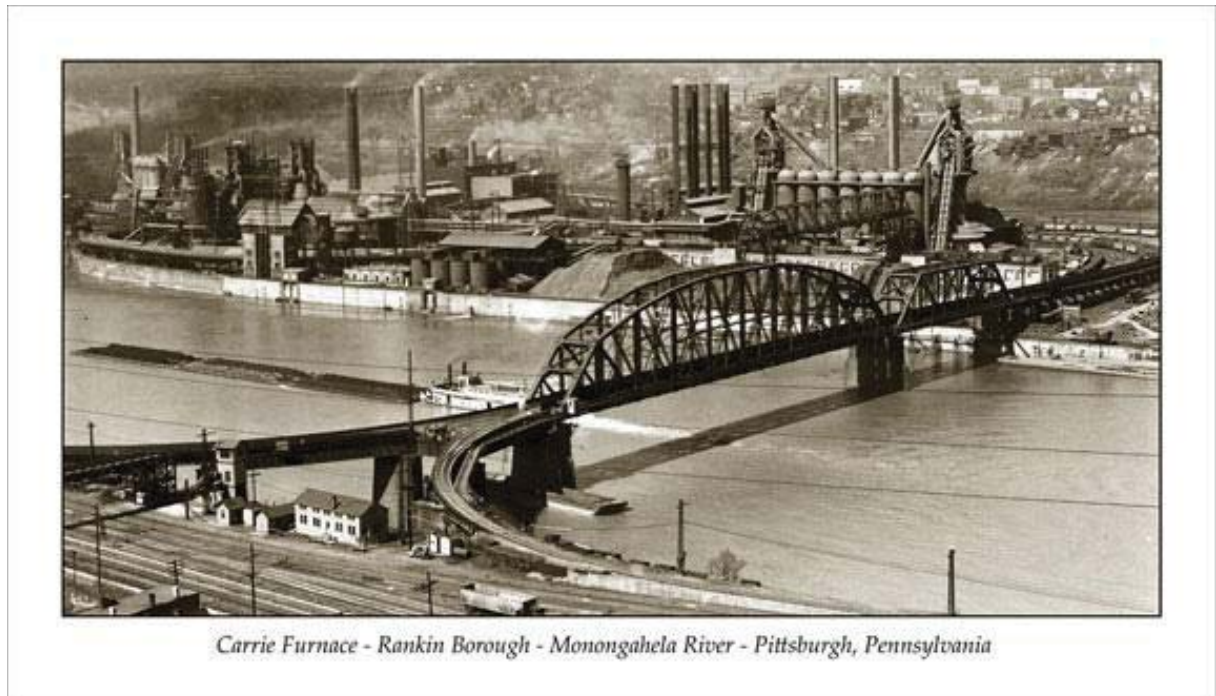
<sup>7</sup> Carnegie Steel Company, Ltd, "Keystone Bridge Works Monongahela River Bridge at Rankin" American Bridge Company Blueprints Sheet 1 of 4 March, 1900 (Pittsburgh: Rivers of Steel Archive) 1.

<sup>8</sup> *Ibid*, 1.

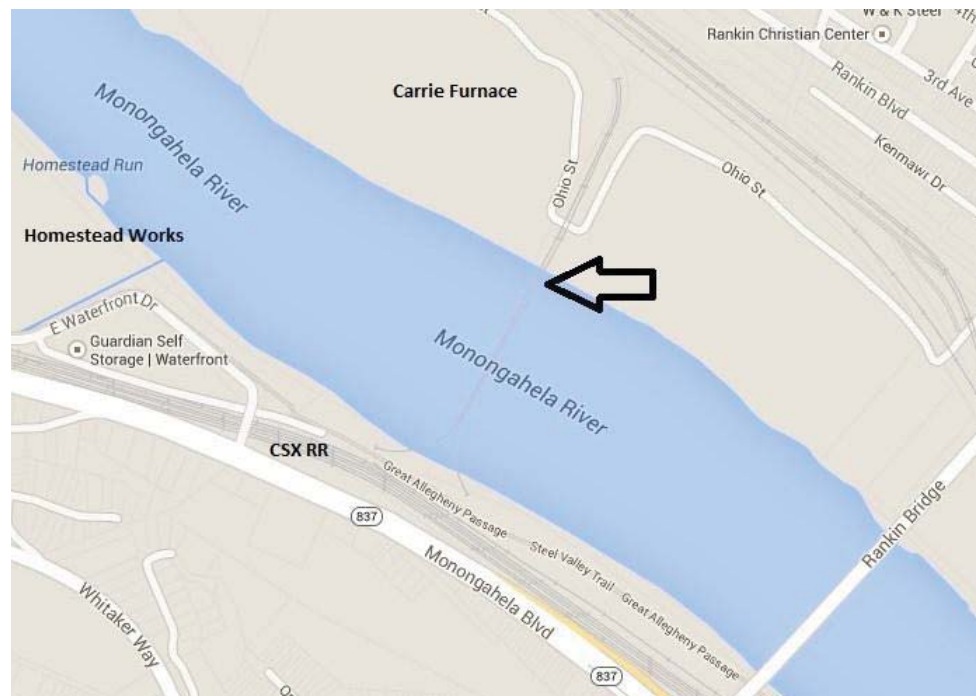
<sup>9</sup>"A Bridge For Carrying Molten Iron," 517.

<sup>10</sup>"Carnegie Steel Company Bridge at Rankin," *Iron Age* 66 (October 4, 1900) 14.





**Figure 3-2:** Carrie Furnace and bridge circa 1945  
*Courtesy of Rivers of Steel*



**Figure 3-3:** Map points to the location of the Carrie Furnace Bridge  
*Courtesy of Google Maps*

The Union Railroad (URR) was created in 1896 as a switching railroad built to connect Carnegie Steel facilities in the Monongahela Valley.<sup>11</sup> Founded by Andrew Carnegie, URR was responsible for switching tasks within each mill and delivering raw materials and finished products to interchange with the major trunk line railroads in the area.<sup>12</sup> A switching line allowed a train to switch from one line to another. The URR eventually expanded to include much of the industrial areas along the Monongahela River.<sup>13</sup> These railroads included the Pennsylvania, the Baltimore & Ohio and the Pittsburgh & Lake Erie. The savings in switching costs that Carnegie previously paid the railroads was enough to compensate for the interest on the cost of building the URR. The URR was of great importance to Pittsburgh throughout the twentieth century.

The Keystone Bridge Company merged with the American Bridge Company and Andrew Carnegie sold his iron and steel producing facilities to J.P. Morgan, who folded the facilities into the United States Steel Corporation in 1901. The hub of iron and steel production of the United States Steel Corporation originated in Pittsburgh, including the former Carrie Furnaces and Homestead Works connected by the Union Railroad Rankin Hot Metal Bridge. Furnace numbers 6 and 7, built in 1907, were in production until 1978 when US Steel abandoned the furnaces.<sup>14</sup> Much of the Carrie Furnace complex has been torn down by Park Corporation, who purchased the site from US Steel. Carrie Furnace numbers 6 and 7 and the Carrie Furnace Bridge are the only remaining elements of the Carrie Furnace plant.

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<sup>11</sup> Wall, *Andrew Carnegie*, 614.

<sup>12</sup> Joseph White and M.W. Bernewitz, *The Bridges of Pittsburgh* (Pittsburgh, PA: Cramer Printing and Publishing Company, 1928) 82.

<sup>13</sup> Harold McClain, *Pittsburgh and Lake Erie Railroad* (New York: General Books, LLC., 2010) 40.

<sup>14</sup> Bennet, *National Register of Historic Places Registration Form*, 15.

The Carrie Furnace Bridge is a contributing resource to the Carrie Blast Furnaces numbers 6 and 7 National Historic Landmark, designated in 2006.<sup>15</sup> Carrie Furnace is a nationally significant industrial cultural resource of river based industries that highlight the integrated nature of the region's iron and steel producing facilities. Ron Baraff of Rivers of Steel calls the bridge an “over-engineered bridge still in very good shape.” According to the Historic American Engineering Record, “The Union Railroad Rankin Hot Metal Bridge #35 (Carrie Furnace Bridge), along with the associated structures of the Carrie Blast Furnace numbers 6 and 7, represent an intact example of one of the most important early twentieth century integrated iron and steel production facilities in the United States.”<sup>16</sup> In *Bridges of Pittsburgh* by Joseph White published in 1928, the author discusses the industrial railroad bridges crossing the Monongahela River, “Because of their position in the midst of furnaces and mills, also as they are not easily seen nor are they known by the general public, yet they are being crossed frequently by heavy trains. In fact, there is not a more concentrated traffic in the Pittsburgh District than that between Homestead and Duquesne on the left bank and between Rankin and Braddock on the right bank, and on the four railroad bridges.”<sup>17</sup> Once victims of deindustrialization, the Carrie Furnace and the bridge now play a central role in the area’s revitalization movement.

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<sup>15</sup> Ron Baraff, Rivers of Steel (Personal Interview, February 25, 2014) pertaining to history and future of Rankin Hot Metal Bridge.

<sup>16</sup> Fitzsimons, ed, *Historic American Engineering Record*, 7.

<sup>17</sup> White and Bernewitz, *The Bridges of Pittsburgh*, 55.

### *Rehabilitation of the Union Railroad Rankin Hot Metal Bridge*

In 1950, Pittsburgh was the sixth largest city in the nation with a total population of 676,806.<sup>18</sup> In the nineteenth and twentieth centuries, immigrants from all over the world traveled to Pittsburgh to work in the steel mills. Pittsburgh by the turn of the century was the center of the industrial world. The pollution from the smoke stacks was so bad, that it blocked all sunshine; Mark Twain once described Pittsburgh as “hell with the lid off.”<sup>19</sup>

The end of the steel industry boom marked the beginning of a mass exodus to other cities and the suburbs. Since 1950, the city’s population has slowly declined along with communities in and around Pittsburgh. Citing IRS figures, Forbes points out that Pittsburgh completely reversed population decline between 2005 and 2009.<sup>20</sup> In 2009 more taxpayers moved in than out of the city. The reversal can be attributed to an influx of economic growth and urban revitalization. Former Mayor Luke Ravenstahl brought a youthful conviction to revitalize the city. He was committed to urban renewal and growth through historic preservation initiatives. Ravenstahl, along with many other Pittsburghers committed to preservation have put in motion many rehabilitation plans. According to Preserve Pittsburgh’s executive summary, the city of Pittsburgh introduced a plan in the summer of 2011 that will greatly influence the city both economically and

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<sup>18</sup> James L. Connolly, ed, *After The Factory: Reinventing America's Industrial Small Cities* (New York: Lexington Books, 2010) 58-59.

<sup>19</sup> William Thomas Stead, ed, “The Kingdom of Carnegie” *The Review of Reviews Volume 35* (Spring, 1907) 491.

