ABSTRACTS

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Session I: 8:30 - 10:00

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Panel I.A: *Rehabilitating Industrial Artifacts*
Chair: Robert Vogel
(Meeting Room 2)

Rehabilitation of the Monocacy and Conococheague Aqueducts of the Chesapeake and Ohio (C&O) Canal

Denis J. McMullan, P.E.
McMullan & Associates

Robert J. Kapsch, Ph.D.
National Park Service

The Chesapeake and Ohio (C&O) Canal National Historical Park administers a 185-mile long historic canal that extends along the north bank of the Potomac River and linked the ports at Georgetown in the District of Columbia to the coal-rich areas of Cumberland, Maryland. The C&O Canal began in 1828 and was completed in 1850. It operated until 1924 when a major flood put the C&O Canal out of business. It was designated a National Historical Park in 1971 and represents probably the finest surviving example of America's canal age.

The Monocacy Aqueduct is the largest of eleven masonry arch aqueducts constructed along the C&O Canal. It is considered one of the most important engineering accomplishments of the C&O Canal Company. Designed by Benjamin Wright in 1828, it was built from 1829 to 1833 and enabled the canal boats to cross over the Monocacy River. The seven span, 516-foot long example of cut masonry was widely considered in its day to be one of the finest examples of masonry construction built in the United States or Europe.

A temporary steel banding support system was installed on this aqueduct in the mid 1970s as a result of flood damage that threatened the structural integrity of the masonry aqueduct. The condition of the steel banding and wood blocking system has deteriorated. There is major scour damage at most of the piers. Without intervention, portions of the aqueduct, along with the associated cultural values, will be permanently lost. This paper will discuss the plans developed by McMullan & Associates and the National Park Service to rehabilitate this important engineering structure.

The second largest aqueduct on the C & O Canal is the Conococheague Aqueduct in Williamsport, Maryland. The upstream parapet has collapsed several times. Floods have also damaged the 260-foot long Conococheague Aqueduct. This three-span masonry arch structure also suffered damage during the Civil War.

The upstream spandrels, berm parapet and portions of the ring arches have collapsed into the river. Plans have been devised to rebuild the missing spandrel walls, berm parapet, and ring arches utilizing the results of extensive testing, computer modeling and a pilot study.

To develop plans for the rehabilitation of the Monocacy and Conococheague Aqueducts, the National Park Service's consultant, McMullan and Associates, had to adapt British engineering standards and techniques, as similar U.S. standards and information for masonry arch structures do not exist.

A Report on the Rehabilitation of the Cast Iron U.S. Capitol Dome

Eric C. Stovener, S.E.
LZA Technology/Thornton-Tomasetti Group, Tustin, California

Emmanuel E. Velivasakis, P.E.
Charles H. Thornton, Ph.D., P.E.
Glenn G. Thater
Christopher P. Pinto
LZA Technology/Thornton-Tomasetti Group, New York, New York

The United States Congress authorized in 1990 a capital program for the renovation of the Dome of the United States Capitol to address concerns of a perceived increase in exterior cracks and water infiltration.

A master plan for rehabilitation was prepared. In 1998, a comprehensive structural analysis was performed. Construction began in 1999 with access provided to interstitial spaces for their lead abatement and repairs to non-structural elements; this work was completed in 2000. Construction is scheduled to begin in 2001 for abatement and repair of exterior surfaces.

The current Dome was built in the 1850s to 1860s atop a Rotunda brick and limestone wall that was built in the late 1810s and had originally supported a lighter, smaller timber dome. The diameter of the current Dome is approximately 100 ft and the height, from the top of the statue to the supporting walls, is approximately 190 ft. The majority of the Dome, complete with its inner and outer shells and lower skirt, is comprised of cast iron. The remainder of the Dome elements are wrought iron. At 4450 tons, the Dome was a crowning achievement in the use of materials and construction methods and remains a powerful symbol of our nation to this day.

This paper will present the history of the Dome, including its design and construction, as well as the role of the SIA Original Chapter's namesake, Montgomery C. Meigs. The speaker will also present the structural analysis and rehabilitation techniques of the Dome.

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Panel I.B: *Pennsylvania from East to West*
Chair: Gray Fitzsimons
Lowell National Historical Park
(Meeting Room 3)

A Survey of Pittsburgh's Leather Industry: 1800-2000

David S. Rotenstein
Dames & Moore

Much of Pittsburgh, Pennsylvania's industrial heritage was hewn from coal, iron, steel, and glass. Alongside these industries there existed a matrix of craft processing that provided the raw materials that enabled Pittsburgh's heavy industries to grow and thrive. Leather making was one of those industries. For two centuries, Pittsburgh was home to craftspersons transforming byproducts from slaughtered meat animals into leather and wool. This paper explores the transformations of Pittsburgh’s leather industry from the generalized workshop tanneries of the early Republic to the tanning factories of the late nineteenth century to the industry’s twentieth century decline by examining the landscape and social dynamics that contributed to the industry’s development and life cycle. The technology of tanning and the integration strategies employed by Pittsburgh’s tanners are analyzed against a backdrop of immigration history, improved transportation networks, environmental constraints, and local and global markets.

Rural Industries and The Pennsylvania Mainline Canal System

Dr. Paul Marr
Shippensburg State University

During the Middle 1800’s the Mainline canal system offered Pennsylvania industries a cost effective means of moving low value, high weight commodities to distant markets. Two of the industries that saw immediate benefits from the canal system were lumber and iron. Prior to completion of the canal, both were typically small, rurally based industries serving local markets. With the opening of the canal system, these industries experienced dramatic changes in their markets and scale of operation. The lumbering industry evolved from spatially diffuse family operations that were often tied to the expansion of agricultural lands, to an industry that was spatially concentrated. The iron industry followed a similar pattern of change, shifting from small, diffuse, rurally based operations to large, highly concentrated operations. While similarities between these two industries existed, it is their differences that are of particular interest. Lumbering shifted in the scale of operation and became more spatially concentrated, but the industry remained rurally based and its location never moved far from the source of raw materials. Conversely, the iron industry, which had also been focused on the locations of the raw materials, shifted from these rural areas and became concentrated in the larger urban centers. This presentation will investigate the role that the Pennsylvania Mainline canal system played in the early development and evolution of these two industries. Other factors contributing to the changes in these industries, specifically capitalization and technology, will also be addressed.

The Chadds Ford Water Powered Generating Station

Robert Howard
Anchorage Productions

Before the large interlocking power grids, there were many small water-powered generating stations serving micro areas. In the Chadds Ford Pennsylvania area one survives almost completely in tact. It is a direct current operation supplying batteries. Besides the physical operation which was shown in the Fitz catalog, and was considered by the maker as a prototype, there are at least a hundred documents in the Hagley Library. These documents are to and from Fitz and the owner describing all the problems in building the plant and some of the operational difficulties. The “mill” property is being restored to operational status and will be used for educational purposes. The paper will show the site, restoration process and describe its history from building to the demise when larger plants made the small stations obsolete.

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Panel I.C: ***Locating and Presenting Historic Industries***
Chair: Lisa Davidson
National Park Service
(Meeting Room 4)

Surviving Historic Industries

Daniel Bonenberger
Institute for the History of Technology and Industrial Archaeology

In 1999 the Institute for the History of Technology and Industrial Archaeology (IHTIA) started an investigation of rare industrial processes and working machinery that survive from 1790 to 1940. We discovered that only a handful of these historic industries survive commercially today. Surviving historic industries are often referred to as *anachronistic* industries or heritage industries. They offer an irreplaceable window on the past.

We first analyzed earlier lists of anachronistic industries compiled 1970-1983 by the Smithsonian, the Society for Industrial Archaeology, and HAER. These lists were combined, culled, and expanded. The scope was broadened in 2000 to include industrial living history exhibitions that function for demonstration purposes. The working GIS database of nearly 100 industrial film repositories will be unveiled on the IHTIA web site in 2001. Illustrations and examples of anachronistic industries will be added to the site as the search for more survivors continues. Each site will be classified in a number of ways (i.e. industry type, products, location, whether open to tourists, listed on the National Register). A planned guide to surviving historic industries (2003) will be a useful resource for identifying sites, film footage collections, and related organizations by subject and location.

