HISTORIC CONTEXT REPORT FOR THE

OHIO DEPARTMENT OF HIGHWAYS, BUREAU OF BRIDGES, 1911–1945

OHIO DEPARTMENT OF TRANSPORTATION, OFFICE OF ENVIRONMENTAL SERVICES

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Cover: Photograph of the Lorain Avenue Viaduct, ca. 1934–1937
Ohio Department of Highways Tri-Annual Report for 1935–1937, provided by State Library of Ohio
INTRODUCTION

This report was created as part of the mitigation for the demolition and replacement of the Fitchville Bridge, an open-spandrel concrete rib-arch bridge designed by D. Henry Overman and Marty X. Wisda of the Ohio Department of Highways, Bureau of Bridges. The Fitchville Bridge was designed by Overman and Wisda in May 1928, and the bridge was completed in the summer of 1929. The Fitchville Bridge was one of Overman’s early open-spandrel concrete rib-arch designs, and it would be followed in the 1930s by several outstanding examples of that bridge type designed by Overman or under his direction.

The Ohio Highway Department’s Bureau of Bridges (referred to as the bureau) had been founded in 1911 and was responsible for the design of many exceptional bridges, especially in the late 1920s and 1930s. Some history on the bureau has been included in several Ohio Department of Transportation (ODOT) statewide bridge surveys, and an article on a few of Overman’s outstanding bridge designs for the bureau was written for the International Historic Bridge Conference in 1992 by engineer and bridge historian Martin P. Burke, Jr. However, an overall historic context on the bureau focusing on its superlative achievements in bridge design had not been written as of the beginning of 2012.

This report seeks to tell the story of the bureau from its fairly modest beginnings in 1911 through the era of the bureau’s high-style aesthetic bridge designs in the late 1920s and 1930s to the end of the Second World War. The context starts with some background material on the early history of highway improvements from ca. 1893 to 1903, and then discusses the establishment and growth of Ohio’s highway department from 1904 to 1910. The report then chronicles the history of the Bureau of Bridges from 1911 to 1945.

The history of the bureau covered in this study is broken up into five subsections, with each covering a specific time period. The first section covers the bureau’s early history from 1911 to 1919, while the second section follows the development and growth of the bureau from 1920 to 1926. The third section examines the bureau and its outstanding bridge designs from 1927 to 1929, and the fourth section covers the bureau’s continued excellence in design during the Great Depression years of 1930 to 1937. The fifth section covers 1938 to 1945, and discusses the bureau in the late 1930s and during World War II. A brief epilogue discusses the departure of major figures from the bureau’s belle époque of the 1920s and 1930s as these men retired in the postwar era. Appendix A includes a reproduction of Martin’s 1992 list of arch bridge engineers and the identification symbols they used on plans.

A variety of sources were used in researching this work. Mr. Burke’s article on Overman’s bridge designs was used as a starting point. The authors also consulted the extensive files on concrete arch bridges on file at ODOT’s Office of Environmental Services. In addition, various books on Ohio’s bridges, as well as the annual and triennial reports of the Bureau of Bridges from 1911 up through the end of World War II were consulted. The Ohio roads periodical Highway
Topics also contained brief biographies of many of the important engineers of the bureau. This publication featured articles written on a variety of bridge-related topics by many of the bureau’s leaders, especially W. H. Rabe and J. R. Burkey. General information on the establishment and evolution of state highway departments and their bridge divisions was gleaned from statewide bridge surveys and contexts completed for Ohio and for neighboring states like Indiana and Michigan. Documents at the Ohio State University Archives were examined to establish cooperation between the university and the Ohio Department of Highways, and the influence of Ohio State’s civil engineering program on the engineers of the bureau.