<sup>20</sup> Francesca Levy, “America’s Most Livable Cities”, *Forbes Magazine* (Spring 2010) <<http://www.forbes.com/2010/04/29/cities-livable-pittsburgh-lifestyle-real-estate-top-ten-jobs-crime-income.html> > (accessed November 30, 2012).

environmentally.<sup>21</sup> Preserve Pittsburgh is a sub-committee created by the Department of City Planning to carry out preservation initiatives. Some of these initiatives include: provide equal access and opportunity and access for people to live, work, play and thrive; grow and diversify Pittsburgh's economy and tax base; foster a sense of city wide community while strengthening city wide identities; capitalize on Pittsburgh's cultural and natural resources; and respect and enhance the relationship between nature and the built environment.<sup>22</sup> In an effort to maintain the traditional neighborhood fabric, the city of Pittsburgh adaptively reused historic landmark buildings and bridges in and around the city's waterfront properties that were originally occupied by steel mills. Through city initiatives including historic preservation ordinances, zoning laws, and expanding city funding and grants, Pittsburgh adopted a redevelopment plan that has revitalized not only many vacant buildings in the area, but has also helped to revitalize communities.

Rehabilitation of the Carrie Furnace Bridge is part of a revitalization plan that includes about 150 acres of the former Carrie Furnace site. After the Park Corporation purchased the site from U.S. Steel in 1988, both parties agreed to address the environmental concerns because the soil was contaminated with PCBs and sulfates.<sup>23</sup> In addition, asbestos from the buildings was removed and Park Corp was threatening to tear down the Carrie Furnace and use the material for scrap, as they had done to the Homestead Steel Works. In 2005, Allegheny County purchased the land from Park

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<sup>21</sup> Preserve PGH "Role of Cultural Heritage and Historic Preservation Planning" (July 24, 2012) <<http://exchange.planpgh.com/portal/preserve/preservepgh?pointId+1337021786152>> (accessed September 24, 2012).

<sup>22</sup> Preserve PGH, "Role of Cultural Heritage and Historic Preservation Planning."

<sup>23</sup> Louis A Corsaro, "Plans heat up to preserve, revive Carrie Furnace Site" (*Pittsburgh Business Journal* April 26, 2013) < <http://bizjournal.com/pittsburgh> > (accessed December 2013) 1.

Corporation for \$5.75 million.<sup>24</sup> The county then leased the property to Rivers of Steel. Rivers of Steel Heritage Area is a non-profit that works to preserve and manage historic, cultural and natural resources related to the steel industry in the eight-county southwestern Pennsylvania region.<sup>25</sup>

The Carrie Furnace location is cut off from main road arteries and active railroads still cross through the site. One of the keys to preserving Carrie Furnace and the bridge is egress and ingress at the site.<sup>26</sup> Carrie Furnace numbers 6 and 7 remain because there is no easy way to access the area. However, access to the site is now a problem that the county is attempting to solve. The topography of the land and waterways surrounding Carrie Furnace along with active railways now separate the surrounding communities. CSX and Tran Star railroads are active on the site and an interchange location is close by. The Carrie Furnace Bridge is located on the eastern end of that property. A small railroad bridge, the Pemickey Bridge is located on the western end of the property which is utilized by CSX and Tran Star along the base of a hill. Proposed infrastructure improvements within the redevelopment parcel consist of construction of a main access road (a flyover road that is currently in construction phase) and installation of an adjacent sewer line. Project design plans propose replacement of 2 to 5 feet of infill soil within portions of the project area to raise the ground surface above the 100 year floodplain elevation.<sup>27</sup>

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<sup>24</sup> Ibid, 1.

<sup>25</sup>Rivers of Steel National Heritage Area “Mission” <[www.riversofsteel/about/mission](http://www.riversofsteel/about/mission) > (accessed December 2013) 1.

<sup>26</sup> John Coyne PE, PLS Senior Director-Engineering GAI Consultants (Personal Interview, March 4, 2014) pertaining to structural design of Carrie Furnace Bridge and surrounding development.

<sup>27</sup>The floodplain area floods every 2 years according to Coyne.

The redevelopment of the Carrie Furnace site has created innovative partnerships. Allegheny County Economic Development (ACED) is the lead economic and residential development agency for Allegheny County. The Development Division works on major development projects including the coordination of property acquisition, site development and redevelopment, and infrastructure development.<sup>28</sup> In partnership with ACED, United States Representative Mike Doyle lobbied for a \$10 million federal Transportation Investment Generating Economic Recovery (TIGER) grant to build a flyover attachment road. The fly over will literally fly over the railroad tracks and provide direct access to the site.

Funding for adapting the bridge for both pedestrian and vehicular traffic is being raised, thus no plans or designs for reconstruction exist. The problem lies on the Munhall side of the River. The grade is too high to connect the bridge to Pennsylvania State Road 837, so engineers will need to solve the problem of connecting it. The connection to PA SR 837 is extremely important for the bridge and the Carrie Furnace site so that the bridge and the site become accessible on both sides of the river. To make room for the flyover, it was necessary to tear down the northern approach ramp. All decision making parties had to agree to the terms of a covenant regarding future plans of the Carrie Furnace Bridge including the removal of the trestle ramp. Rivers of Steel leases Carrie Furnace, but the county now owns the Carrie Furnace Bridge. Mitigation for the impact of demolishing the northern approach ramp of the bridge includes recordation in the form of measured drawings, large format photography and written data.<sup>29</sup> Mitigation is

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<sup>28</sup> Allegheny County “Allegheny County Economic Development 2014” <[www.alleghenycounty.us/economic](http://www.alleghenycounty.us/economic)> (accessed February 2014) 1.

<sup>29</sup> Erin Deasy, Project Manager, Allegheny County Economic Development (Personal Interview, March 11, 2014) pertaining to funding and Section 106 process for Carrie Furnace

needed for loss of the northern approach ramp because it was a contributing element to the National Historic Landmark. Once the plans for renovation of the bridge are complete, the blueprints will need to be reviewed by the State Historic Preservation Office. These steps will determine if further mitigation is necessary. A feasibility report identified several repairs required for future use of the bridge.

### *Feasibility Report*

Although the county has not drawn plans or blueprints for the redesign of the bridge, they have completed a structural feasibility report. The feasibility report was completed on the Carrie Furnace Bridge in August 2002 by the Wilbur Smith Associates inspection team of Steven Kocsuta, P.E. and Darin Hettich, P.E.<sup>30</sup> A feasibility report is vital to the rehabilitation process for many reasons. It arms decision makers with a better understanding about long term planning and cost of rehabilitation. It also leads to better evaluation of how to move forward with planning. The feasibility report for the Carrie Furnace Bridge proved that the bridge was still in exceptionally good condition. The bridge experienced several major rehabilitations, repairs and expansions since its construction. Repairs completed in 1941 included replacing the lateral bracing system of the Pennsylvania thru-truss main span; a 1979 rehabilitation included replacement of top chord cross bracing members of the Baltimore thru-truss. Wilbur Smith Associates completed a visual inspection of all elements of the various structures making up the bridge analyzing the bridge's structural integrity. In converting a railroad bridge to a vehicular and pedestrian bridge, the engineer's analysis seeks to understand if the bridge

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<sup>30</sup> Steven Kocsuta and Darin Hettich. "Carrie Furnace Site Redevelopment Phase II: Hot Metal Bridge Structural Inspection and Feasibility Report" (Pittsburgh: Wilbur Smith Associates, Summer 2002) 1.



can structurally support the weight of large vehicles in combination with the weight of a group of people spanning the entire length of the bridge.

The report states that the 248 foot Baltimore thru-truss span is in fairly good condition having been repaired as recently as 1979. The main members of the truss have surface rusting, but no major deterioration. The 496 foot Pennsylvania thru-truss span is also in good condition except for paint loss in the top cord members.<sup>31</sup> Several of the top chord cross members were replaced in an earlier renovation.

The results of the structural capacity analysis indicate approximately 58% of the load carrying capacity of the structure would be utilized under the new service condition for vehicles and pedestrians.<sup>32</sup> The analysis included an estimate of the increased dead load of the concrete deck and superstructure alterations as well as the Pennsylvania Department of Transportation (PennDOT) designated live load vehicle weights. The live load calculation for the full load on both tracks is 15.1 kips<sup>33</sup> per foot for trains and the live load calculation for a truck load in both lanes is 5.0 kips per foot.<sup>34</sup> This figure indicates that the bridge is more than able to handle the conversion from train loads to vehicular loads.

In the redesign, it will be necessary to remove the hot metal portion of the rail line including the hot metal pan in the substructure to make room for the concrete deck. This action requires removal of firebricks, ballast, rails, and deck pan floor members. All alterations of the bridge must be approved by the State Historic Preservation Office.

Because the bridge is contributing to the Carrie Furnace 6 and 7 National Historic

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<sup>31</sup> Ibid, 10.

<sup>32</sup> Ibid, 15.

<sup>33</sup> A kip equals 1000 pounds-force, used primarily by American architects and engineers to measure engineering loads < <http://www.sizes.com/units/kip.htm> > (accessed February 2014)

<sup>34</sup> Kocsuta and Hettich, "Carrie Furnace Site Redevelopment," 3.

Landmark, a Programmatic Agreement was written by the Pennsylvania Bureau for Historic Preservation to ensure that all appropriate historic integrity is protected.<sup>35</sup>

A study of the configuration of the existing structure as well as its relationship with the surrounding roadways proved that the attachment of PA SR 837 was a feasible scenario for the utilization of the structure. The truss spans will be converted for vehicular traffic by adding a similar structural slab and floor system. Since the structure diverges on the south approach, a new structure will be constructed which would land adjacent to the active CSX rail lines. It will tie into the existing roadway system at the waterfront bridge which crosses over the CSX tracks east of the bridge.<sup>36</sup>

Cost estimates are based on assumptions from the feasibility report as well as comparisons made for the conversion of the Monongahela Connecting Railroad Bridge in the South Side. Lead paint removal and disposal will cost roughly \$7 million. Additionally, general conversion and rehabilitation of the bridge, demolition of the Rankin approach, additional structure for South approach, widening of existing structure and retaining walls will cost approximately \$19 million dollars with a \$500,000 per year maintenance cost.<sup>37</sup> The raising of funds is ongoing through development efforts by Allegheny County. These funds are a result of both public and private efforts to obtain them. The bridge will also be made available for use in the Great Allegheny Passage trails system, which is a large incentive for investment.

The future of the third case study, The Ohio-West Virginia Railroad Bridge, is unknown.

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<sup>35</sup> Full Programmatic Agreement content located in Appendix A

<sup>36</sup> Ibid, 5.

<sup>37</sup> Kocsuta and Hettich, "Carrie Furnace Site Redevelopment," 2.