Industrial Heritage Tourism in Europe

Dr. Wolfgang Ebert
German Society of Industrial Heritage

Within the last decades Industrial Heritage Tourism became more and more popular in Europe. Several old industrialized areas have looked for a sustainable development of their heritage and noticed, that heritage tourism could be a chance, to develop a new economic future. Good examples are the Bergslagen region at Sweden, the Mining Trails at Austria or the “Route of Industrial Heritage” at the Ruhr, Germany. A new project is now entering the stage: “ERIH - European Route of Industrial heritage” which one day wants to cover all the most important sites in Europe, starting soon with a model where the UK, The Netherlands, Belgium and parts of Germany will be linked.

Washington and the National Meridian

Richard Quin
National Capital Region, NPS

With the birth of the new Republic, Americans wanted to proclaim their independence from Great Britain not only politically but also celestially. Dropping dependence on the Greenwich meridian would not only make for easier measurements and the regulation of time, but would also reflect America as a power of its own. Beginning in 1791, a series of new meridii were established in the new capital of Washington, culminating in the 1850 National Meridian along the 16th Street corridor. This paper explores the story of the establishment of a National Meridian and other measurement features such as the Zero Milestone.

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Panel I.D: *18th Annual Historic Bridge Symposium*
Organizer and Chair: Eric DeLony
(Meeting Room 5)

Advocating and Educating for Bridge Preservation in Rural Northern New York

Steven Engelhart
Adirondack Architectural Heritage

The Adirondack region is blessed by extraordinary natural resources - forested mountains, miles of rivers and streams, and hundreds of lakes - and a remarkable number of small communities, many of which began as 19th century industrial villages. These villages produced iron products, textiles, wood products, and other finished materials by utilizing power from their rivers, by extracting the abundant natural resources at hand and by ingenuity. In part, because the region has not been subject to many of the dramatic changes of the late 20th century, many late 19th and early 20th century bridges have survived into the present. One of the challenges faced by Adirondack Architectural Heritage (AARCH), the non-profit, historic preservation organization for the Adirondack Park, and other advocates for the preservation of these bridges has been how to convince the public and government officials to see these structures as assets worth preserving. Over more than a ten year period, this has been done is several ways - by mounting a public education campaign, by developing alternatives to replacement, by forming partnerships, and by providing persistent advocacy on their behalf.

The largest group of historic bridges in the region are found along the Au Sable River and its tributaries, including a stone arch, a covered timber truss, a wire suspension foot bridge, metal trusses fabricated by five different companies, a steel arch bridge and several stone-faced concrete arch spans. Greater public and governmental support for the preservation of these bridges has been generated in a variety of ways, including by undertaking a comprehensive historic bridge survey, by placing sixteen bridges on the National Register of Historic Places, by designating three bridges in Keeseville as a National Historic Civil Engineering Landmark, by publishing *Crossing the River,* through good press and publicity, and by working with the bridges' owners to find sources of funding for their rehabilitation. All this has led, directly or indirectly, to rehabilitation work on the Jay Covered Bridge (1857), the Stone Arch Bridge (1843) and Upper Bridge (1878), the Au Sable Chasm Bridge (1932), the Wilmington Bridge (1934), and the Notman (1913) and Beer's (c. 1900) Bridges in Keene Valley.

In addition, scattered throughout the region, are other historic metal, stone, concrete, and timber bridges. AARCH has been most involved with efforts to save the Hadley Bow Bridge, an 1890 parabolic, half-deck truss bridge over the Sacandaga River. In 2000, with AARCH's help, Saratoga County was able to obtain a grant to have an engineer do an historic structures report for the bridge, which may provide the basis for its rehabilitation. AARCH has also helped to get an 1876 timber truss bridge transferred from private to non-profit ownership and to raise money for planning and restoration work. It also continues to advocate and educate by offering slide lectures and sponsoring tours of historic bridges. All of this has added up to some moderate successes in preserving the historic bridges of the region.

The Tragedy and Triumph of the Quebec Bridge

William D. Middleton

The long struggle to bridge the St. Lawrence River at Quebec lasted almost 70 years from the time the idea was first seriously studied in the mid-19th century until the Prince of Wales formally opened the completed structure in 1919. Along the way there were several proposals for a suspension or cantilever bridge at the site that never materialized. A plan for a record cantilever span finally moved forward at the beginning of the 20th century, only to end in the tragedy of one of the greatest construction failures of all time, when the still-incomplete structure collapsed into the river in 1907 with a loss of 75 lives. From the ruins of this first attempt emerged still another plan. By 1916 the great bridge was nearing completion when tragedy struck once again. As the huge center span was being lifted into place to complete the bridge it fell into the river, taking another 11 lives. A replacement finally was lifted into place a year later, and the great bridge was finally complete. More than 80 years later, the Quebec Bridge still stands firmly astride the St. Lawrence, safely carrying the commerce of Canada across the broad waters of the river. No one has yet built a longer cantilever span, and the bridge still stands today as the greatest of its kind ever built, recognized as an International Historic Civil Engineering Landmark by the American Society of Civil Engineers and the Canadian Society for Civil Engineering, and as a National Historic Site by the Department of Canadian Heritage.

The presentation will provide an account of the long effort to build a bridge across the St. Lawrence at this difficult site, with particular emphasis on the extraordinary story of the failure of the first bridge, the human tragedies that accompanied it, and the lessons that it holds even today for engineers and builders as they continue to extend the boundaries of technology. The presentation will be illustrated with slides.

Works - In - Progress

"If You Can't Lower the River, Raise the Bridge"

David A. Simmons
Ohio Historical Society

The Zoarville Bridge in Tuscarawas County, Ohio, is among America's most significant bridges. It is the only known example of a Fink through truss, and is the sole example of a structure built by the Baltimore Bridge Company or that can be directly associated with Charles Shaler Smith, one of America's leading nineteenth-century engineers. Built in 1868 as part of a three-span structure in Dover, Ohio, this single span was relocated to a rural highway north of town in 1905. Abandoned in the early 1940s, it was acquired by the adjacent property owner in 1969 to sell as scrap. Although never scrapped out, annual floods caused by the downstream Dover Dam resulted in corrosion in the bottoms of the vertical Phoenix columns extensive enough to threaten the bridge's structural integrity.

The new owner of the bridge, a foundation operating a nearby youth camp, has devised a preservation project that involves disassembly and restoration of deteriorated components. The abutments will be built-up twelve feet and new earthen ramps constructed to provide access to the new elevated location. Here, high enough to avoid the recurrent floods, the bridge will serve as part of a cross-country hiking trail for the camp.

"Yesterday's bridge for today's students to become tomorrow's business leaders"

Todd A. Milano
Central Pennsylvania College

Central Penn, a growing college just outside Harrisburg, Pennsylvania, is currently doubling the size of its academic facilities. A bridge is needed to connect existing facilities with a proposed 50,000 square foot Academic Technology Education Center. The college president will deliver a 10-15 minute Works-in-Progress report on the Ontelaunee Creek Bridge, which has been identified as the bridge of choice.

The Ontelaunee Creek (Moser's) Bridge is a 90-foot single-span, wrought-iron, bowstring truss bridge based on the 1969 patent of Joseph Henszey. It has a lower cord assembly, horizontal bars that arch below the bars from the end supports and midspan. It was moved once before - in 1900.

Relocation efforts of this circa 1869 bridge have resulted in a partnership being formed with four senior Engineering students from Bucknell University, who have embraced this project as their capstone experience. Also assisting are representatives from the Pennsylvania Department of Transportation, owners of the historic bridge which has been sitting unused since 1986. Working together, the complex and delicate task of safely transporting the bridge from its present site to the campus of Central Penn is our hoped-for vision. Renovation efforts can then begin to ensure preservation of the National Register-listed resource for generations to come.

Others supporters of this project are alumni of the college, politicians, representatives from the Pennsylvania Historical Museum Commission, the Pennsylvania Department of General Services, and other professionals.

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Session II: 10:30 - 12:00

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Panel II.A: *The Urban Infrastructure*
Chair: Helena Wright
(Meeting Room 2)

Capitalizing on the Hill: The History, Impact, and Remains of the Washington, DC Streetcar System, 1862-1962

Steven R. Strohmeier
Scenic America

This study examines the unique and overlooked history and development of Washington, DC's streetcar system and its impact upon the city. The development of Washington was a direct result of planned streetcar expansions, which in turn were influenced by the growth of the federal government and rising numbers of federal employees. The steady expansion of the federal government provided Washington streetcar companies with a reliable passenger base for over 80 years, an anomaly among American traction companies.