Finally, the authors contacted a variety of individuals knowledgeable about the Bureau of Bridges and about Ohio’s historic bridges in general. These individuals included Richard Irwin of ODOT’s Office of Structural Engineering, Martin P. Burke, J. Patrick Harshbarger, and David Simmons. Special thanks go to Mr. Harshbarger for providing guidance on tracing the generational changes in engineers at the bureau through the 1920s and 1930s, and in pointing out many valuable sources. Thanks also to Mr. Simmons for alerting the authors to the existence of the Ohio Historical Society’s collection of the Highway Topics periodical, which contained a wealth of information useful in this study.

The authors would like to thank Tom Barrett of ODOT OES for serving as project manager on this task and for providing access to ODOT’s bridge files. Thanks also go to the State Library of Ohio for access to their collections of annual reports for the Department of Highways, and to the Ohio Historical Society Archives/Library for providing access to their collection of the volumes of Highway Topics from the 1920s and 1930s.
HISTORY OF THE BUREAU OF BRIDGES

1. Background - Early Years of the Ohio Department of Highways: 1904–1910

2. Establishment and Early Years of the Bureau of Bridges: 1911–1919

3. The Bureau in the Early to Mid-1920s: 1920–1926

4. The Bureau in the Late 1920s: 1927–1929

5. The Bureau in the Great Depression: 1930–1937

6. The Bureau in the Late 1930s and World War II: 1938–1945

7. Epilogue - The End of the Burkey-Rabe-Overman Era
Background - Early Years of the Ohio Department of Highways: 1904–1910

During the nineteenth century, the construction and maintenance of roads was generally handled through local initiatives or by private companies. County and township governments were often the governmental organizations that were in charge of building and maintaining roads. However, a federal aid program for roads had been initiated in 1893 as the result of a federal investigation of deteriorated and inadequate roadways in the United States. This federal aid program, however, was only concerned with educational and promotional activities, and did not provide funding for road construction.¹ Still, the federal aid program was the starting point for federal involvement in the construction and management of roads, as well as the system we have today involving federal road funding and highway or transportation departments in each state that manage our current extensive system of highways.

Development of the personal automobile and the growing popularity of automobile travel led to increasing concerns about roads across the United States. Automobiles were primitive and experimental in the early 1890s, but by 1904 more than 55,000 motor vehicles were in use in the United States. Mass production of affordable automobiles by organizations like the Ford Motor Company would lead to further growth in automobile traffic, with over 500,000 automobiles on the roads of the United States by 1910. In response to these rapid developments, numerous “Good Roads” organizations were founded to promote road construction and maintenance, and many states established highway departments to deal with these issues.²

In 1904, the Ohio General Assembly approved the establishment of the Ohio Department of Highways, which had its first full year of operation in 1905. At first, the department was a very small-scale organization. The department’s first annual report characterized its work as “preliminary and fragmentary.”³ The commissioner of highways was Sam Houston, and the department staff consisted of chief clerk Fred Burdel and clerk/stenographer Hannah Jones. The department could not find its own space in the state capitol or state office buildings, so it was housed in a pair of extra rooms at the state’s agriculture department offices.⁴ The report stated that the mission of the department was to “…instruct, assist, and cooperate in the building and improvement of the public roads under the direction of the Highway Commissioner, in such counties and townships in the State of Ohio as shall comply with the provisions of the act.”⁵

The report also included complaints about how the state’s highway department legislation had been set up. A small appropriation was given to assist county governments with highway issues, but the money had to be divided evenly between each county, leaving each of the 88 counties with a fairly small amount of funds, considering that the full amount

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⁴ Ibid.

⁵ Ibid., 4.
of money appropriated by the state for highway assistance was only about $150,000. Highland County applied for road assistance in 1905, but its project was denied since the highway department could not grant the county a large block of money for the project since state law said that the money had to be split up equally among the counties.\textsuperscript{6}

The situation for the Department of Highways was similar in 1906 and 1907, with $150,000 in state road money handed out in each of those years. The Department of Highways also set up a small laboratory for testing road construction materials in 1906.\textsuperscript{7}