## CHAPTER FOUR: OHIO-WEST VIRGINIA RAILROAD BRIDGE

The Ohio-West Virginia Railroad Bridge is a monumental industrial railroad bridge that crosses the Ohio River between Steubenville, Ohio and Follansbee, West Virginia. Built by the Ohio-West Virginia Bridge Company in 1917, this bridge is an example of a cantilever Baltimore thru-truss bridge.<sup>1</sup> A cantilever bridge utilizes structures that project horizontally into space, supported only on one end.<sup>2</sup> The steel truss cantilever bridge was a major engineering achievement when first put into practice in the nineteenth century because it can span long distances with minimal obstructions in the territory being crossed. The future of this industrial railroad bridge is uncertain. The bridge is fully operational, however, it is in ultimate danger of demolition because of the struggling industry that surrounds it. The booming iron and steel industry that at one time depended on and supported the maintenance of the bridge is almost entirely gone. The bridge's current owner, Frontier Industries, has a business model based on tearing down industrial complexes and selling the material for scrap.

### *History*

The Ohio-West Virginia Railroad Bridge is one of only a few steel mill structures left behind from the industrial operations of the Wheeling Pittsburgh Steel Corporation in Steubenville. The Wheeling Pittsburgh Steel Corporation's ancestors possessed a long history dating back prior to the American Revolution. Originally named La Belle Iron Works, the company settled in Steubenville in 1859 with the purchase of Jefferson Iron

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<sup>1</sup>J.L. De Vou, "Locomotive Cranes Erect Cantilever Bridge Over Ohio River" *Engineering News-Record* 79 (July 19, 1917) 105.

<sup>2</sup>Diana Briscoe, *Bridge Building: Bridge Designs and How They Work* (Minnesota: Red Brick Learning, 2005) 47.

Works to supply its facilities with pig iron used for cut nails and later tin.<sup>3</sup> The name La Belle originated from a group of pioneers that settled around Fort Steuben in 1787.<sup>4</sup> The town subsequently organized around the settlement of La Belle was named Steubenville. The Jefferson Iron Works was so successful that it was dismantled and rebuilt on a new and larger location. La Belle Works eventually expanded into an iron and steel company owning coal mines, iron ore mines, coke ovens, blast furnaces, steel production and finishing facilities.<sup>5</sup>

Between 1915 and 1917, La Belle Works built the first by-product coke plant in Follansbee, West Virginia directly across the Ohio River from La Belle's iron and steel making complex in Steubenville. The by-product coke oven replaced the company's beehive coke ovens. La Belle joined the general movement in the United States away from beehive ovens to by-product plants as the principal source of blast furnace coke. Several factors helped the by-product oven's popularity. The by-product oven used less coal which allowed for conservation of natural resources and reduced the cost of coking.<sup>6</sup> In addition, by-product ovens could be constructed near the blast furnaces and the coke oven gas could be used as fuel throughout different sections of the plant.

In the process of converting coal into coke using a by-product coke oven, the hazardous matter in the coal is vaporized then leaves the coke oven chambers as hot, raw

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<sup>3</sup> Lee Maddox, "La Belle Iron Works" *Historic American Engineering Record HAER No. WV-47* (Washington, D.C.: National Park Service 1990)13.

<sup>4</sup> Mike Lohr and Judy Lohr. "A Short History of the Steubenville (Market Street) Bridge." Jeffcochapter.com < <http://www.jeffcochapter.com/SteubenvilleTwp/History>> (accessed March 2014).

<sup>5</sup> Raymond-Lynn Boothe, *Fire on the Water: A New History of the Wheeling Steel Corporation* (Dr. Raymond-Lynn Boothe, 2011) 5.

<sup>6</sup> William T. Hogan, *Economic History of the Iron and Steel Industry in the United States Vol 2: Part III* (Lexington, Massachusetts: Heath and Company, 1971) 377-384.

coke oven gas. The raw coke oven gas is cooled which results in a liquid condensation and a gas stream. The by-product plant processes these two streams to be used as fuel.<sup>7</sup> The demand for coke increased sharply at the onset of World War I.<sup>8</sup> Coke was needed to fulfill increasing need for steel and by-product used in munitions during the war. The supply of by-products was small and the demand was large, so prices increased exponentially. By-product coking not only contributed to the war effort, it aided in the development of chemical industries. Medical products like aspirin also developed out of this by-product.

The incorporation of the by-product oven influenced the construction of the Ohio-West Virginia Railroad Bridge to connect the new by-product coke plant in West Virginia with iron and steel making facilities in Steubenville, the Steubenville Works. The Ohio-West Virginia Bridge Company, chartered in 1915, was a subsidiary of La Belle Iron Works. The company immediately began construction of a bridge that would connect La Belle's integrated mill complex as part of a general expansion of the business.<sup>9</sup> La Belle grew through backwards vertical integration, beginning with a finished product and then subsequently gaining control of the raw materials.

In June of 1920, La Belle Iron Works merged with Wheeling Steel and Iron Company and Whittaker Glessner Company to form the Wheeling Steel Corporation.<sup>10</sup> The merger came at a time when all three companies had seen large profits from World War I and were considered the three most successful iron and steel companies in the Upper Ohio Valley. By 1929, the open-hearth furnaces at Steubenville Works were

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<sup>7</sup>James A. Kent, ed, *Kent and Riegel's Handbook of Industrial Chemistry and Biotechnology Vol 1*. (New York: Springer Science and Business Media, LLC, 2007) 868.

<sup>8</sup>Hogan, *Economic History*, 377-384.

<sup>9</sup>Maddox, "La Belle Iron Works," 10.

<sup>10</sup>Boothe, *Fire on the Water*, 301.

updated and enlarged because of the success of the business. Throughout the twentieth century, the corporation consistently upgraded their equipment and technology which allowed them to effectively produce a quality product and maintain their autonomy. Carnegie Illinois Steel Corporation sold their Mingo Junction Works to the Wheeling Steel Corporation in 1945.<sup>11</sup> Mingo Junction Works was located about two miles south of the Steubenville Works and the property was large enough for future expansion. The coke plant in Follansbee, West Virginia eventually provided the coke for the two blast furnaces at the Steubenville Plant and the three blast furnaces at the newly acquired Mingo Junction Plant. All three of these plants were joined by an industrial rail spur that was owned and operated by the former Wheeling Steel Corporation.

By 1969, Wheeling Steel Corporation became the Wheeling Pittsburgh Steel Corporation when it merged with Pittsburgh Steel. The combination of modern facilities with ample raw material sources enabled the company to continue to prosper until the mid-1980s when the demand for steel began to decline as interest rates increased due to a severe economic depression. The corporation had been investing in a modernization program and contending with a surge of imports of steel. Compliance with federal and state governments on environmental restrictions proved to be an expensive endeavor and labor relations agreements were costly. As a result, Wheeling Pittsburgh Steel Corporation filed for bankruptcy in 1988 and was incorporated into a holding company. Eventually, Severstal purchased the Steubenville Plant; followed by RG Steel, which filed for bankruptcy in 2012.<sup>12</sup>

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<sup>11</sup> Ibid, 125

<sup>12</sup> Bud Smith, Director of Environmental Control, Mountain State Carbon (Personal Interview March 13, 2014) regarding current business trends and future of Mountain State Carbon.

### *Construction of the Ohio-West Virginia Railroad Bridge*

The Ohio-West Virginia Railroad Bridge is a riveted connection cantilever Baltimore thru-truss. It is a single track railroad bridge with a plate girder approach at each end. The bridge was designed, fabricated and erected under the direction of Albert Lucius, consulting engineer for the American Bridge Company.<sup>13</sup> The Ohio-West Virginia Railroad Bridge is significant because it was the first to be built without a traveler. A traveler is a small movable platform running on a track on the upper chord of a truss used in the building of bridges.<sup>14</sup> The bridge is 1,120 ft long.<sup>15</sup> Built by two locomotive cranes operating on a central track, it is believed to be the first cantilever bridge to use this building technique. Another construction technique that is unique to the bridge is the use of hydraulic jacks instead of wedges and screws for the final adjustment when swinging the suspended span into place. Albert Lucius thoroughly designed the construction features to include special pins for I-bar top chords and spacing of the trusses 30 feet apart. This spacing allowed for maneuverability of the erecting cranes.

Four thousand eighty nine tons of steel was needed to construct the Ohio-West Virginia Railroad Bridge.<sup>16</sup> The design of the bridge, weights of all members, and capacity of the cranes required the use of wooden false work during construction. False work is a temporary framework used in the building of bridges to hold items in place until the structure is able to support itself. The false work withstood three floods, two of which were accompanied by running ice. The stability of the false work was very important in bad weather because builders could lose their lives if the false work had

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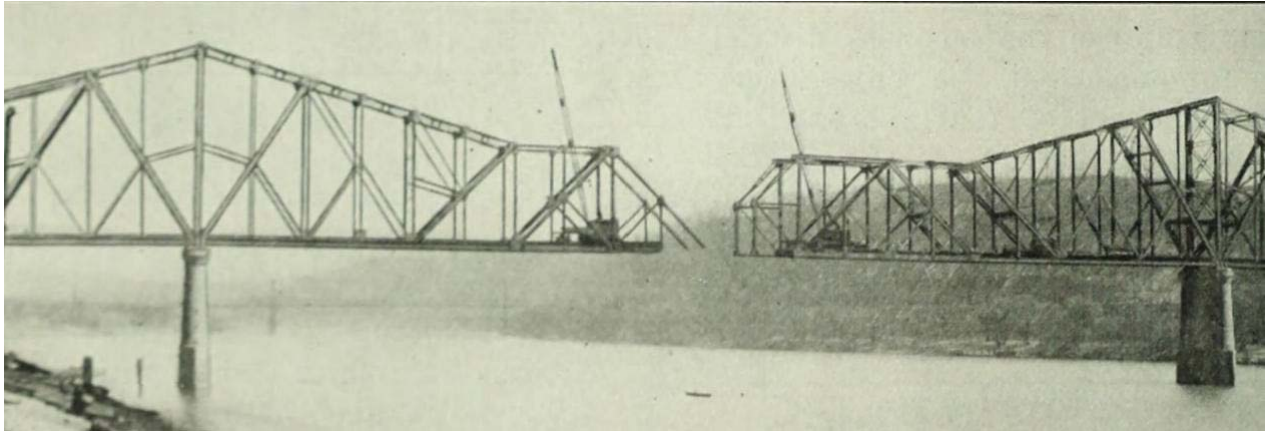
<sup>13</sup> De Vou, "Locomotive Cranes," 105.

<sup>14</sup> JAL Waddell, *Bridge Engineering* (New York: John Wiley and Sons, Inc, 1916) 30.

<sup>15</sup> Dr. Raymond-Lynn Boothe (Personal Interview March 27, 2014) pertaining the Ohio-West Virginia Railroad Bridge Statistics.