Washington's streetcars were also unique in that Congress had power over their chartering, routing, fares, and most importantly, their regulation. Due to aesthetic concerns, and experience gained from exposure to traction systems in other parts of the country, Congress voted in May 1890 to ban horse cars and overhead wires from the city. These requirements led to a mishmash of experiments that eventually saw conduit, horse, cable, pneumatic, and storage cell cars operating on Washington's streets simultaneously— truly a unique phenomenon. By 1900, consolidations left Washington with only two major traction companies operating on a conduit system, a method of power supply Washington shared with only a handful of cities, including London and New York.

In addition, Washington's adoption of new technology affected the growth of the city. The area's steep terrain meant that mass transit was not possible outside of the central city before the advent of mechanical traction. As a result the city did not expand beyond its central core until the 1880s. The development of suburbs and outlying neighborhoods was coordinated to a large degree with planned streetcar extensions and real estate prices in Washington were set in accordance to a property's proximity to a street car line!

The final part of this study focuses on the remains of Washington's streetcar system as of August 2000. The author conducted an extensive walking tour of the CTCo routings circa 1950, identifying several extant CTCo buildings and tracks, as well as dozens of contemporary structures and street alignments that reveal the impact of the system on the city. No interpretation exists of these structures and most Washingtonians are unaware of their significance.

Bringing the Finger Lakes to Syracuse: The 19th Century Challenge of Finding a Municipal Water Supply for the Salt City

Dennis J. Connors
Onondaga Historical Society

Like many American cities, Syracuse, New York struggled with an inadequate municipal water supply during much of the 19th century. This Central New York community grew rapidly after completion of the Erie Canal in 1825. Its population expanded from 2,565 in 1830 to over 43,000 by 1870. Early privately owned systems, based on springs, were supplemented at mid-century by water drawn from small creeks flowing through the city. An interesting system of small reservoirs and pump houses was constructed, but both quantity and quality remained serious concerns. On at least two occasions, major 19th century fires in downtown Syracuse threatened massive destruction when firefighters could not secure sufficient water pressure. In 1885, one system intake was located downstream from the effluence of a tannery and glue factory.

By 1888 a municipal commission was launched to study the problem. After looking at various alternatives, a decision was reached to tap into the waters of Skaneateles Lake, lying across hilly terrain nearly 20 miles to the west. Construction of an intake system, a lengthy iron conduit and a new 121-million gallon Syracuse reservoir were huge undertakings. But they were successfully completed in 1894, and still serve as the city's primary water system, complete with original reservoir and associated buildings.

Utilizing several slides of historic and contemporary images, this paper will examine the social and physical history if Syracuse's 75-year struggle for an adequate water supply, culminating in a review of the 1890-94 construction of the Skaneateles to Woodland Reservoir system.

Early Urban Water Supply in Philadelphia

Jane Mork Gibson

Just two centuries ago, urban water supply was successfully provided to citizens in Philadelphia in January of 1801, marking the first time a municipality had assumed this responsibility. There had been a public outcry for "pure and potable water" since a massive yellow fever epidemic in the summer of 1793, and the pressure for action accelerated with the return of the disease in 1798. After extensive debates in the city's Select and Common Councils, Benjamin Henry Latrobe's plan for a steam-powered pumping system was adopted. Nicholas Roosevelt at his Soho Works in New Jersey constructed two large steam engines at a time when no one in the United States had experience for such in undertaking, resulting in major difficulties. The main pump house designed by Latrobe was architecturally stimulating in the neoclassical style, but was an interior disaster. The water distribution system was well thought out and became the model for gas and electric utilities in later years. With the need to increase the supply and continual problems in operation, the city sought to improve the system. In 1814 the Fairmount Water Works took over the duty of providing water to the city, using both a low-pressure engine and a new Oliver Evans high-pressure engine. This was a major improvement and served the city until 1822 when Fairmount Water Works became famous as a water-powered system.

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Panel II.B: ***IA of Government Facilities***
Chair: Duncan Hay, National Park Service
(Meeting Room 3)

U.S. Army Engineers and Development of Iron Skeleton Lighthouse Construction

Sara Wermiel

Although the idea of iron skeleton lighthouses originated in Great Britain, Americans adopted and developed the technology in the nineteenth century and made skeleton lighthouses a characteristically American type of lighthouse structure. About fifty of the structures had been built by the 1870s; they were the featured type in the lighthouse engineering display at the U.S. Centennial Exposition of 1876. The small, "Cottage" version of these lighthouses - dozens of which once dotted the Chesapeake Bay - are well known to Washington-area lighthouse enthusiasts, although only four of them survive. But remarkably, some of the largest and most technologically daring examples were the earliest ones, erected in the 1850s off the Florida coast. Several of these now nearly 150-year-old structures are still doing lighthouse service.

Since the founding of the nation, the federal government built all lighthouses. Congress assigned the task of erecting the nation's first iron lighthouses to U.S. Army engineers. It was under their direction - implementing the early projects and, later, as engineers to the lighthouse service - that the technology evolved. In this paper, I trace the origins of the iron skeleton lighthouse idea, the reasons America adopted the system, the early development of the technology (1847-1861), and the use of the system in the latter nineteenth century. I will explain the role of U.S. Army engineers - officers of the Corps of Topographical Engineers and Corps of Engineers - in the development of the system. My talk will be illustrated with pictures of the lighthouses.

The Virginia Shipbuilding Corporation, 1918-1921

Edward Morin
URS Corporation

A Phase II archaeological investigation of the Virginia Shipbuilding Corporation Site (44AX78) was conducted by the Potomac Crossing Consultants (PCC) and URS Corporation (URS) for the Federal Highway Administration (FHWA) and the Virginia Department of Transportation (VDOT). The goal of the investigation was to formally evaluate and document the National Register eligibility of the site, which is located in Jones Point Park in Alexandria, Virginia. The Virginia Shipbuilding Corporation was constructed at Jones Point in 1918 in an effort to enlarge the merchant fleet during World War I. Prior to 1910, Jones Point was a thin peninsula extending into the Potomac River. However, in 1910, the Army Corps of Engineers filled the cove to the east of the peninsula (known as Battery Cove) and enlarged Jones Point to its current 46-acre size. The shipyard, therefore, extended over the original point and the filled-in Battery Cove. The yard once consisted of approximately 22 primary buildings of brick and concrete and some steel-frame construction, a fitting out dock and four reinforced concrete shipways. It was contracted to build twelve 9,400-ton steel cargo ships. When the war ended, this yard and others like it were no longer needed and shipbuilding operations were discontinued. This paper will present the results of both the historical and archaeological investigation investigations of the shipyard.

Can a Buzzard Fly? - The National Advisory Committee on Aeronautics (NACA) and Some Early Facilities for Aerodynamics Research at Langley Air Force Base

Robert Stewart
Historical Technologies, Inc.

This paper describes three research facilities dating from the 1930s that were instrumental in developing modern aircraft designs. Early aeronautical researchers constructed wind tunnels to learn about the forces generated by air flowing over aircraft surfaces. They quickly discovered that at atmospheric pressure, all the aerodynamic characteristics of a small model could not be directly correlated to the flight performance of a full-sized aircraft. In 1931 NACA built a wind tunnel capable of testing full-sized aircraft. It was instrumental in improving the design of aircraft used in WWII.

As aircraft speed increased NACA noted the need for a wind tunnel capable of testing complete models of aircraft and aircraft components in a high-speed airstream approaching and surpassing the speed of sound. The most important contributions of the high-speed tunnel were in defining the causes and cures for severe adverse stability and control problems encountered in high-speed dives. This tunnel also produced design data for the high-speed cowling shapes used in World War II aircraft and efficient air inlets for jet aircraft. After WWII it produced information leading to the discovery of fundamental engineering data used in supersonic aircraft design.

Aeronautical engineers recognized that the airplane on the water has problems that are not shared by the airplane in the air or on the landing strip, and in 1929 NACA decided to conduct research in hydrodynamics. The chief test facility for seaplane hulls was a 2960 foot long tank with a tow carriage capable of testing hull models at speeds of up to 80 mph. The facility was instrumental in developing hull designs of most “flying boats.” It continues in use as a facility for testing torpedoes.