Around 1908, more automobiles began to appear on the nation’s roads, and road building and maintenance became a more important issue in Ohio and around the United States. An automobile tax instituted in 1908 provided more money for roads.\textsuperscript{8} While state highway aid appropriations had hovered around $150,000 from 1906 to 1907, appropriations for 1908 were $440,000, and by 1910 the total had risen to over $550,000. Ohio had also lifted the requirement that state highway aid be spread evenly among the 88 counties. Now, funds were distributed only to the counties that applied for funds for specific projects. Less than half of the counties in a given year applied for the assistance funds, so larger sums of money could be given out for projects. Still, the highway department’s annual report of 1910 contained a lament that the state had only so far funded projects to build short stretches of roadway.\textsuperscript{9}

The engineering program at the Ohio State University would play a strong role in the evolution of the Ohio Department of Highways, including the eventual development of a bridge bureau. During the highway department’s formative years in the early twentieth century, Ohio State offered civil engineering degrees in association with the university’s College of Engineering. The head of the civil engineering program at Ohio State through most of the period covered by this context was Christopher Elias Sherman, who had spent his early years learning the surveying trade by working in a county surveyor’s office in Ohio.\textsuperscript{10} Sherman started teaching at Ohio State in 1896 and was department chair for civil engineering from 1902 to 1938. Sherman emphasized practical training and initiated a summer surveying camp for civil engineering students that remained a part of the university’s civil engineering curriculum for many years.\textsuperscript{11}

Sherman’s specialization was surveying, but the civil engineering program at Ohio State also had bridge engineers on the faculty in the early years of the twentieth century. For example, Albert Henry Heller joined the university in April 1902 as professor of structural engineering after working as a designer for private bridge companies. Unfortunately, Heller died in 1906 and did not have very long to make a mark on the department. Heller was replaced by Clyde Tucker Morris (usually referred to as C. T. Morris). Morris remained in the

\textsuperscript{6} Ibid.
\textsuperscript{8} Ibid.
\textsuperscript{10} J. Merrill Weed, "Civil Engineering in the First Century at Ohio State University." 1969, 5–6.
\textsuperscript{11} Ibid., pp. 9–10.
engineering school at Ohio State until after World War II.\textsuperscript{12} Morris had graduated from Ohio State in 1898 with a civil engineering degree and, like Heller, worked for private bridge design and construction firms before joining the College of Engineering faculty in 1906.\textsuperscript{13}

The influence of the Ohio State College of Engineering on the Ohio Department of Highways in the first years of the twentieth century took several forms. Key figures in the future of the department studied engineering at Ohio State during this time period. For example, future Bureau of Bridges director J. R. Burkey was a student in the College of Engineering during the early twentieth century, and graduated from Ohio State with a civil engineering degree in 1908. Burkey probably studied bridge engineering with C. T. Morris and possibly also with Albert Heller. The College of Engineering also completed some cooperative projects with the Ohio Department of Highways in the early years of the twentieth century. For example, a series of state highway maps issued in 1909 by the highway department were produced by Ohio State engineering students as part of a summer program.\textsuperscript{14} Morris would go on to have a role in establishing a bridge bureau within the Ohio Department of Highways in 1911.

\textsuperscript{12} Ibid., pp. 13–14.
\textsuperscript{13} Ibid., 20.
\textsuperscript{14} Ibid., 13.
Establishment and Early Years of the Bureau of Bridges: 1911–1919

With proliferation of mass-produced automobiles after 1910, the Ohio Department of Highways continued to grow. On May 31, 1911, as part of an act by the Ohio General Assembly reorganizing the department, the Ohio Department of Highways established a Bureau of Bridges. The state appointed a deputy and division engineer for the bureau, and the two began their work in July 1911. Records at Ohio State University indicate that C. T. Morris, a professor of structural engineering at the university, was on leave from teaching during the 1911–1912 year in order to assist the Ohio Department of Highways in establishing the Bureau of Bridges.