<sup>16</sup> De Vou, "Locomotive Cranes," 107.

collapsed. The erection of the cantilever arm began on March 3, 1917 on the West Virginia end and was completed on March 24, 1917 on the Ohio end.<sup>17</sup>



**Figure 4-1:** Locomotive cranes erecting the Ohio-West Virginia Railroad Bridge over the Ohio River, July 1917.

*Courtesy of Engineering News-Record*

The Ohio-West Virginia Railroad Bridge connected the Follansbee coke plant and the Steubenville steel mill by carrying the railroad track that was immediately adjacent to the two blast furnaces. The coke carried in hopper cars could be off loaded directly into the hoppers beneath the blast furnaces.<sup>18</sup> The layout and structure of the railroad track with the bridge reduced production time and increased productivity. The bridge also served as the route for utilities including water, electric power, and coke oven gas to connect the coke plant with the Steubenville and Mingo Junction Plants. Such connections still exist on this bridge. The coke plant still receives Ohio River water from the Ohio side, as well as backup electric power. The coke oven gas line is no longer in use, but it was previously used to convey coke oven gas from the coke plant via a pipeline across the

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<sup>17</sup> Ibid,108.

<sup>18</sup> Benjamin Halpern, Photographer (Personal Interview November 2013) pertaining to history of Wheeling Pittsburgh Steel Corporation.



bridge to Steubenville and for about two miles south to the Mingo Junction Plant. The coke oven gas was used as fuel for the boilers at both Ohio plants, as well as for the reheat furnaces at the hot strip mill at the Mingo Junction Plant.

#### *Current Use*

The bridge is currently utilized by Mountain State Carbon, LLC on the West Virginia side of the Ohio River where it owns and operates a coke plant. Since 2005, Mountain State Carbon LLC has operated as a joint venture between Severstal Wheeling, Inc. and SNA Carbon LLC. The coke-making process involves the carbonization of coal. Coke is an important raw material used as fuel that is fed into a steel mill's blast furnace. In the coke making process, coke oven gas is generated from the coal and is subsequently "free" fuel. It has about half the BTU<sup>19</sup> value of natural gas.<sup>20</sup> The bridge carries coke from Mountain State Carbon's Follansbee plant across the river to Mingo Junction, a nearby Norfolk Southern station where the coke is loaded onto Norfolk Southern trains and transported to its final destination. Its final destination is a former steel plant that was once part of the Ford automobile plant (now owned by Severstal) in Dearborn, Michigan. Severstal is currently Mountain State Carbon's only client. The coke plant no longer supplies blast furnaces in Steubenville and Mingo Junction. These plants were demolished with the bankruptcy of RG Steel in 2012. The coke market is slow and Mountain State Carbon is struggling to maintain its business in a sluggish economy. Mountain State is the third-largest U.S. coke producer with a 1.2 million-ton capacity and is using only 60% of total capacity.<sup>21</sup> The company is attempting to integrate foundry

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<sup>19</sup> British thermal unit (BTU or Btu) is a traditional unit of energy equal to about 1055 joules. <[http://www.energy.gov.ab.ca/about\\_us/1132.asp](http://www.energy.gov.ab.ca/about_us/1132.asp)> (accessed February 2014).

<sup>20</sup> Smith, Personal Interview, March 13, 2014.

<sup>21</sup> Ibid.

coke into its production with furnace coke to increase business and diversify its customer base. Typically, 90 hopper cars (100 tons) of furnace coke are shipped to Dearborn every 2 to 3 weeks via the Ohio-West Virginia Railroad Bridge.

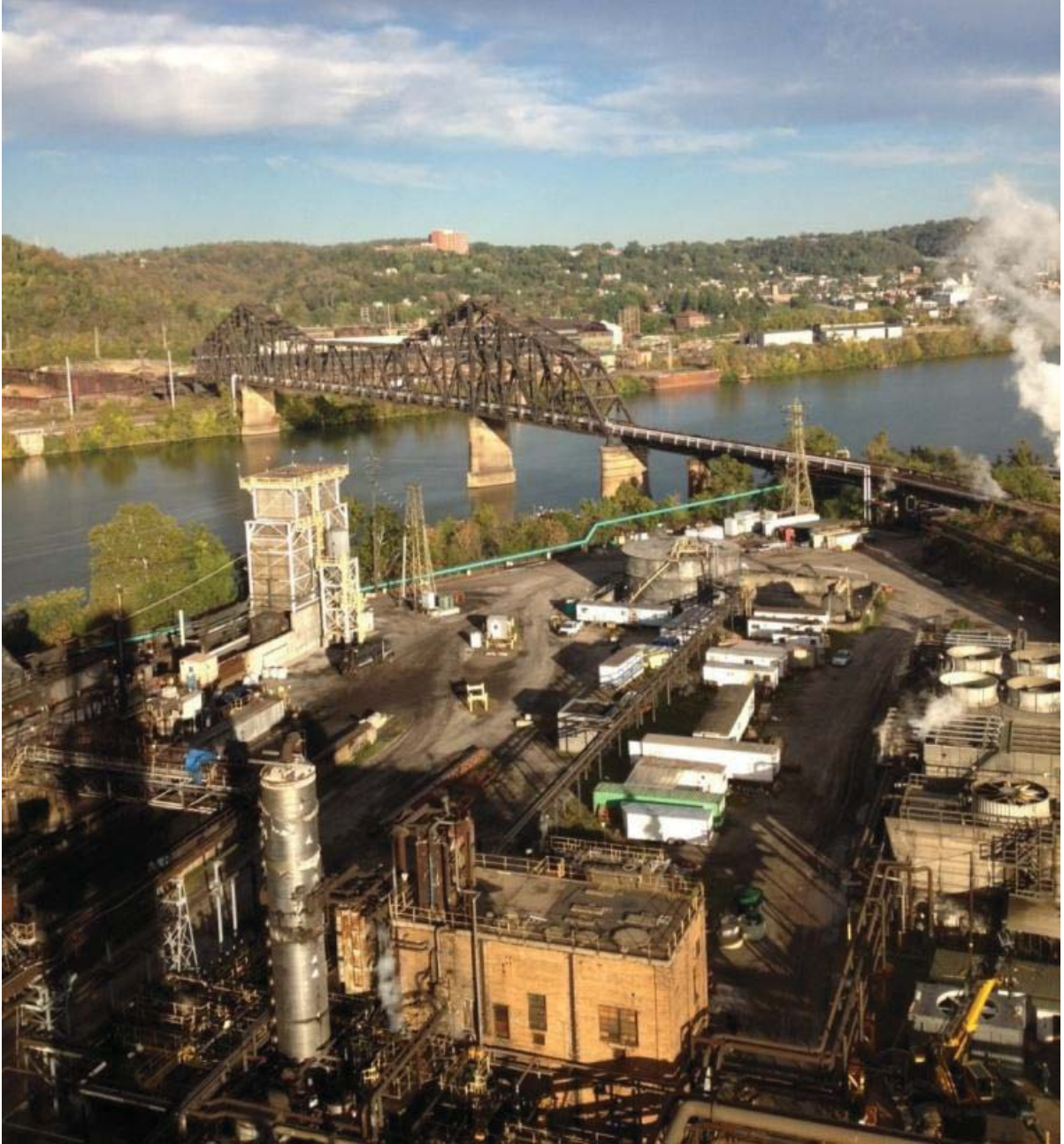
Due to RG Steel's 2012 bankruptcy, a demolition group called Frontier Industries purchased the remainder of the portions of the former Wheeling Pittsburgh Corporation's facilities for \$20 million including the Ohio-West Virginia Railroad Bridge.<sup>22</sup> Frontier Industries obtained demolition permits for the older sections of the remaining mills. The company specializes in dismantling, industrial gutting, plant strip outs and scrap metals recycling.<sup>23</sup> Jim Bradley, former CEO of RG Steel, argues that if Mountain State Carbon were to close, Frontier Industrial could make a huge profit from dismantling the bridge and selling the metal for scrap.<sup>24</sup>

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<sup>22</sup> Casey Junkins, "Steel mill demolition begins" *Herald Star* (February 17, 2014)1.

<sup>23</sup> Frontier Industrial Corporation "Home Page" <<http://www.fic-services.com>> (accessed March 2014).

<sup>24</sup> Jim Bradley, former CEO of RG Steel (Personal Interview March 2014) pertaining to future of the railroad bridge.



**Figure 4-2:** Aerial view of Mountain State Carbon in Follansbee, West Virginia and the Ohio-West Virginia Railroad Bridge crossing the Ohio River into Steubenville.  
*Courtesy of Bud Smith, Mountain State Carbon*

## *Future*

The City of Steubenville is one of over 50 Certified Local Governments (CLG) in Ohio.<sup>25</sup> In order to qualify to be a CLG, the city must follow guidelines for preservation. Steubenville follows an ordinance designed to protect historic resources. There are nine National Register listed properties in Steubenville, of these; two are historic districts making Steubenville very active in preservation. According to Christopher Petrossi, Urban Projects Director in Steubenville, most public funds are being utilized for maintaining the Market Street Bridge located about a mile from the Ohio-West Virginia Railroad Bridge.<sup>26</sup> The Market Street Bridge is a vehicular bridge in Steubenville. Built in 1905 by the Ohio Steel Company, the bridge is listed as eligible for the National Register of Historic Places. The Market Street Bridge is a metal wire cable suspension bridge with a metal stiffening truss that is about twenty years older than the Ohio-West Virginia Railroad Bridge. It also maintains a history that connects it to the city's steel industry. According to the Ohio Historic Inventory, Steubenville businessman, Dohrman Sinclair, made a deal with the Follansbee brothers of West Virginia that if Sinclair built the Market Street Bridge, the Follansbee brothers would build a tin mill on the West Virginia side of the river on farm lands.<sup>27</sup>

The Market Street Bridge has become a symbol of Steubenville and in a way has overshadowed the Ohio-West Virginia Railroad Bridge. The Market Street Bridge is slated to become part of the Cross State Bike Path and the Brooke Pioneer Trail. The

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<sup>25</sup> Susan Tietz, Survey and National Register Manager, Ohio Historical Society (Personal Interview March 31, 2014) pertaining to the City of Steubenville.

<sup>26</sup> Christopher Petrossi, Urban Projects Director, City of Steubenville (Personal Interview, March 2014) pertaining to the bridges of Steubenville.

<sup>27</sup> Mike and Judy Lohr, "A Short History of the Steubenville Market Street Bridge" <<http://www.jeffcochapter.com/SteubenvilleTwp/History/>> (accessed March 2014) 5.

Cross State Bike Path starts in Ohio, crosses the entire state of West Virginia from west to east, and reaches Pennsylvania and returns. It should be noted that Old Fort Steuben is also located along this path. The Market Street Bridge will also link into the Brooke Pioneer Trail. The Brooke Pioneer Trail follows the east bank of the Ohio River between Wellsburg and the Brooke–Ohio County line at Short Creek. At this juncture, it would be extremely difficult to connect the Ohio-West Virginia Railroad Bridge into a trail system because of the industrial landscape that surrounds it.