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Panel II.C: ***Industry in the Great Lakes Region***
Chair: Susan Trail
Monocacy NB, NPS
(Meeting Room 4)

Archaeological and Historical Investigations of Pittsburgh and Boston Copper Harbor Mining Company Operations, Copper Harbor, Keweenaw Peninsula, Michigan

Michael J. Madson
Michigan Technological University

In the summer of 1844 a group of eastern investors initiated copper mining operations at Copper Harbor in Michigan’s Upper Peninsula. The company opened three vertical shafts adjacent to the U.S. Army’s Fort Wilkins, and in the summer of 1845 employed between 30 and 40 people, primarily contract miners. The company erected timber structures in the vicinity to house workers, supplies, and to enclose support activities, including a blacksmith shop and cooperage. After the lack of profitable results in the Fort Wilkins vicinity, the company shifted efforts another leased location southwest of Copper Harbor and soon abandoned their operations in the area, probably by summer 1847.

Michigan Technological University, under an agreement with the Michigan Historical Center, conducted pedestrian survey and excavation in the summer of 2000 within the boundaries of Fort Wilkins State Park (20KEI31. Analysis of artifacts and subsurface features in excavation units identified a portion of the company's blacksmith shop, including a forge base, slag, structural timbers, blacksmithing and coopering tools and debris, and mining related implements including hammers, a pick, and drill steel bits. In addition, MTU archaeologists identified and excavated a local stone and refractory brick hearth, possibly a roasting furnace or an experimental smelter for copper ore processing. Contemporary geological reports, travel journals, Pittsburgh and Boston Company and U.S. Army documents and maps, General Land Office survey notes and maps, and archaeological data contribute to a greater understanding of the history of early copper mining in the region. The blacksmith shop remains and the large hearth feature, both associated with the company's mining operation, are evidence of the efforts to exploit mineral resources at one of the earliest copper mines in the Keweenaw Peninsula.

The Soudan Mine and Its No. 8 Engine House

Amanda M. Gronhovd
Statistical Research, Inc.

This paper discusses the history of the Soudan Mine, and demonstrates the relationship between regional and corporate histories and the development of the mine's No. 8 Engine House. In 1880, Charlemagne Tower and Edward Breitung opened northeastern Minnesota to non-native iron mining by forming the Minnesota Iron Company and beginning operations at the Soudan Mine. Soudan operated almost exclusively as an underground, shaft mine from 1893 to 1962, when US Steel halted mining operations and turned the property, structures, and machinery over to the Minnesota Department of Natural Resources (MnDNR). The MnDNR opened the Soudan Underground Mine State Park in 1963, and the Mine achieved National Landmark status in 1979. The No. 8 Engine House remains one of the central structures at the Soudan Mine. Completed in 1893, and modernized from steam to electrical power in 1923-24, it contains a great deal of Soudan's mining equipment, much of which remains operational. Although the Soudan Mine does not currently extract ore, it is still an active part of the community. Currently the mine employs area residents to maintain the park, operate the machinery, and guide thousands of annual Park visitors on mine tours. The Soudan Mine remains a vital component of northeastern Minnesota's economy and history, making it important to understand the mine, the engine house, and their roles in the life of the

The Process of Completing Historic American Engineering Record (HAER) Documentation of the Hulett Ore Unloaders, Cleveland, Ohio

Stanley J. Popovich, AICP
Hardlines Design Co.

The most unique aspect of this HAER project was the actual documentation process. I propose to discuss the difficulties that the team encountered in recording the huge complex structures, how these difficulties were solved, the field work and background information that was completed, and how ultimately the HAER documentation was produced using AutoCAD technology.

I will begin the presentation with a discussion of our learning process that started with a review of old construction drawings and a site visit. Due to the large scale of the Huletts, we had only a few drawings that showed the entire Huletts. Therefore, each existing drawing was a detail of a specific Hulett part. These detail drawings presented themselves like a jigsaw puzzle, with each piece intricately connected to other pieces, and it was our task to complete the puzzle.

After reviewing the drawings, a field team visited the site and climbed onto the Huletts. We took numerous pictures, discussed Hulett operations with people who worked on them, and began to understand how the parts made the whole. We took this information back to our office and began to produce the drawings using AutoCAD.

We produced the majority of the drawings in 3-D. The 3-D aspect of the drawings enabled us to show all the key functions of the Huletts in a manner that explained the process from unloading, weighing, and loading onto railcars. AutoCAD also enabled us to create one master Hulett drawing and modify it to show various positions in unloading the ore. In essence, we utilized existing construction drawings, interviews with workers, and field inspections to "reconstruct" the Hulett ore unloaders in 3-dimensional views using AutoCAD.

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Panel II.D: *Learning from Others: Historic Bridge Management 101*
Chair and Organizer: Amy Squitieri
Mead & Hunt, Inc.
(Meeting Room 5)

Government agencies, bridge owners, engineers, and preservationists have all struggled with using historic bridges to serve today's roadway needs. Accepted policies, programs, and standards traditionally lead to the replacement of historic bridges once they become structurally deficient or functionally obsolete. New funding sources and new commitments to preservation offer fresh opportunities to restore, reuse, and mothball select historic bridges. Learn about practices being used nationwide to preserve historic bridges. Share knowledge of successful bridge management practices in your state.

Reinventing the Wheel: Comparisons of Statewide Historic Bridge Management Efforts

Mark Hufstetler and Mitzi Rossillon
Renewable Technologies, Inc.

Large-scale statewide inventories of historic highway bridges have been taking place across America for some two decades, producing a vast body of data describing these important cultural resources. The inventories, designed and monitored by individual state transportation departments and State Historic Preservation Offices (SHPOs), vary greatly from state to state in scope, level of detail, and results. Yet, all were prepared for essentially the same purpose: to facilitate federally-mandated compliance procedures for undertakings involving historic bridges.

For many states, it quickly became evident that the accumulation of inventory and context information for historic bridges was no solution to the compliance problem: mitigative measures remained undefined, for example, and inventory data became less useful with the passage of time. This has led to a desire in many circles for Programmatic Agreements and other comprehensive bridge management tools that can pro-actively address such problems. Relatively few states have developed such products, however, and those documents that do exist are often less than complete.

This presentation provides a brief status report on states' attempts to devise comprehensive historic bridge management documents. The presenters will report on the results of a query to all 50 state Departments of Transportation, and briefly review the types of planning efforts that have been attempted to date. Hufstetler and Rossillon will conclude by considering the strengths and weaknesses of some of these approaches, and briefly speculating on the future of statewide bridge planning efforts.

"Where Do We Go From Here, Now That All Of Our Inventories Are Wrapping Up?"

Amy Squitieri
Mead & Hunt, Inc.

Many states have completed inventories of historic bridges, and several have even progressed through one or more inventory updates. Though disagreements over what's historic and what's not remain, the greater challenge is what to do with historic bridges. Most states are struggling mightily with this next step. Identifying and implementing practical and acceptable management practices challenges all parties engaged in owning, fixing, replacing, or preserving an historic bridge.

In spring 2001, consultants from Mead & Hunt-AKRF completed in-depth interviews with transportation agency and SHPO staff in states actively engaged in historic bridge management activities/practices. States were selected based on the results of Renewable Technologies, Inc.'s questionnaire, which was distributed to 50 states in fall 2000, and on recommendations of national leaders in bridge preservation.

This presentation looks at the often conflicting interests of four players in historic bridge management: bridge owners, SHPOs, Departments of Transportation (DOTs), and the Federal Highway Administration (FHWA). Owners may be concerned about the cost of rehabilitation and future maintenance, diminished function of an historic versus new bridge, and liability for a historic bridge. SHPOs are interested in the preservation and integrity of historic bridges. DOTs and FHWA are most concerned with legal compliance, safety, and cost efficiency.

Based on interviews with people nationwide who are working to preserve and manage historic bridges, the presenter will suggest how conflicting interests may be reconciled. She'll show how some states have resolved or are working to resolve traditional differences by tapping into new funding sources, granting exceptions to design standards, accepting unconventional rehabilitation techniques, and renewing commitments to preservation.

As moderator, Squitieri will engage audience members in a discussion about potential solutions to the challenges presented by the panelists.