In its first half-year of existence, the bureau produced general specifications for steel highway bridges, piers and abutments, and concrete and reinforced concrete structures. This effort was part of a project to standardize the designs for new bridges being built in Ohio. The bureau was in charge of designing bridges and culverts for roads that were constructed with financial assistance from the state, but county and municipal officials were still in charge of overseeing the construction of these structures. The bureau staff was concerned that even if county or municipal engineers used the bureau’s standardized bridge design documents, the construction of these structures might not be carried out correctly if there was no state supervision of construction. On roads that were built without state financial aid, county or municipal engineers were free to design bridges and culverts as they wished and were not under any obligation to use the state’s new standardized design documents.

To encourage the county engineers to use the bureau’s newly developed standards, the bureau sent out a copy of the newly developed specifications to county engineer offices across the state in 1911, along with this message:

According to the new law creating the Highway Department, the State Highway Commissioner is directed, so far as possible, to standardize the highway bridge construction in the state; and he is given direct charge of the making of all plans and specifications for bridges and culverts on State Aid Roads but this forms only a small part of the bridge work of the state. The great majority of bridges of the state must be designed in the offices of the County Surveyors, so it is only with your help and cooperation that anything like a uniform standard of construction can be attained.

The bureau’s annual report for 1911 stated that drawings of standard bridge designs would be completed during the winter of 1912. The Bureau of Bridges chapter in the Ohio Department of Highways’ 1912 annual report contained standard design drawings for a variety of structures and parts of structures, including a vitrified pipe stone box and

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16 Weed, 1969, 22.
17 Ibid.
18 Ibid.
19 Ibid.
reinforced concrete culverts. Also reproduced were drawings for a standard concrete bridge with a 17-foot clear span, carrying a 16-foot wide roadway. Other drawings included a design for a standard beam bridge, a standard plate girder bridge, and a standard steel truss bridge with a 70-foot span and a 16-foot wide roadway. The drawings ranged in date from April through October 1912. Some of the drawings were unsigned, while others were drafted by Professor C. T. Morris of Ohio State, who was on leave from teaching at the university to assist with establishment of the bureau. Some of the drawings were reviewed by J. R. Burkey, a 1908 Ohio State civil engineering graduate and future chief of the bureau.20

Joseph Raymond Burkey (1882-1961), who went by J. R. Burkey, joined the bureau at its inception in 1911, and would play an important role in the organization through the 1930s. Burkey had graduated with a civil engineering degree from Ohio State University in 1908, where he almost certainly studied with C. T. Morris. Burkey then worked for a time as a railroad construction engineer in Oregon and as a highway engineer in Washington State. Burkey served as the bureau’s Division Engineer of Bridges beginning in 1911, and had a long and distinguished career, culminating with his term as chief of the bureau from 1925 to 1939.21

The 1912 highway department report indicated that the bureau had been occupied during that year with preparing the standard plans for bridges and culverts, visiting and inspecting construction sites, and preparing plans, specifications, and estimates for various culverts and bridges, including in some cases ones that did not involve state aid construction. The bureau staff also researched and tested corrugated metal for culvert pipes, and tested reinforced concrete for culvert tops and for bridge decks, both in laboratories at the Ohio State University and on existing bridges. The report emphasized the importance of the bureau’s work in attempting to encourage engineers across the state to adopt best practices in bridge and culvert construction.22

The Department of Highways' annual report for 1913 includes a description of activities for the bureau that sounds very similar to what was described in 1912. Plans and estimates were prepared for bridges and culverts on state-aid roads and on county roads. Bureau staff produced more standardized plans, checked and approved plans submitted by county engineers, and continued testing work on concrete bridge floors at the Ohio State University’s Civil Engineering Laboratory.23

In addition to completing testing work at Ohio State’s engineering laboratories, the Ohio Department of Highways sponsored courses at Ohio State geared at educating future highway engineers. One such program was a winter course in highway engineering that Ohio State offered in February and March, 1913. The topics discussed included roadway-related subjects such as grading, drainage, and different types of

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22 Ibid., 199–201.
23 Ohio Department of Highways. *Ninth Annual Report, of the State Highway Department of Ohio for the Year 1913* (Columbus, OH: Heer Printing, 1914).
pavement. However, C. T. Morris also gave several bridge-related lectures, including ones on culvert and bridge design. This course was presented in cooperation with the Ohio State Highway Department and was funded by the Ohio Good Roads Federation.