As mentioned earlier, bridge inventories are helpful when attempting to preserve bridges. Although the Ohio Department of Transportation (ODOT) and the Ohio Rail Development Commission do not maintain a railroad bridge inventory, the State of Ohio does maintain an Ohio Historic Inventory which includes historic bridges. This inventory includes a small number of railroad bridges. Most of these railroad bridges are included because they are listed in the National Register individually or as part of a district. The West Virginia State Historic Preservation Office presides over most of the bridges that cross the Ohio River on the Ohio and West Virginia border. The Ohio-West Virginia Railroad Bridge is not listed in the National Register in either Ohio or West Virginia. It has not been recorded in the Ohio Historic Inventory. Since most of the railroad bridges have been privately owned and maintained by the railroads, ODOT has not been involved with them unless they cross over or under a public road. As private property of the railroads, the owners have been restrained about sharing information or having the bridges recognized as historic. Because the Ohio-West Virginia Railroad Bridge is located in a heavy industrial area with no direct connection into a state road or path, it is almost impossible to convert it to a vehicular bridge. In order to become a vehicular

bridge, it would inevitably need to be widened to be converted into two lanes because it is a single track bridge. The bridge would also require an intense inspection and removal of any hazardous materials. Additionally, the surrounding area would need to be invigorated economically. A connection would need to be constructed to connect to West Virginia State Road 2 which runs parallel to the Ohio River.

Although it seems quite a challenge to convert the bridge for vehicular and pedestrian use, it is possible for a local railroad to purchase it. The Ohio-West Virginia Railroad Bridge could be folded into two railroads, the Wheeling and Lake Erie Railroad (WLE) to the south and the Norfolk Southern to the west. The Wheeling and Lake Erie Railway Company is a class II regional railroad that has approximately 840 miles of track in Ohio, Pennsylvania and West Virginia.<sup>28</sup> The WLE is the largest Ohio based railroad and one of the largest regional railroads in the nation. The WLE moves approximately 140,000 carloads of freight per year.<sup>29</sup> RG Steel utilized WLE to transport coal-tar pitch to a client in Canada. If Mountain State Carbon or another business in the area can support the use of this railroad, it is possible that the railroads would be interested in maintaining the bridge. The future of rail volume at the Massillon Branch, located a few miles down-river and Mingo Junction, will predict if the railroads will need the Ohio-West Virginia Railroad Bridge. If there is enough industry to support this bridge, it will continue to be utilized. However, incorporation into a local railroad for utilization by the growing interest in Marcellus shale could be another option to repurpose this bridge.

Although the Ohio-West Virginia Railroad is not listed on the National Register, it would seem appropriate to at least preserve a pier as a monument to the bridge that

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<sup>28</sup> “Wheeling and Lake Erie Railway” < <http://www.wlerwy.com/>> (accessed March, 2014) 1.

<sup>29</sup> Ibid, 1.

once served industry in Ohio and West Virginia if the bridge is demolished. A pier could be converted into an observation platform or a bird sanctuary. A plaque or memorial should be placed on the pier to remember the great industrial history that once was.

## CHAPTER FIVE: FUTURE OF INDUSTRIAL RAILROAD BRIDGES

Pennsylvania and Ohio are home to some of the most unique and historic bridges in the country. These bridges are not merely a linking of one land mass to another, but are symbols of our heritage and provide our community with a sense of place and identity. Communities across Pennsylvania and Ohio are struggling with lack of funding for failing and outdated transportation systems, thus preserving these bridges presents many challenges. However, the economic benefits of community revitalization are often a compelling argument to preserve a bridge.

The National Register of Historic Places utilizes specific criteria in its designation process. The criteria include: if the structure made a significant contribution to the broad patterns of American history, if it is associated with a significant engineer or architect, embodies the distinctive characteristics of a design type, period of time, method of construction or has yielded or may be likely to yield information important to history.<sup>1</sup> Historic context provides a means for evaluating each bridge and its technological significance. Each bridge is evaluated on its own merits while identifying crucial distinctions of significance among groups of similar resources.

The Department of Transportation defines preservation of a historic bridge as including rehabilitation, re-purposing and relocating. Many historic bridges are saved due to a perfect combination of circumstances. In some cases, it becomes more cost effective to rehabilitate a bridge rather than replace it. Usually, larger bridges are

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<sup>1</sup>Norman Tyler, *Historic Preservation: An Introduction to Its History, Principles and Practice* 2<sup>nd</sup> edition (New York: W.W. Norton and Company, 2009) 135.



rehabilitated instead of being replaced because the cost of demolition and building a new bridge is usually more expensive. Also, the bridge's environment may be a reason for rehabilitation because it may still be viable and able to support that area's average daily traffic.

*Allegheny Trail Alliance and an Industrial Survey of the Great Allegheny  
Passage: Pittsburgh to Cumberland, Maryland.*

A significant advance in the preservation of railroad bridges was the Rail Banking Act. In 1983, Congress amended the 1968 National Trails System Act to give interested parties the opportunity to negotiate agreements with rail carriers to use railroad rights-of-way (the property used for rail lines) for trails, known as the Rail Banking Act.<sup>2</sup> Rail banking makes the property available for use as a trail. The Surface Transportation Board administers the rail-banking program under which a trail sponsor assumes full managerial, financial, and legal responsibility for a right-of-way.<sup>3</sup> The National Park Service emphasized that communities often receive benefits from the development of rail-banked trails, such as an improved quality of life and increased economic development. Trails must be maintained according to state and local land use plans, zoning ordinances, and public health and safety legislation. Included in the Rail Banking Act, the tracks and ties of a rail banked line can be removed but bridges and trestles must remain in place.<sup>4</sup>

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<sup>2</sup> Rails to Trails Conservancy, "Rail Banking: What and Why?" <[www.railstotrails.org](http://www.railstotrails.org)> (accessed March 13, 2014) 1.

<sup>3</sup> Ibid, 1.

<sup>4</sup> Linda McKenna Boxx, Allegheny Trail Alliance (Personal Interview, March 21, 2014) Pertaining to connection and funding of Carrie Furnace Bridge as well as the Bollman Bridge in Somerset County.

The Carrie Furnace Bridge is slated to be incorporated as part of the Great Allegheny Passage (GAP). The GAP is 150 miles long and connects with the 184.5 mile C&O Canal Towpath at Cumberland, Maryland to create a 334.5 mile pedestrian path between Pittsburgh and Washington, DC.<sup>5</sup> The Allegheny Trail Alliance is a coalition of trails that raise funds for additions, maintenance and improvements of trails. They also work with city and local governments in the utilization of bridges along the trail. The Allegheny Trail Alliance was integral to the preservation of many historic bridges along the GAP. In Pittsburgh, it helped to raise money and gain support for the Hot Metal Bridge in the South Side. It spearheaded an effort to create a ramp from the Hot Metal Bridge connecting to a technology park. Small groups of activists assisted by state grants, pursued rails-to-trails conversions around these bridges. As the trails have appeared, so have cyclists, hikers, runners and skaters.

The Steel Valley Trail is part of the Great Allegheny Passage; however, it is the only part of the GAP that is not on former railroad tracks. The Steel Valley Trail Council manages the portion of the GAP that runs from Sandcastle Water Park to McKeesport, Pennsylvania.<sup>6</sup> The trail runs along an old United States Steel gas pipeline. The GAP contains industrial heritage resources along its entire length and many are significant and have been listed or determined eligible for the National Register of Historic Places. These resources have been compiled and mapped by several organizations including the National Park Service and Preservation Pennsylvania in conjunction with the GAP. They

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<sup>5</sup> Great Allegheny Passage “The Cumberland and Pittsburgh Trail” < [www.atatrail.org](http://www.atatrail.org) > (accessed March 2014) 1.

<sup>6</sup> Steel Valley Trail Council. *Steel Valley Trail*. Pittsburgh: Steel Valley Trail Council, 2013.

include coal and coke resources such as the archaeological sites of Little Falls Iron Furnace to pre-Civil War coal miners' villages.<sup>7</sup> If the GAP crosses a bridge, usually the local government will allow the GAP to utilize it as a crossing if possible.

Several historic truss bridges are found along the GAP trail and the Bollman Bridge stands out as a prime example of successful preservation efforts along the trail. GAP was a central force in the preservation of a rare Wendell Bollman iron railroad bridge that is listed on the National Register of Historic Places. This surviving iron bridge was built in 1871 to carry the Baltimore and Ohio railroad over Willis Creek in Somerset County.<sup>8</sup> The Bollman Bridge had been scheduled for demolition after 137 years of service. In 2007, the Allegheny Trail Alliance and Somerset County relocated the bridge to be installed along the GAP in the Allegheny Highlands. The bridge relocation does not affect the bridge's status on the National Register of Historic Places. The Bollman Bridge is eighty-one feet long, thirteen feet wide, weighs thirty tons, and has cast and wrought iron members.<sup>9</sup> Bollman is known for iron bridges that were easy to erect by unskilled laborers. Each part had numbers cast into it for easy identification and all of the members were held together by bolts, mortise and tenon joints and wrought iron pins. They are the "IKEA" bridges of their day. Bridge companies fabricated each member so that the structure was easily assembled on site.

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<sup>7</sup> Trail Towns. "Industrial Survey Along the Great Allegheny Passage." trailtowns.org <[http://www.trailtowns.org/1\\_studies.aspx](http://www.trailtowns.org/1_studies.aspx)> (accessed February 2014) 1-25.

<sup>8</sup> Allegheny Trail Alliance. *The Bollman Bridge: A Rare Iron Railroad* (Pittsburgh: ATA, 2007) 2.

<sup>9</sup> Ibid, 3.



**Figure 5-1:** Relocating the Bollman Bridge to the Allegheny Highlands in 2007.  
*Courtesy of Linda McKenna Boxx, Allegheny Trail Alliance*

The rehabilitation of historic bridges has significant and ongoing economic impact beyond the project itself. The project creates jobs, stimulates private investment and tourism, increases property values, enhances quality of life, and creates a sense of neighborhoods and community pride. Reinvestment in the historic built environment offers some of the best hope for improving communities through civic activism and

luring new residents to replace the ones that left. Governments at all levels have recognized that preservation and rehabilitation often requires incentives to get things started. Successful rehabilitation of bridges can be grass roots or local effort or can be funded by the government. Usually, the local grass roots efforts are the most successful because the locals have a vested interest in maintaining their neighborhoods and growing their economies. Even with an abundance of initiative from government and grass roots efforts, the task of finding a preservation “happy medium” with private railroad companies can be difficult.

### *Railroads and Preservation Policy*

One of the most difficult obstacles to railroad bridge preservation efforts is a lack of information about the number and type of bridge in each state. Although there has been significant effort to inventory highway bridges, a collective statewide inventory on railroad bridges does not exist. The Federal Railroad Administration maintains the National Grade Crossing Inventory;<sup>10</sup> however this inventory is not historic in nature nor does it contain any historic information except for the date the bridge was built. The purpose of the National Grade Crossing Inventory is to provide a database that can be applied to the improvement of safety at highway-rail intersections.