Historic Bridge Management In Practice: An Engineer's Perspective

Thomas Lester, P.E.
Virginia Department of Transportation

In spring 2001, the Virginia DOT will publish its treatment plan for the state's 70 Vests bridges. The treatment plan presents four basic options:

- Preserve in-place
- Dismantle and save
- Bypass
- Document

The Virginia DOT, working cooperatively with the Virginia SHPO, evaluated the feasibility of applying these options to 70 bridges identified to be the state's most historically significant. An engineering matrix, which included attributes such as sight distance, number of vehicles carried, structural condition, and initial and long-term costs, was used to select which option was feasible for each bridge. Preservation in place was the favored treatment, but was recognized as impractical for some bridges such as a concrete arch that serves a high traffic volume.

This presentation uses case studies to demonstrate how the matrix was applied to different bridges, what treatment option was selected, and how the treatment plan is being implemented. Lester will review how projects are coordinated with field personnel, and describe efforts to establish cost estimates for treatment options.

Though the final treatment plan was just published, the Virginia DOT is already making use of the results. The agency has improved routine maintenance for some bridges and undertaken a few major rehabilitation projects. For the state's most significant bridges, the Virginia DOT has made compromises between design standards and what is a tolerable deviance from these standards. The presentation concludes with a description of lessons learned in implementing the treatment plan.

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Lunch - Annual Business Meeting: 12:00 - 2:15
Renaissance Ballroom West

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Session III: 2:30 - 4:30

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Panel III.A: *The Society for Industrial Archeology at Thirty Years*
Moderators: Fred Quivik, Consulting Historian;
Duncan Hay, National Park Service
(Meeting Room 2)

The Evolution of the Society for Industrial Archeology

Timothy A. Tumberg
University of Arizona

It is generally acknowledged that the discipline of archaeology, as it is practiced in North America, has developed within the theoretical framework of anthropology. Despite the preponderance of anthropological influence upon American archaeology, many members of the Society for Industrial Archeology (SIA) have no connection with anthropology. This paper addresses the reasons why industrial archaeology emerged as a discipline in the United States, and as a corollary, why industrial archaeology has remained largely independent of the anthropological constructs that form the contextual framework for virtually all other types of archaeology (e.g., prehistoric, historic, and underwater) conducted in the United States. Perhaps the most perplexing aspect of the non-anthropological perspective of industrial archaeologists is illustrated by their relationship (or lack thereof) with historical archaeologists. Industrial sites are by definition also historical sites, and it would appear eminently logical that historical and industrial archaeology are in fact very nearly the same thing. It is strange, therefore, that a comparison of individuals who identify themselves as industrial archaeologists and those who self-identify as historical archaeologists reveals a striking lack of interaction between the two disciplines. This paper assumes that an emerging discipline gains a certain amount of legitimacy through the establishment of its own professional society. In that vein, data collection and analysis are based largely on quantitative and qualitative comparisons and contrasts between the membership rosters and publications of the SIA and those of the Society for Historical Archaeology (SHA).

SIA: The Next Thirty Years

Gary van Lingen

Michigan Technological University

Elizabeth Norris
Michigan Technological University

For thirty years the SIA has brought together a wide variety of interests and backgrounds that contribute to the diversity of the present group. This diversity is an asset to the well being of the Society and as such, should be fostered by continuing to solicit members from all regions and levels of interest. The future should look to providing this diverse population with meaningful opportunities to participate in IA-oriented activities. This paper suggests how the management of these opportunities can be provided for all involved by exploring alternative methods of communication, advocacy, and outreach. We will provide ideas of how to support and expand the diversity of IA enthusiasts through such means as activities, chapters, virtual communities, and publications.

Moderated Discussion: The SIA at Thirty Years

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Panel III.B: *Making Iron*
Chair: Jet Lowe, Historic American Engineering Record
(Meeting Room 3)

Studies of the Cultural Landscapes of the New Jersey Highlands Charcoal Iron Industry

By Edward S. Rutsch
Historic Conservation and Interpretation, Inc.

This paper will illustrate research focuses that have proven useful in my studies of the industry and region. As part of this work, a second and third type of social unit have been added to the *Iron Plantation* model that has been in use for the last 50 years or so. These are the *Forge Farms*, far more numerous and more important in total finish iron production, and the *Farmstead*, upon which most iron workers and their beasts of burden were raised and lived. My studies have shown that deposits of arable lands in this glaciated region were as important as waterpower in determining the location of successful charcoal iron works. I will also explain the manner of obtaining fuel evolved from a task undertaken by ironmasters to that of landowners who sold their coppice wood to speculators who put colliers to work on “50 acre jobs”.

In the difficult task of defining iron works, I have found that using boundaries of original furnace and forge tracts useful for setting *National Register* boundaries. This practice has proven especially fruitful in obtaining and organizing historic information regarding the sites of charcoal kilns, sawmills, and the network of roads necessary to harvest the forest.

A 19th Century Bloomery Iron Forge Revealed: Excavations in the Adirondacks of New York

Dr. Gordon Pollard
SUNY Plattsburgh

Research at one of the world’s largest 19th century iron production sites has yielded unusually good preservation of the lower portions of a bloomery forge. Such forges, measuring approximately 6 feet square, contained a small firebox area in which iron ore was smelted using charcoal fuel. Evidence uncovered at Clintonville, in the Adirondacks of upstate New York, provides documentation of the construction of such forges, and of experimentation that was undertaken to improve their efficiency.

Results of the most recent excavations at the Clintonville site are presented, along with a brief overview of this iron production process.

Antietam Iron Works: the McPherson & Brien Era, 1806-1853

H. Marc Howell, Ph.D.

Blast furnaces dotted the United States in the late 18th and early 19th centuries. The Antietam Iron Works, under other names, dating back to precolonial times was one of these. John McPherson, a prosperous businessman from Frederick, bought it in 1806. In 1807 John Brien, a Pennsylvania ironmaster, became the on site manager while McPherson was the business strategist with connections.

The Works developed a reputation for custom casting and pig iron. About 1830, after the death of John McPherson, Brien adopted puddling and rolling technology from Wales to produce cut nails. It was a difficult time to shift into a new venture. The C&O canal reached the Works in 1832 along with the cholera pandemic. Brien was taken sick with a liver ailment in 1834 and died, exposing his huge debt. The Panic of 1837 hit. While the Works hit its stride in nail production, its expenses continued to mount.

In the early 1840s a deep Pockets Baltimore investor named Robert Gilmore took over the Works, leaving John McPherson Brien, John Brien's son as a manager. Debt still mounted and in July 1848, Gilmore gave up. A Maryland Chancery Court sold the Works to John McPherson Brien allowing him to make debt payments as he sold the extensive land holdings.

John McPherson Brien died in April 1849. The manager of the Works could not sell enough nails and Mrs. Brien could not sell land fast enough. In 1853, the Works was sold to a speculator, ending McPherson-Brien family involvement.

"Carried On At A Very Great Expense And Never Produced Any Profit": Titanium and the Ruination of the Albemarle Ironworks (1770-72)

James H. (Jamie) Brothers IV

John Old and John Wilkinson spent seven years finding the perfect spot to build the Albemarle Ironworks. The site they chose in South Garden, VA, on the South Hardware River, appeared to have everything required for a successful blast furnace: a good dependable water supply, good timber for charcoal production, a number of large iron ore deposits, and access to the James River. Wilkinson also organized a well financed partnership of local Virginians and Pennsylvania ironmen to underwrite the construction and operation. Yet with all the care taken to ensure its success, the Albemarle Ironworks was "carried on at a very great expense and never produced any profit," operating for less than a year over the Winter and Spring of 1771-72. Local tradition holds that the ore used came from the Martin Mine in North Garden, VA. This mine was reopened after the Civil War, but in spite of good financing failed after less than a year. The 1880 Census and a 1977 study showed that the ore contained large amounts of titanium. Utilizing archival records, site reconnaissance, analysis of the slag using PIXE (proton-induced x-ray emission) and SEM (scanning electron microscope energy dispersive X-ray) this paper will demonstrate that although many factors contributed to the failure, the proximate cause was the titanium in the ore. In addition the analysis shows that had the owners overcome the titanium problem, the iron would have been so cold short (due to phosphorus) that it would have been unusable.