A special section in the bureau’s chapter in the 1913 highway department annual report focused on the devastating floods of March 1913. The report emphasized the great damage done to bridges across the state as a result of the flood, and indicates that the bureau was collecting data from local authorities to try to determine the extent of the destruction. The author of the report also took the opportunity to blame some of the bridge failures on a lack of consideration of bridge opening sizes, character of sub-foundations, and depth of substructure, on the part of bridge designers and builders. Apparently the bureau visited many of the sites where bridges had failed in the flood and collected data related to these areas of concern.

By 1915, the bureau’s chapter in the highway department’s annual report indicates that the state had been divided into two regions, east and west, with each region assigned its own bridge engineer. A third engineer was retained who specialized in steel bridge design. All three engineers reported to the chief of the bureau, who at the time was a deputy director of the highway department. Each of the regional engineers had an assistant engineer, and the bureau had access to a drafting staff that was also used by other divisions of the highway department.

In 1913, the federal government established the Bureau of Public Roads, out of which came the Federal Aid Road Act of 1916, which allowed the federal government to provide a match to state funds for road building. Road projects originated at the state level, but to receive the matching funds, the projects had to comply with rules and regulations of the Federal Road Act. State highway departments were responsible for interacting with federal authorities on these projects. Once the projects were completed, ownership and maintenance of the roads was the responsibility of the state highway departments. Part of the federal policy was that states could not collect tolls on roads that received federal funding for construction. After the 1916 Federal Aid Road Act, the federal Division of Highway Bridges and Culverts became the Bridge Division of Public Roads, and was in charge of setting standards for bridges constructed with funding from the 1916 act.

The bureau continued to design large and small bridges for the state road system during the World War I years of 1917–1919. The bureau remained busy because of the 1916 Federal Road Aid Act and because the process of replacement of bridges damaged or destroyed by the 1913 flood continued for many years. The bureau designed a wide variety of both steel and concrete bridges during this time, and experimented with many types of concrete bridges, including slab, girder, etc.

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26 Ibid., 210.
cantilevered, and closed and open-spandrel arched, as well as through arch. Automobiles continued to gain popularity, so the pressure to improve highways and other roads continued, as did the need for bridges.
The Bureau in the Early to Mid-1920s: 1920–1926

As the 1920s progressed, mass-produced automobiles continued to proliferate, and a demand for better roads continued. Several major projects and changes in laws pertaining to roads and highways affected the bureau at this time. The early to mid-1920s were a busy time of bridge construction and increased responsibilities for the bureau.

Several staff members who would go on to be influential in the bureau also joined the organization during this time or returned after absences. These men included William H. Rabe (1891–1977), who returned in 1920; J. R. Burkey, who returned in 1922; and D. Henry Overman (1898–1972), who joined the bureau in 1923.

By 1923, A. W. Zeisinger was chief of the bureau and W. H. Rabe was serving as first assistant (Figure 1). Rabe in particular was an important figure in the bureau during the 1920 and 1930s. Rabe would continue in service with the bureau through the early 1930s. Rabe had started work at the bureau as early as 1914, and after a stint in the U.S. Army during World War I, returned to the bureau in 1920. Rabe’s education included attendance at the U.S. Naval Academy in Annapolis and study at the Ohio State University.29

Rabe was a frequent contributor to *Highway Topics*, a journal published in the 1920s and 1930s by Ohio’s chapter of the national good roads organization. Rabe’s articles focus on practical matters; instead of bridge aesthetics, Rabe seems to have preferred practical topics such as the benefits of increasing roadway width on bridges, or the advantages of embedding reinforcing steel in bridge approach slabs to avoid potholes and sagging pavement.30