Railroad bridges are privately owned, making historic railroad bridges a generally unknown population to the general public. Railroad companies are hesitant to acknowledge the existence of historic structures. Many railroad companies perceive preservation as a heavy financial and clerical burden that they don't wish to sustain. In

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<sup>10</sup> Federal Railroad Administration, “National Grade Crossing Inventory” <[www.fra.dot.gov](http://www.fra.dot.gov)> (accessed February 2014) 1.

2013, the president of the Association for American Railroads noted that the National Environmental Protection Act and National Historic Preservation Act were obstacles to making a 2015 Federal Communications Commission’s regulatory process deadline for constructing and placing antenna structures. Railroads are required by the federal government to install more than 20,000 new antenna structures nationwide to transmit Positive Train Control (PTC) signals, a new safety device.<sup>11</sup> Almost ninety-seven percent of these will be relatively small poles installed on railroad rights-of-way.<sup>12</sup> According to the FCC, all PTC antenna structures are subject to the National Historic Preservation Act of 1966 that requires federal agencies to evaluate the impact of all federally funded or permitted projects on historic properties. Additionally, every PTC antenna could be subject to a separate Section 106 evaluation. This FCC regulation stands out as an example that historic preservation can be bothersome to railroads.

The Association of American Railroads, an industry trade group representing primarily the major freight railroads of North America, conducted a railroad bridge survey that identified 100,000 railroad bridges nationwide.<sup>13</sup> Approximately forty-seven percent of the bridges are of metal construction, thirty-five percent are of wood or timber

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<sup>11</sup> “Testimony of Edward R. Hamberger, President and CEO of the Association of American Railroads before the United States Senate Committee on Commerce, Science and Transportation” (Washington, D.C: Association of American Railroads, June 19, 2013) 10.

<sup>12</sup> Ibid, 23.

<sup>13</sup> Association of American Railroads, “Railroad Infrastructure Investment” [https://www.aar.org/keyissues/Pages/Infrastructure-Investment.aspx#.U1Gi6\\_lidWS0](https://www.aar.org/keyissues/Pages/Infrastructure-Investment.aspx#.U1Gi6_lidWS0) (accessed February 2014) 1.

construction and eighteen percent are of masonry construction.<sup>14</sup> U.S. railroads have an average of one bridge every 1.4 miles of track with an average length of 120 feet.<sup>15</sup>

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<sup>14</sup> Federal Railroad Administration, “Overview of Railroad Bridges and Assessment of Methods to Monitor Railroad Bridge Integrity” (Washington D.C.: U.S. Department of Transportation Federal Railroad Administration, 2004) 12.

<sup>15</sup> Ibid, 14.

## CONCLUSION

Metal truss railroad bridges are constants on the industrial landscape. They stand steadfast as meaningful, functional, and adaptable industrial heritage resources. For decades, industrial railroad bridges have aided in the connection of industries that sustained and shaped the communities that surrounded them. They are a constant reminder of a day gone by, symbolizing strength and durability while at the same time they remain standing like ghosts as reminders of deindustrialization. They tap into our consciousness as a symbol of American ingenuity. Industrial railroad bridges contain the capacity to symbolize a reimagining and reinvention of rust belt communities. The rehabilitation of the Union Railroad Rankin Hot Metal Bridge #35 and the South Side Hot Metal Bridge epitomize a renewed vision of what is possible in repurposing metal truss railroad bridges, while the Ohio-West Virginia Railroad Bridge illustrates some of the constraints involved in repurposing.

Industrial railroad bridges are interesting case studies in preservation because they represent advances in engineering, innovation and technology, having been constantly maintained and updated to facilitate increasing needs. Often, they are still in use and not accessible to the general public, making them difficult to include in a historic survey or district. However, these bridges embody the history of their communities, quietly existing as symbols of the past. The culmination of the work of metal truss bridge designers is highly visible in patented metal truss railroad bridges. Because bridges are utilitarian in nature, their rehabilitation must allow for a varied interpretation of meaning and authenticity. The engineers of the South Side Hot Metal Bridge incorporated new materials and engineering design techniques making the bridge safe and long lasting.



They rehabilitated the bridge in a way that was sensitive to history and function. The Hot Metal Bridge is historically and inherently an adaptable structure and is now a time capsule of engineering innovation.

Solutions for rehabilitating industrial railroad bridges are often elusive, like many preservation initiatives throughout the country. Economic incentives, bridge advocates and innovative partnerships, significance of place, and community identity are central themes in giving these bridges new life. Interwoven factors culminate to provide for rehabilitation of industrial railroad bridges. These equally significant factors must work in tandem in order to create the perfect conditions for rehabilitation.

It seems obvious that economic incentive is a powerful force behind the preservation of industrial railroad bridges. However, not so obvious economic drivers are making a big difference. Economic incentives such as the Rails to Trails Program are helping to drive tourism in small and large communities of the rust belt. Rails to Trails and their affiliates are succeeding at helping post-industrial communities in Western Pennsylvania and Eastern Ohio protect and interpret their industrial heritage resources, resulting in recognition of industrial railroad bridges. To that end, significance of place is an important component of a successful rehabilitation. If the railroad bridge can be easily integrated into a trail or a town close by, it is more likely that the community will come together to attempt to rehabilitate it. It is often likely that the same industry that sustained that community has gone away if the railroad has abandoned the bridge. Opportunity, however, often arises from an influx of tourism. Tourism is not always successful at maintaining heritage resources, but is a step in the right direction.

Community identity, bridge advocates and innovative partnerships combine to have a powerful effect on the successful rehabilitation of railroad bridges. U.S. Representative, Mike Doyle tirelessly lobbied for funds to rehabilitate the Union Railroad Rankin Hot Metal Bridge because of his personal connection to the bridge. His grandfather immigrated to Pittsburgh from Ireland at the turn of the twentieth century and built a career at Carrie Furnace that lasted for forty-one years.<sup>1</sup> Doyle's personal connection and identity influenced his advocacy for the bridge. This advocacy is the trigger for moving rehabilitation initiatives in a positive direction. Bridge advocacy is extremely important for the preservation of the bridge, whether it be the State Historic Preservation Office advocating or strong local support which usually involves important political support. Jonathan Daily, Cultural Resource Professional for the Pennsylvania Department of Transportation argues, "the one element that most often "wins the day" in deciding that a historic bridge will be restored and not replaced, is the involvement of one dedicated "champion", who will adopt the bridge as their cause, tirelessly advocating, enlisting the help of others, and seeing it through to the end."<sup>2</sup>

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<sup>1</sup> Louis Carsaro, "Plans heat up to preserve, revive Carrie Furnace site" *Pittsburgh Business Times* (April 2013) 1.

<sup>2</sup> Jonathan Daily, Cultural Resource Management for Pennsylvania Department of Transportation (Personal Interview, August 2013) pertaining to preservation of bridges.

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## Appendix A

PROGRAMMATIC AGREEMENT  
AMONG THE REDEVELOPMENT AUTHORITY OF ALLEGHENY COUNTY,  
ADVISORY COUNCIL ON HISTORIC PRESERVATION, AND THE  
PENNSYLVANIA STATE HISTORIC PRESERVATION OFFICER  
REGARDING THE REDEVELOPMENT OF THE CARRIE FURNACE  
REDEVELOPMENT PARCEL, ALLEGHENY COUNTY, PENNSYLVANIA BY THE  
REDEVELOPMENT AUTHORITY OF ALLEGHENY COUNTY

THIS PROGRAMMATIC AGREEMENT (the “**Agreement**”) is entered into this February 3 , 2012, by and among the UNITED STATES OF AMERICA, acting by and through the REDEVELOPMENT AUTHORITY OF ALLEGHENY COUNTY (“**RAAC**”) Pursuant to 40 U.S.C § 550(h) and 36 CFR § 800.14(b), the ADVISORY COUNCIL ON HISTORIC PRESERVATION (“**ACHP**”) and the PENNSYLVANIA STATE HISTORIC PRESERVATION OFFICER (“**PASHPO**”).

### WITNESSETH:

WHEREAS, RAAC owns and controls that certain property shown as Exhibit A attached hereto and incorporated herein known as the Carrie Furnace Redevelopment Parcel (being hereinafter referred to as the “**Property**”; and the disposition of the Property being collectively hereinafter referred to as the “**Undertaking**”);

WHEREAS, the Undertaking consists of preparing the Property for redevelopment, which may include excavation activities for foundations and infrastructure, construction of new buildings and roadways, grading and filling activities, installation of utility lines, and possible demolitions within the Property;

WHEREAS, the United states Department of Housing and Urban Development has delegated authority of RAAC to serve as “Lead Agency” for the Undertaking (Exhibit B);

WHEREAS, RAAC consulted with the PASHPO, pursuant to Section 106 of the National Historic Preservation Act of 1966 (16 U.S.C § 470f) (“**Section 106**”) (“**NHPA**”), and its implementation regulations (36 CFR § 800) to resolve the effect of the Undertaking on historic properties and is a signatory to this Agreement;

WHEREAS, RAAC notified the ACHP of the potential effect of this Undertaking pursuant to 36 CFR §§ 800.6 (a)(1) and 800.11(b), and ACHP has participated in the consultation process and is a signatory to this agreement;

WHEREAS, RAAC notified the NPS of the potential effect of this Undertaking pursuant to 36 CFR §800.11©, and NPS has participated in the consultation and has been invited to concur with this Agreement;

WHEREAS, the consulting parties for this Undertaking have been determined to be the National Park Service (“NPS”) the Borough of Munhall, the Borough of Rankin, the Borough of Swissvale, the Borough of Whitaker, Steel Industry Heritage Corporation (“SIHC”), the Pennsylvania Department of Transportation, the Steel Valley Trail Council, the Pennsylvania Turnpike Commission, the Swissvale Historical Society, the Mifflin Township Historical Society, Historical Society of Western Pennsylvania, and the Pittsburgh History and Landmarks Foundation (each a “**Consulting Party**” and collectively referred to herein as “**Consulting Parties**”);

WHEREAS, the Property contains the Carrie Blast Furnaces Number 6 and 7 National Historic Landmark District (“CFNHL”), which includes the Carrie Furnaces (“CF”) and the Rankin Hot Metal Bridge (“HMB”), and the parties hereto desire to ensure the long-term preservation, public accessibility, and stewardship of the CFNHL and HMB for future generations;

WHEREAS, ownership of the HMB has transferred from SIHC to RAAC, as outlined in a Lease and License Agreement, executed on May 26, 2010;

WHEREAS, the SIHC is the designated management entity for the Rivers of Steel National Heritage Area (the “RSNHA”) under the Omnibus Parks and Public Lands Management Act of 1996, P.L. 104-333, 16 U.S.C. § 1244 and in such capacity should have approval authority, as a signatory to this Agreement with respect to any provisions of this Agreement that relate to the following resources in the Rivers of Steel National Heritage Area eligible for inclusion in the National Register of Historic Places (“NRHP”): the CF and HMB (collectively, the “**Designated Resources**”);