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Panel III.C: ***Harmony Brickworks, Leetsdale, Pennsylvania***

Chair and Organizer: James Foura
(Meeting Room 4)

The Harmony Brickworks, constructed in 1889-1890, was unusual due to its ownership by the Harmony Society, a celibate, utopian, communal religious organization based nearby at Old Economy Village. As originally constructed, the Harmony Brickworks contained seven up-draft kilns, a large hot-floor drying house, and a steam-powered brick machine. The factory's production goal was 20,000 bricks per day, with on-site clay deposits providing the raw materials. The Harmony Society sold bricks to private builders in western Pennsylvania and northeastern Ohio. Problems plagued the Harmony Brickworks throughout its history, including floods, a devastating fire, and numerous interruptions in fuel supplies. The Harmony Brickworks closed in 1901, and the land was sold for real estate development. At the same time, the celibacy requirement took its toll on the Harmony Society. By 1900, membership had declined to a few Hannonists and the Society was formally dissolved by 1905.

The Harmony Brickworks and Turn of the Century Brickmaking Technology in Allegheny County, PA

Roy Hampton
Hardlines Design Company

This paper will discuss the technologies used at the Harmony Brickworks during its operation from 1890-1901, and will place the facility within the context of late-nineteenth century brickmaking in Allegheny County, Pennsylvania. The plant represents, in some ways, a midway point between the hand-operated brick production methods of the early to mid-nineteenth century, and the highly automated industrial brickmaking more common in the twentieth century. Technology allowed operators of the Harmony Brickworks to escape the mid-nineteenth century brickmakers's dependence on labor intensive hand-molding of bricks, and on the often slow and risky practice of drying newly molded brick in the open air. At the same time, the Harmony Brickworks used clay processing and kiln-drying techniques. The paper will explore the level of technological sophistication at the Harmony Brickworks as revealed by a number of sources, including company records, brick industry literature, historic maps, and an archaeological investigation of the plant's physical remains. Earlier nineteenth-century brick factories often relied on hand-production methods in all aspects of their operations. While the Harmony Brickworks was not completely mechanized, it did use a number of industrial technologies to increase production speed and capacity. The paper will cover a number of production areas, including clay processing, brick molding, brick drying facilities, and kilns. Specific equipment touched upon will include soak pits, steam powered brick molding machines, the transition from hot floors to steam tunnels for drying brick, and the operation of periodic up-draft kilns. The paper will also bring in information on the layout, production technology, and manufacturing methods of other brick factories in 1890s Allegheny County. This information was gleaned from brick industry journals, Sanborn maps, geological surveys, and archeology reports to provide a project context. The paper will indicate the ways in which the Harmony Brickworks was typical of 1890s Allegheny County, and will also point out the facility's more unusual features.

Interpretation of the Harmony Brickworks Site

R. Joe Brandon

The Harmony Brickworks site represented a unique opportunity to gain insights into the history of brickmaking in late nineteenth-century western Pennsylvania. Records of the Harmony Society and its brickworks were preserved by the State of Pennsylvania, offering a unique look at the operation of a 19th century brick factory. The presence of extensive remains of the original 1890-1901 Harmony Brickworks also provided vital information on the company and its facilities that had not survived in written documentation. Field investigation of the site revealed specific details on many aspects of the facility, especially the firing and drying aspects of the operation. In addition, while an early map of the facility had been located at the start of the project, the plant was largely rebuilt in 1897 after a fire. No maps survive of this late phase in the plant's history, and textual descriptions of the later history of the plant left many gaps in information. The field investigation of the site was thus a unique opportunity to gather vital information on the layout and facilities of the plant as they existed after the 1897 fire. Photography, field measurements, and GIS mapping were used to document the layout of the site, and clarify the later history of the facility. Specifically, detailed information was gathered on the design and function of the factory's hot floor, a facility essential in assuring that bricks could be quickly moved from the molding facilities into the kilns for firing. This structure contained a complex labyrinth of walls, vents, and furnaces. Computer mapping of these structures was essential in interpreting the site. Computer mapping was also used extensively to plot features dating to the later history of the plant, so that these features could be compared with early maps of the site. This allowed the project team to document changes made after the 1897 fire. In the end, the field investigation was able to provide, us with a detailed picture of the facilities of the Harmony Brickworks. Detailed mapping of the site and close examination of surviving architectural features provided many details about the operation and technology of the facility that were not recorded in the archival record.

Use of Computer Mapping and Imaging at the Harmony Brickworks

James C. Foura
Hardlines Design Co.

Computer mapping was an essential tool in documenting and interpreting the Harmony Brickworks site. The site contained a large number of complex architectural features related to two different building episodes in the plant's history: the original 1889-1890 construction of the facility, and partial reconstruction after an 1897 fire. Use of a total station was essential in mapping these complex features to assist in their interpretation. Computer enhanced imaging derived from modem and historic USGS maps was also used in the project to assist in analyzing changes in topography that took place at the site, and to assist in the analysis of a historic photograph of the site. This presentation will explain how these resources were used to provide a more complete picture of the Harmony Brickworks and its operation.

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Panel III.C: *National Historic Covered Bridge Preservation Program*
Chair: Justin Spivey
Historical Consultant
(Meeting Room 5)

Sheila Rimal Duwadi, P.E.
Federal Highway Administration

The National Historic Covered Bridge Preservation program was established in 1998 under the Transportation Equity Act for the 21st Century (TEA-21) as amended by the TEA-21 Restoration Act. It provides for research, and for preservation of covered bridges that are listed or eligible for listing in the National Register of Historic Places. Section 1224 of the Act authorizes $10 million to be appropriated for each of fiscal years 1999 through 2003; however, in FY1999, no funds were provided for this program. In FY2000 and FY2001, $8 million and $10 million have been authorized, respectively.

To carry out the intent of the Act the Federal Highway Administration (FHWA) established a two part program in FY2000. In order to find improved means and methodologies for restoring and protecting covered bridges and to develop technical aids a Research Program was established. In order to assist the States in their efforts to rehabilitate, repair, or preserve the Nation's historic covered bridges a Bridge Preservation program was established. Of the available $8M FY2000 funding, $IM was set aside to carry out Research, and $7M to carry out Bridge Preservation programs.

In FY2000 the following research studies were initiated:
- Development of a Covered Bridge Manual
- Strengthening Historic Covered Bridges to Carry Modern Traffic
- Fire Retardant Treatments for Historic Covered Bridges
- Educational Guide on the History of Covered Bridges in the United States
- 'A Bridge to the Past' documentary

Through a solicitation memorandum issued by the FHWA Bridge Office, a total of 74 applications was received for bridge preservation projects. The FHWA awarded 25 applications in 14 States in FY2000 for bridge preservation projects.

This presentation will summarize the research program and the studies underway, and the bridge preservation program and the restoration projects underway. It will also present the FY2001 project status.

Reclaiming the History of the Vernacular Suspension Bridge

Dr. Mark Brown

The fifteen years of HAER's historic bridge program have taught us much about reinforced concrete and truss bridges. Suspension bridges, however, present a different case. Unlike the monumental tradition of Ellet, the Roeblings, Amman, and Steinman, much less is known about the once common short- and micro-span suspension bridge. Researching this class of bridge is especially problematic. Few were published in the technical literature. Many of the remaining examples are often hard to locate because they are "off-system" and therefore not on governmental inventories. Still others "survive" only as archeological sites or in archival collections.

Nevertheless, recent research by Allen in the California gold fields, by Simmons in Ohio's Miami Valley, and by HAER in North Central Texas demonstrates that suspension bridges were particularly practical in remoter locations, could be competitive with other types under certain circumstances were as varied in their form as trusses, and that non-university trained builders could be startlingly creative. Despite the difficulties, the findings suggest the need for research nation-wide into the long overlooked class of bridge.

The Design and Construction of Concrete Truss Bridges, 1910-1920

Pete Brooks
Historic American Engineering Record

Although never a common type, the concrete truss bridge enjoyed a time of limited development and acceptance between 1910 and 1920. Echoing the general spirit of experimentation in reinforced concrete, patents and articles about concrete trusses from this period reveal a wide range of solutions to common problems. A group of concrete truss bridges built neat Las Vegas, N.M. between 1914 and 1918 demonstrate many of the best solutions, while exposing characteristic problems. After 1920, concrete trusses were rarely built because other types of concrete bridges had been better designed, engineered and marketed for short and medium spans. A few recent innovations point to a small revival of the concrete truss bridge, and show that both the problems and solutions posed 80 years ago are still sound.