WHEREAS, RAAC hired GAI Consultants, Inc. (“GAI”) to complete a Phase IA Cultural Resources Survey (“Survey”) to evaluate the archeological and historic architecture sensitivity of the Property;

WHEREAS, the Survey identified a total of forty-four (44) historic-era potentially eligible archaeological features within the Area of Potential Effect for archaeological resources (“APEA”), as defined at 36 CFR §800.16(d); the eligibility of which will be determined at a later date;

WHEREAS, the Area of Potential Effect (“APE”) for historic structures, buildings, sites, and districts, as defined at 36 CFR §800,16(d), includes all potential direct or indirect impacts to historic properties within audible and visual distance of the Property and is depicted on **Exhibit A** attached hereto and incorporated herein;

WHEREAS, the following resources were identified within the APE and are listed in or have been determined to be eligible for inclusion in the NRHP:

1. Bost Building/Columbia Hotel, 621-623 E. 8<sup>th</sup> Avenue, Homestead, Allegheny County (National Historic Landmark)

2. Homestead Historic District, Munhall and Homestead, Allegheny County
3. U.S. Steel (Carnegie Steel) Homestead Works Historic District, Munhall and Homestead, Allegheny County
4. Battle of Homestead/U.S. Steel Pump House/Pinkerton Landing Site, Munhall, Allegheny County
5. Pittsburgh, McKeesport & Youghiogeny (Pemickey) Railroad Bridge and Pittsburgh & Lake Erie Rail Road District, Allegheny County
6. Carrie Furnace 6 & 7 and the Hot Metal Bridge, Rankin, Whitaker, Swissvale, Munhall, Allegheny County (National Historic Landmark)
7. Baltimore & Ohio Railroad, Allegheny County
8. Kopp Glass, Inc., 2108 Palmer St., Swissvale, Allegheny County
9. Pittsburgh, Virginia & Charleston Railroad/Pennsylvania Railroad: Monongahela Division, Allegheny County

WHEREAS, the following resources were identified within the APE and have been determined not eligible for the inclusion in the NRHP::

10. George Rankin, Jr. Memorial Bridge, Rankin, Braddock, Whitaker, Allegheny County
11. Price House, 801 E. 8<sup>th</sup> Ave., Munhall, Allegheny County
12. Riggs House, 1054 E. 8<sup>th</sup> Ave., Munhall, Allegheny County
13. 1048 E. 8<sup>th</sup> Ave., Munhall, Allegheny County
14. Woolheater House, 1040 E. 8<sup>th</sup> Ave., Munhall, Allegheny County
15. Reuter House, 825 Whitaker Way, Munhall, Allegheny County
16. Bodnar House, 811 Whitaker Way, Munhall, Allegheny County
17. 10 Talbot Street, Rankin, Allegheny County
18. McGrady Brothers' Property, Mifflin Rd., Whitaker, Allegheny County
19. Stingi House, 1342 River Rd., Whitaker, Allegheny County
20. Stingi House, 1338 River Rd., Whitaker, Allegheny County
21. Boyce House, 1336 River Rd., Whitaker, Allegheny County
22. Patton House, 1326 River Rd., Whitaker, Allegheny County
23. Rall House, 1324 River Rd., Whitaker, Allegheny County
24. Lucarelli House, 1320 River Rd., Whitaker, Allegheny County
25. Marecic House, 1316 River Rd., Whitaker, Allegheny County
26. Mitchell House, 1314 River Rd., Whitaker, Allegheny County
27. Bernet House, 1312 River Rd., Whitaker, Allegheny County
28. Urso House, 1310 River Rd., Whitaker, Allegheny County
29. Shaffner House, 1308 River Rd., Whitaker, Allegheny County
30. Winters House, 1306 River Rd., Whitaker, Allegheny County
31. Rush House, 1304 River Rd., Whitaker, Allegheny County
32. Brian McClaren House, 1302 River Rd., Allegheny County
33. South Hills transmission, 1238 River Rd., Whitaker, Allegheny County
34. Tucibat House, 1234 River Rd., Whitaker, Allegheny County
35. Schuffert House, 1230 River Rd., Whitaker, Allegheny County
36. John/Sharon McClaren House, 1226 River Rd., Whitaker, Allegheny County
37. Brunetti House, 1222 River Rd., Whitaker, Allegheny County

38. Abt House, 1220 River Rd., Whitaker, Allegheny County
39. 1218 River Rd., Whitaker, Allegheny County
40. Bretzel House, 1216 River Rd., Whitaker, Allegheny County
41. Solack House, 1210 River Rd., Whitaker, Allegheny County
42. Mac's Automotive Service, 1204 River Rd., Whitaker, Allegheny County
43. 1204 River Rd., Whitaker, Allegheny County
44. Duquesne Light Company Power Station, Rankin, Allegheny County
45. 2<sup>nd</sup> and 3<sup>rd</sup> Avenue, Rankin, Allegheny County

WHEREAS, RAAC has, pursuant to Section 106 of the NPHA served public notice of the Undertaking in the Federal Register, the Pittsburgh Post-Gazette, and the Pittsburgh Tribune Review, in which said notice advised the public of the Undertaking and invited public comment;

WHEREAS, the potential for prehistoric-era archaeological resources has been determined to be very low, the tribal consultation has therefore not occurred nor will occur unless prehistoric resources are identified during the term of this Agreement. In such event, RAAC will initiate tribal consultation at that time with appropriate Native American tribal organizations who are federally recognized at the time and who may attached ancestral or historical association with the area of discovery;

WHEREAS, the parties to the Agreement recognize the long-term nature of the Agreement and thus the potential future need to contact, involve, and invite to participate in the Agreement, other entities (public and private), as appropriate;

WHEREAS, a portion of the Property may be converted into a National Park, and transferred to the NPS. At which point, portions of this document will need to be reexamined prior to any such transfer;

WHEREAS, the effects of the Undertaking cannot be fully determined prior to the approval of the Undertaking, and RAAC, ACHP, and the PASHPO desire to enter into this Agreement for the purposes set forth herein;

NOW, THEREFORE, in consideration of the terms, conditions, agreements, covenants, and restrictions hereinafter set forth, RAAC, ACHP, and PASHPO hereby agree that the Undertaking will be implemented in accordance with the following stipulations to take into account the effects of the Undertaking on historic properties and to minimize their adverse effects:

#### STIPULATIONS:

RAAC, shall ensure that the following stipulations are carried out:

##### A. General Stipulations

1. RAAC, in consultation with the PASHPO, RAAC will develop and implement an interpretative plan for the Property within three (3) years of the date of this Agreement. The PASHPO will review within thirty (30) calendar days of receipt of the document, the proposed interpretative plan before it is implemented, and RAAC in consultation with the PASHPO, SIHC will determine an appropriate strategy for making the interpretations plan available to the public.
2. RAAC, in consultation with the PASHPO will develop and implement a plan for continued Public Involvement within one (1) year of the date of this Agreement. RAAC, in consultation with the PASHPO, will review and update the Public Involvement plan every three (3) years during the term of the Agreement.
3. RAAC will conduct periodic, ongoing consultation with the signatories of this Agreement on a regular basis with the interval between consultations not to exceed three (3) years.
4. Due to the long term nature of the Agreement, RAAC, in consultation with the PASHPO, will contact and invite other agencies to become involved and participate in the Agreement, as needed, throughout the term of the Agreement.

#### B. Historic Resources

5. In the event that portions of the Property containing known historic resources will be subdivided and/or ownership transferred to another party, RAAC will ensure that a covenant is recorded on the parcel in the form attached hereto as **Exhibit C** in accordance with its terms.
6. RAAC, in consultation with the signatories to this Agreement and the Consulting Parties will develop specific design guidelines that will govern the design of any development on the Property (“**Guidelines**”). The purpose of these Guidelines will be to ensure that designs are sympathetic to the historic nature of the property. Prior to implementations of these Guidelines, RAAC will seek comments from the PASHPO.
7. RAAC, in consultation with the signatories to this Agreement and the Consulting Parties, will develop a design review process (“**Design Review Process**”), which will be included within the guidelines; the purpose of which is to ensure that future designs adhere to the Guidelines and are sympathetic to the historic nature of the property and surrounding resources.
8. If portions of the property are to remain under ownership of RAAC and be leased to tenants under lease agreements, RAAC and the PASHPO shall, within two (2) years of the execution of this Agreement, develop tenant

guidelines establishing what alterations, work, or ground disturbing activities can be done at the Property to assure conformance with the Secretary of the Interior's Standards.

9. Any development and/or construction occurring on the Property will be subjected to the Design Review Process in accordance with the Guidelines.
10. As development of the site is planned and progresses, and prior to implementation/construction of any planned development, RAAC shall provide the PASHPO, for their review and comment, individual reports on each planned phase of development. The review period will be thirty (30) calendar days. These reports shall include information on the specific planned development, including site plans and renderings where available, and statements relative to how the proposed plans meet the Guidelines. Further, RAAC will apply the Criteria of Adverse Effect in accordance with the 36 CFR §800.5, to determine if the proposed specific development plan will cause an Adverse Effect to those resources determined to be eligible for or listed in the NPHR (listed above). For resources listed as National Historic Landmarks, RAAC will also consult with ACHP and NPS (and to the extent affecting the Designated Resources, SIHC), in addition to the PASHPO on assessment of Adverse Effects.
11. If it is determined that an Adverse Effect will occur to an historic property, RAAC will consult with the PASHPO and ACHP (and to the extent affecting the Designated Resources, SIHC), in accordance with 36 CR §800.6 and §800.7 to develop appropriate plans to either avoid, minimize, or mitigate the adverse effect(s).
12. In the event that a decision is made to demolish the Hot Metal Bridge trestle north of the northern bank of the Monongahela River, and such demolition is determined to have an Adverse Effect upon the resources, RAAC, prior to demolition, and in consultation with the PASHPO and SIHC, will develop and implement a Level I historic American Engineering Record (HAER) documentation of the significant historic elements, which will be affected by the demolition. The details of this recordation and development of a Disposition Plan for these elements will be completed by RAAC within one (1) year of the date of this Agreement. Further, prior to demolition of any portion of the HMB, RAAC will explore options for reuse of those portions being demolished, including potential for salvage and reuse as part of the interpretative plan for the Property.
13. The signatories responsible for historic preservation work under this Programmatic Agreements shall ensure that such work is carried out by or under the direct supervision of a person or persons meeting at a minimum the Secretary of the Interior's Professional Qualification Standards for Architectural Historian Professionals (48 FR § 44738-9).



14. SIHC, in its capacity as the designated management entity for the RSNHA, shall have approval authority, as a signatory to this Agreement, with respect to any decision or action relating to Undertaking that directly affects the Designated Resources.
15. No exercise by any party hereto, or failure to such party to exercise, any power or right hereunder at any time shall operate as a waiver of the right to exercise such power or right at any later time, nor shall any single or partial exercise of any such power or right preclude any other or further exercise thereof or the exercise of any other power or right.