Rogue Bridges: Deviations from Mainstream Nineteenth Century Truss Bridge Forms

David Guise

As the forms of American truss bridges evolved, the timber roof trusses adapted to span stream crossings in the East matured into the long-span steel bridges over major rivers in the Midwest. Their shapes metamorphosed along a rational course of development based on a changing palette of materials and a growing base of engineering knowledge and sophistication.

The “establishment” type truss forms, such as the Long, Howe, Pratt, Whipple, Bollman and Fink, Post, Warren, Baltimore and Pennsylvanian, when totaled, constitute only a small fraction of the hundreds of ideas and patents put forth.

What drove inventors to tinker with the established approaches of the day? Why did they propose alternatives? What eventually led builders to put most of these experiments aside and return to the mainstream solutions?

By looking at some of these short lived anomalies, we can gain insight regarding the issues that concerned builders at a particular point in the evolution of truss shapes and see why a particular proposal made sense in the context of its time.

This slide presentation will examine four different innovative approaches and the reasons they ultimately proved to be impractical.

- Kellogg and Steams wrestled with the problem of deflection in the bottom chord between panel points. They provided additional diagonals between their primary panel points. In the process they rendered their designs vulnerable to other issues.

- Greiner and Lane utilized discarded railroad-rails to build their trusses. This concept reversed the normal design process. The designers had to start with the answer, the size of the member, and walk their calculations backward to determine what the truss could support, searching for a configuration that would produce a reasonable span.

- Thacher, and Bollman before him, developed moveable links to deal with unbalanced expansion and contraction forces induced by their truss configurations which called for opposing diagonals of different slopes and lengths to meet at a common point. Hammond-Morse-Abbott chose to ignore the issue. Only Bollman’s variation saw significant use, and only for a short period of time.

- Thayer and Fisher were concerned with post-construction adjustability. They contrived devious Rube Goldberg devices to facilitate maintenance and tuning of their trusses.

Restoration of 1854 Haupt Truss Bridge at Railroaders’ Memorial Museum, Altoona, PA

Edward Windhorst
DeStefano and Partners

This presentation describes the in-progress restoration and planned re-erection of one of the oldest cast- and wrought-iron railroad bridges in America, a single span, half-through 100’ tied arch and Pratt truss combination designed by Herman Haupt for the Pennsylvania Railroad. First erected 1854, the structure, one span of a multispan double-track bridge originally at Vandevander, Pa., was moved c. 1870 and placed in service as a road bridge over the PRR main line at Thompsontown, Pa. In 1984 the bridge was removed from service and the trusses saved and relocated in parts to the Railroader's Memorial Museum in Altoona, Pa. (the bridge was in fact fabricated in the PRR's Altoona Shops). The structure was subsequently documented by HAER and by researcher Victor C. Darnell (1921-1999), but was otherwise neglected until last year. The presenter and a team of engineers and fabricators approached the Museum in 1999 with an offer to privately restore the bridge on condition that the Museum eventually re-erect and interpret it as part of its facility. The two trusses—one seriously damaged in the 1984 removal—were disassembled in August, 2000 and shipped to Chicago. They are now being documented, and planning is underway for the casting and fabrication of required replacement elements. The presentation will include preliminary findings on material testing, structural modeling and a report on new-component fabrication.

Presenters

Daniel Bonenberger received his M.A. from West Virginia University and is currently Associate Director of the Institute for the History of Technology and Industrial Archaeology at WVU. He has worked on numerous HAER projects and has presented papers on topics ranging from GIS and database development to the history of rocketry to wire cable production.

R. Joe Brandon is director of Archaeology for Hardlines Design Company. His fifteen years of experience in the field encompass a wide range of field methodologies, research design strategies, and technical applications. He has played an active part in the mid-depth multi-year projects that require pre-excavation research design, hypothesis development, and implementation of practical field methodologies. This work has been followed by rigorous analysis of results and publication of findings.

Pete Brooks received degrees from Yale University in English, Architectural Theory and Architecture. In addition to extensive work on HAER projects, including documentation of Park road systems, a cast iron pipe foundry, the Columbia River Parkway and Texas bridges, he has also documented a collection of 18th and 19th century globes for Yale's Cartographic Library and has built models for Ceasar Pelli, architect.

James Brothers, IV holds a BA in anthropology from the University of Pennsylvania and an MBA from the Fuqua School of Business at Duke University, and will receive an MA in historical archaeology at the College of William and Mary this May. He is a retired US Army Field Artillery Officer and has worked in industrial marketing and CRM.

Mark M. Brown wrote his dissertation on the architecture of the American steel industry. He has spent more than three years documenting heavy industry and transportation for the HAER program. His most recent publication was "Nineteenth-Century Cable-Stayed Bridges in Texas" for the Fourth Historic Bridge Conference.

Dennis J. Connors holds a BA in Museum Studies from SUNY @ Buffalo. He has worked in the field of historic preservation in western New York since 1973, and chaired the Syracuse Landmark Preservation Board for six years. His publications include work on the boiler and brewing industries.

Sheila Rimal Duwadi, P.E., is a Research Structural Engineer at the FHWA's Turner Fairbank Highway Research Center. Sheila manages several bridge research programs at Turner Fairbank, including the program on Horizontally Curved Steel Bridges and on Timber Bridges. She is now managing the Historical Covered Bridge Preservation Program. Sheila has a M.A. from Oregon State University and is a registered Professional Engineer in Virginia.

Wolfgang Ebert is President of the German Society of Industrial Heritage, Secretary of "The Route of Industrial Heritage at the Ruhr," and Secretary of ERIH - the European Route of Industrial Heritage. An Art Historian by training, he has studied at Zuerich, Boston and Dublin. He was principal host for the SIA Study Tour of the Ruhr in March 2001.

Steven Englehart is the Executive Director of Adirondack Architectural Heritage (AARCH), the regional historic preservation organization of the Adirondack Park. He is a native of the region and has a B.A. from SUNY Plattsburgh and a M.A. in Historic Preservation from the University of Vermont. He is the author of *Crossing the River: Historic Bridges of the Au Sable River.*

James A. Foura is an archaeologist at Hardlines Design Company specializing in historical archaeology. Since joining HDC, he has worked on projects for the Ohio Department of Transportation, the U.S. Army Corps of Engineers - Pittsburgh District, and the Naval Facilities Engineering Command - Southern Division.

Jane Mork Gibson received B.A. and M.A. degrees from the University of Pennsylvania. In addition to her work on the HAER documentation of the Fairmount Water Works, she is a consultant for Philadelphia Water Department, has researched exhibits on the Fairmount Water Works, Franklin Institute, and the Philadelphia Maritime Museum, and performs environmental studies for engineering firms. Her publications include chapters in *Workshop of the World* (a guide to industries in Philadelphia prepared for the 1990 SIA annual conference), and *Invisible Philadelphia* (a history of voluntary associations in Philadelphia).

Amanda M. Gronhovd is currently an archaeologist with Statistical Research, Inc. in Tucson, AZ. She was formerly co-owner and project manager for 10,000 lakes Archaeology, and has worked as an archaeologist for Loucks & Associates. She received her M.S. in Industrial Archaeology from Michigan Technological University, and has been a principal organizer of the Newcomers Group in the SIA.

David Guise was Principal in the Office of David Guise, Architect, from 1962-1996. He is also Professor Emeritus from CCNY, and Visiting Professor at Columbia University and the University of Pennsylvania. He is the author of *Design and Technology in Architecture*, entries in the *Encyclopaedia Britannica Yearbook,* and annual articles in *Architecture* and *Civil Engineering.*

Roy Hampton is a historian with Hardlines Design Company specializing in the research, publication and documentation of historic buildings and structures. His extensive preservation work includes historic building surveys, National Register evaluations, HABS/HAER documentation, and cultural resources management plans. He has worked on numerous projects encompassing a wide variety of structures, including residences, public and commercial buildings, bridges, and dam and lock facilities. He has also published a paper on German-American church architecture in the *U.S. Catholic Historian.* He has presented papers at the 1998, 1999 and 2000 SIA conferences.

Robert Howard is currently Principal of Anchorage Productions L.L.C., which does restoration, research, design and fabrication of industrial and military exhibits. He "retired" as Curator of Industry and Technology from Hagley Museum after thirty years, and has published numerous articles, reviews and technical illustrations. His claim to infamy: he was a participant at the Washington founding meeting of the SIA (along with about 30 others).

H. Marc Howell received his M.S. and Ph.D. (Microbiology) degrees from the University of Illinois at Urbana. After retiring from the US Army in 1993, he began researching early 19th century family connections to the Antietam Iron Works. His research soon shifted from genealogy to the history of iron in Washington and Frederick Counties, Maryland.

Mark Hufsteter has been an architectural historian with Renewable Technologies, Inc. since 1990, where he performs field work, scholarly research, and writing for a variety of professional projects relating to historic preservation, cultural resource management, and academic research. He serves as Project Manager for selected RTI contracts, and is corporate treasurer and management team member. He also works as an independent historian, developing National Register nominations, historic site surveys, and a variety of other research projects. He received an M.A. in History from Montana State University, and a B.A. from Westminster College.

Robert J. Kapsch has Ph.D. degrees from the University of Maryland (American Studies) and Catholic University of America (Engineering and Architecture). The author of numerous articles on the history of engineering and technology, he was formerly Chief of the Historic American Buildings Survey/Historic American Engineering Record. He is currently Special Assistant to the Deputy Director, National Park Service, serving as program manager on such projects as the $6 million rehabilitation of the Moncacacy Aqueduct, C&O Canal; rehabilitation of the Conococheague Aqueduct, C&O Canal; stabilization of the Mary Locher Cabin, Antietam National Historical Battlefield; stabilization of the Sudley Post Office, Manassas National Historical battlefield; and others.

Thomas F. Lester, P.E., has worked since 1975 with the Virginia Department of Transportation, Structure and Bridge Section, in both the Richmond and Central offices, where he has managed statewide bridge safety inspection programs and statewide bridge inventories. A member of the Historic Structures Task Group since 1991, he holds a B.S. in Civil Engineering and is an adjunct faculty member at john Tyler Community College.

Gary van Lingen is presently working towards his M.S. in Industrial Archaeology at Michigan Technological University. He is in possession of B.A.s in Medieval History from the University of Waterloo and in archaeology and geography from Wilfrid Laurier University (Canada). During his undergraduate years he worked as a shift supervisor in a palliative care facility and as a volunteer coordinator for a mental health program. His primary interests in archaeology center around the impact of the rise and fall of industrialization on urban planning, social structure and education.

Michael J. Madson received his B.A. from Carleton College with a concentration in Archaeology, and is a candidate for the M.S. in Industrial Archaeology at Michigan Technological University. He has broad experience as a field archaeologist, field monitor and research archaeologist in consulting archaeology and academic settings. He has conducted cultural resource overviews and assessments for federal and state agencies, other public agencies, and private firms, including the U.S. Army Corps of Engineers, the U.S. Forest Service, Michigan Historical Center, Washington State Department of Transportation, the Port of Seattle, and others.

Paul Marr is Assistant Professor in the Department of Geography and Earth Science at Shippensburg University, Shippensburg, PA. He has presented extensively on the history of mining and transportation, and his articles have appeared in the *Pennsylvania Geographer* and the *Proceedings of the International Symposium on Computer Mapping in Epidemiology and Environmental Health.*

Denis J. McMullan, P.E., President, McMullan & Associates, has thirty years experience in structural engineering design encompassing a wide variety of facilities for both public and private sector clients. He has conducted numerous surveys, investigations and evaluations of existing structures, and has specialized experience in the structural evaluation and repair of existing structural systems. With Abba Lichtenstein, P.E., he presented “Stone Arch Aqueducts of the C&O Canal” at the American Civil Engineering World “Building to Last” Conference in Portland, Oregon. He lectures on the evaluation of historic structures and masonry arches at the University of Wisconsin. McMullan & Associates is providing physical analysis, condition assessment and existing condition documentation for the Conococheague and Monocacy Aqueduct restorations.

William D. Middleton, P.E., has been active as a transportation and engineering historian and journalist for more than 50 years. His sixteen books include a number of titles concerned with the history of electric railways and rail transit in North America, including *The Time of the Trolley, The Interurban Era,* and *When the Steam Railroads Electrified.* His history of the Quebec Bridge, *The Bridge at Quebec* is scheduled for publication by Indiana University Press in spring, 2001, and he is currently, with Professor George Smerk of Indiana University, editing the *Encyclopedia of the Railroads of North America* for the same publisher. He is a 1950 civil engineering graduate from Rensselaer Polytechnic Institute and is a registered Professional Engineer in Virginia and Wisconsin. His professional career has included work as a structural engineer and bridge designer, and he completed a 29-year career in the U.S. Navy's Civil Engineer Corps in 1979, retiring as a commander. He joined the University of Virginia in 1979 as its chief facilities officer, retiring again in 1993.

Todd A. Milano is the President of Central Pennsylvania College and the member of numerous boards and associations. He received a B.S. in Industrial Management from Purdue University. He has been instrumental in the preservation and relocation of the Henszey patented bridge.

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Elizabeth Norris graduated last year with a B.A. from the University of Pennsylvania, majoring in anthropology and minoring in history and working at the University museum. Her enthusiasm for the industrial period stems from her upbringing in Cleveland where she volunteered at the Cleveland Museum of Natural History. She is currently working towards her M.S. degree at Michigan Technological University in Industrial Archeology.

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Edward S. Rutsch is Principal in the firm Historic Conservation and Interpretation, Inc. He is a founding member of SIA, and a founder and long time member of the Roebling Chapter. He has researched and presented extensively on the archeology and history of the iron industry.

David A. Simmons is an associate editor of *Timeline*, an illustrated magazine embracing the fields of history, prehistory, and the natural sciences published by the Ohio Historical Society. Previously he was in charge of the department in the Historic Preservation Division at the Society responsible for the identification and listing of historic sites in the state. He holds both undergraduate and graduate degrees in American History from. Miami University. A veteran of two terms on the SIA board, he has also been a member of the nominations committee. He has published articles on a variety of technological history topics, including military architecture, canal construction, and the history of bridge engineering and is the recipient of two Norton Prize awards.

Amy R. Squitieri is Manager of Historic Preservation at Mead & Hunt, Inc. with eight years' experience preparing management plans for historic engineering structures such as bridges and hydroelectric structures. She works with state transportation agencies to satisfy requirements for compliance with state and federal preservation law, and has served on three long-term planning committees with members of the Federal Highway Administration, State Historic Preservation Office, and Department of Transportation. As project director, she supervises field investigations, research, property evaluations, and final report preparation. She also advises engineers on completing the Section 106 process developing alternatives to avoid historic properties and mitigate the effects of projects. She has an M.A. in Architectural History from UVA and an E.M.B.A. from the University of Wisconsin.

Robert Stewart is a retired engineer currently working as a historian and industrial archeologist. Bob spent thirty years at Pratt & Whitney doing a variety of engineering jobs, including work in forensic metallurgy, jet engine materials development, fuel cell research and designing automated production machinery. He has worked extensively as an industrial archaeologist, surveying dams on the Naugatuck River and grist mill sites in Connecticut, and developing documentation on gas plants, bascule bridges, ropemaking technology, a water pumping station, and numerous railroad sites. His HAER work includes the Cos Cob power plant, the Philadelphia Naval Shipyard, Admiral Dewey's flagship, the USS Olympia, NASA wind tunnels and several southern textile mills. Bob grew up in Everett Massachusetts.

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Sara E. Wermiel received her Ph.D. from MIT in 1995, and her revised dissertation, *The Fireproof Building: Technology and Public Safety in the Nineteenth-Century City* was recently published by Johns Hopkins University Press. She has written extensively on the history of fireproof construction, and is currently researching a book on architect/engineers of the 19th century and their role in the development of building construction technology. She has also recently completed a study of Army engineers' contribution to the development of structural iron in the 19th century.

Edward Windhorst is an architect specializing in urban design and the architecture of engineering structures. He is a design partner with DeStefano and Partners, a 120-architect firm with offices in Chicago, London and Naples, Florida. In addition to new design work, he has worked extensively on renovations for historic bridges. He received his Master of Architecture degree at Illinois Institute of Technology, where he completed a thesis under architect/engineer and bridge specialist Prof. Myron Goldsmith.