### C. Archaeological Resources

1. Prior to construction or activities, that could potentially disturb surface or subsurface soil, sediments, or deposits and penetrating to a depth equal to or greater than the elevation of ground surface as documented on the Property in February 2008, RAAC shall conduct a detailed surface survey of the Property for the purpose of documenting the locations of known, visible surface features associated with the historic-era use of the property. This survey shall be completed prior to the placement of any fill materials or ground disturbing activities.
2. In the event that portions of the property will be subdivided and ownership transferred to another party, RAAC will ensure that a covenant is recorded on the parcel in the form attached hereto as **Exhibit C**, in accordance with its terms.
3. RAAC shall follow the recommendations set forth in Section VI of the Survey and develop a program of archaeological monitoring, which will take place during potentially ground disturbing construction activities on the Property. This program shall be developed in writing and submitted to the PASHPO (and to the extent affecting the Designated Resources, SIHC for review and comment prior to commencement of any ground disturbing activities on the Property. The review period will be thirty (30) calendar days. The monitoring plan will provide for the monitoring archaeologist to have the authority to issue a “work stoppage” directive; at which point procedures established under Stipulation C.4 below will be implemented. Further the program of archaeological monitoring shall ensure that any such monitoring work carried out pursuant to this Programmatic Agreement is carried out by a person or persons meeting at a minimum. The Secretary of the Interior’s Professional Qualification Standards for Archeologists (48 FR § 44738-9)
4. Prior to construction and in accordance with Section VI of the Survey, RAAC shall conduct a Phase IB Archeological Investigation (“**Phase IB**”) on any portion(s) of the Property that will be subjected to ground disturbing activities.

These investigations will be conducted in a manner consistent with the “Secretary of the Interior’s Standards and Guidelines for Identification” (48 FR §§44720-23) and taking into account the NPS’s publication, “*The Archaeological Survey: Methods and Uses*” (1978:GPO stock #024-016-00091) and the PASHPO’s “*Cultural Resource Management in Pennsylvania: Guidelines for Archaeological Investigations*” (2008) (Bureau of Historic Preservation/**BHP Guidelines**)”

If the archaeological resources are identified, RAAC shall evaluate the eligibility of such resources for listing in the NRHP. This may involve conducting additional Phase II archaeological investigations in accordance with BHP guidelines for the purpose of acquiring sufficient level of information necessary to evaluate the site’s eligibility for NRHP listing. RAAC shall prepare a report on the findings of the archaeological survey for submission to the PASHPO and the Consulting Parties, as appropriate. RAAC will request the PASHPO’s concurrence on recommendations of eligibility. The review period will be thirty (30) days.

In the event that prehistoric resources are identified during the term of this Agreement, RAAC will initiate consultation with appropriate Native American tribal organization that are federally recognized at that time of discovery and who may attached ancestral or historic association with the area of discovery.

5. If NRHP-eligible archaeological resources are identified, RAAC will notify the PASHPO and will make a reasonable effort to avoid these archaeological sites and preserve them in place. If RAAC determines that disturbance of the archaeological sites cannot reasonably be avoided, RAAC will apply the Criteria of Adverse Effect, in accordance with 36 CFR §800.5. If the project will have an adverse effect on the resources, and if the resources are eligible for NRHP-listing chiefly under National Register Criterion D (36 CFR §63) for the significant information in prehistory or history they are likely to yield, RAAC will ensure that a data recovery plan or a plan for alternative mitigation is developed and implemented within thirty (30) calendar days. Any data recovery plan will be consistent with the Secretary of the Interior’s Standards and Guidelines for Archaeological Documentation (48 FR §§44734-37) and will also take into account the ACHP’s publication “*Recommended Approach for Consultation on Recovery of Significant Information on Archaeological Sites.*” The proposed data recovery or alternative mitigation plan will be submitted to the PASHPO for their review and comment. The review period will be thirty (3) calendar days. If archaeological resources are identified which are eligible under Criteria other than or in addition to Criterion D, RAAC shall comply with 36 CFR §800.6.
6. If mitigation is necessary, RAAC in consultation with the PASHPO will prepare public participation and public information materials within two (2)

years of the data recovery. The specific public outreach materials produced will be determined by RAAC in consultation with the PASHPO, individually for each site for which data recovery or alternative mitigation is deemed necessary and may include, but is not limited to, pamphlets, brochures, artifact displays, exhibits, or booklets on the history or prehistory (as appropriate) of the project area. The public information materials will explain the purpose of the Project, methods used to identify archaeological sites, results of the data recovery or alternative mitigation, and significance of the archaeological sites. RAAC will develop a proposal for the materials and will submit the proposal to the PASHPO for review and comment. The review period will be thirty (3) days. RAAC will forward a draft of any public materials to the PASHPO for review and comment prior to finalizations of the materials. The review period will be thirty (30) days.

7. RAAC shall prepare a report on any data recovery or alternative mitigation undertaken. A draft report will be completed within 18 months of conclusion of the data recovery excavations or alternative mitigation study. Reports will be provided to the PASHPO and Consulting Parties as appropriate. Data Recovery reports will meet professional standards set forth by the Department of the Interior's "Format Standards for Final Reports of Data Recovery Programs" (42 FR §§5377-79) and will be prepared in accordance with the BHP Guidelines. RAAC will take into account any comments received in the preparation of a final report.
8. RAAC shall ensure that any human remains and/or grave-association artifacts encountered during archaeological investigations are brought to the immediate attention of the PASHPO. Notification will be within twenty-four (24) hours of discovery. A field view of the site will take place within seventy-two (72) hours of notification. No activities that might disturb or damage the remains will be conducted until RAAC, in consultation with the PASHPO, has determined appropriate treatment. All procedures will follow applicable federal and state law, which may include the Native American Graves Protection and Repatriation Act of 1990 (PL 101-601) and will follow the PASHPO's "*Policy for the Treatment of Burials and Human Remains*" (1993) and the ACHP's "*Policy Statement Regarding Treatment of Burial Sites, Human Remains, and Funerary Objects*" (2007).
9. All records and materials resulting from archaeological investigations that are not privately owned will be curated in accordance with 36 CFR §79 and the curation guidelines developed by the PASHPO (June 2006). RAAC will ensure that all artifacts that are not privately owned and resulting documentation are curated with the state Museum of Pennsylvania/Pennsylvania Historical and Museum Commission, Harrisburg or other appropriate local repository to be agreed upon by RAAC, and PASHPO, and the Consulting Parties, as appropriate.

10. The signatories responsible for archaeological work under this Agreement shall ensure that such work carried out pursuant to this Programmatic Agreement is performed by or under the direct supervisor of a person or persons meeting at a minimum The Secretary of the Interior's Professional Qualification Standards for Archaeologists (48 FR §44738-9).

11. Late Discovery

- a. If any unanticipated discoveries of historic properties or archaeological sites are encountered during the implementation of this Undertaking, all work will cease in the immediate vicinity of the discovery. RAAC will, in accordance with 36 CFR §800.13, notify the PASHPO within twenty-four (24) hours. RAAC and the PASHPO will conduct a joint field view within seventy-two (72) hours of the notification. RAAC, in consultation with the PASHPO will develop a treatment plan for the discovery prior to the resumption of construction activities in the area of the discovery.

D. Administrative Stipulations

1. Any party to this Agreement may propose to RAAC that the Agreement be amended, whereupon RAAC shall consult with the other parties to this Agreement to consider such an amendment. An amendment will go into effect upon written concurrence by all signatories.
2. RAAC shall provide PASHPO (on a biannual basis) a report detailing activities that have taken place during the previous two (2) years as well as planned activities for the next two (2) years. This report shall be provided to PASHPO at least sixty (60) calendar days prior to the sale or development of any parcels planned within the next two (2) year period. The PASHPO will have thirty (30) calendar days to review and provide comments on the proposed actions to RAAC.
3. RAAC will meet annually with the signatories to this Agreement on a face-to-face basis for the purposes of discussing any amendments, problems, conditions, or changes with or to this Agreement, as appropriate. Additionally, during this meeting, signatories will discuss the need to invite additional signatories to the Agreement.
4. Resolving Objections
  - a. Should any signatory to this Agreement object at any time to actions proposed or the manner in which the terms of the Agreement are implemented, RAAC shall consult with such party to resolve the objection., If RAAC determines that such objection cannot be resolved, RAAC will:

- i. Forward all documentation relevant to the disputer, including RAAC's proposed resolution, to the ACHP. The ACHP shall provide RAAC with its advice on the resolution of the objection within thirty (30) days of receiving adequate documentation. Prior to reaching a final decision on the dispute, RAAC shall prepare a written response that takes in account any timely advice or comments regarding the dispute from the ACHP, the signatories to this Agreement, and the Consulting Parties, as appropriate, and provide them with a copy of this written response. The signatories agree to proceed according to the final decision of the RAAC.
  - ii. If the ACHP does not provide its advice regarding the disputer within the thirty (30) day time period RAAC may make a final decision on the disputer and proceed accordingly. Prior to reaching such a final decision, RAAC shall prepare a written response that takes into account any timely comments regarding the disputer from the signatories to this agreement and/or the Consulting Parties, as appropriate, to the Agreement, and provide them and the ACHP with a copy of such written response. The signatories agree to proceed according to the final decision of RAAC.
  - iii. The responsibilities of RAAC to carry out all other actions subject to the terms of this Agreement that are not the subject of the dispute remain unchanged.
- b. Resolution of Objections by the Public
  - i. Should any objection pertaining to the implementation of the terms of this Agreement be raised by a member of the public, RAAC shall notify the parties to this Agreement and take the objection into account, consulting with the objector in writing, followed by a face-to-face meeting, as appropriate.

## 5. Sunsetting and Duration

- a. If the terms of this Agreement have not been implemented within twenty (20) years after the execution of this Agreement, it shall be considered terminated, and RAAC shall proceed according to Stipulation D.6.d below.

## 6. Termination

- a. If a signatory determines that the terms of this Agreement cannot be implemented, or the Agreement is not being properly implemented, the signatory may propose to the other parties to this Agreement that it be terminated.
- b. The signatory proposing to terminate this Agreement shall so notify all signatories to this Agreement and the Consulting Parties, explaining the reasons for proposed termination and affording them at least thirty (30) days to consult and seek alternatives to termination, which may include amendments. The parties shall then consult.
- c. Should such consultations fail, the signatory may terminate the Agreement by so notifying all signatories to this Agreement and Consulting Parties in writing.
- d. Should this Agreement be terminated, RAAC shall either:
  - i. Consult in accordance with 36 CFR § 800.6(a)(1) to develop a new Programmatic Agreement; or
  - ii. Request, consider, and respond to the comment of the ACHP, pursuant to 36 CFR §800.7.

Execution of the Programmatic Agreement by RAAC, ACHP, and the PASHPO, and implementation of its terms, evidence that all parties have taken into account the effect of the Undertaking on historic properties.