Figure 1. W. H. Rabe, ca. 1934-1937
From 1935-1937 Ohio Department of Highways Triennial Report (Provided by the State Library of Ohio)

J. R. Burkey, who had joined the bureau in 1911 and had served as designing bridge engineer through the end of World War I, was briefly absent from the bureau during the early 1920s (Figure 2). In 1920, Burkey began a brief stint as a professor at Ohio State University, filling in while C. T. Morris of the university’s engineering school was involved in


the construction of the Ohio Stadium. Burkey remained at Ohio State through 1922, and then resumed his duties as designing bridge engineer at the bureau.  

The bureau’s principle high-profile project in the first half of the 1920s was construction of the Conneaut Viaduct in Ashtabula County, Ohio (Figure 3). This high bridge was 1,189 feet long, had seven open-spandrel concrete arch spans and stood 94 feet high, measuring from the foundation to the road pavement on the deck. The viaduct started out as an Ashtabula County project and was designed by Wendell P. Brown, a Cleveland engineer who would design many of the state’s open-spandrel concrete arch bridges of the 1920s. Eventually, the project received federal aid, so the construction of the viaduct was supervised by J. R. Burkey of the bureau. Although this viaduct was not designed by the bureau, its construction was one of the major projects that the bureau was involved with during the first half of the 1920s.

Construction of the huge viaduct was quite an accomplishment for the state and the county, and the bridge attracted quite a lot of attention. In a 1924 article on the structure, J. R. Burkey mentioned that the bridge “required 90 carloads of cement, 10,000 tons of sand, 350 car loads of stone and slag, and 1,100,000 tons of reinforcing steel.” The total dead weight of the bridge was 30,000 tons. Burkey went on to praise the aesthetics and practical features of the bridge, stating that “…its beautifully curved and clean cut lines add a charm to an already scenic spot, while its almost level grade and good alignment are a welcome sight to the motorist who is familiar with the difficulties encountered in traversing this portion of the Chicago-Buffalo Road in the past.

Another article penned around the time of the completion of the Conneaut Viaduct mentions some experiments completed during the bridge’s construction that illustrate both the bureau’s interest in improving structural performance of concrete bridges, and that shows the bureau’s use of partnerships with the academic world. A special committee had been formed in association with the American Society of Civil Engineers to conduct experiments associated with reinforced concrete arches in connection with the

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34 Ibid.
construction of the Conneaut Viaduct. The committee included A. W. Zeisinger and J. R. Burkey from the bureau, plus engineering academics associated with Ohio State University, Princeton University, and the University of Illinois, as well as private engineers and an official of the Nebraska Bureau of Public Roads. Some of the experimentation involved taking measurements of the viaduct during construction to record movement of the concrete arches and other structural elements as they were exposed to increasing structural loads as the bridge neared completion. This work and other research conducted by the bureau would lead to improvements in open-spandrel concrete arch bridge design in the late 1920s and into the 1930s.

Several federal aid bridges in the mid-1920s did involve design by the bureau. The Great Miami River Bridge, built from 1925 to 1927, had five 86-foot long concrete through arch spans and, at the time of its completion, was the largest through arch bridge built in the state. The bureau was in charge of the design, with W. H. Rabe playing a particularly strong role in the project. Another major bridge of this time with state involvement was the steel Grant Memorial Bridge in Clermont County (1925–1927). The filled-spandrel concrete arch Maumee-Perrysburg Bridge in Lucas and Wood Counties was also a bureau design dating to ca. 1926 and placed under construction in 1927.

Another major development of this era was a change in the way railroad grade separations were designed and constructed. Before 1923, the Bureau of Bridges had little authority over grade separations and these projects were left to county and municipal governments. In 1923, however, the Ohio General Assembly authorized the State of Ohio to eliminate at-grade railroad crossings on inter-county highways and on other major arteries. However, funding for this program was limited at first. Only six grade separations were built in association with the program between 1923 and 1926. Although the program did not result in the construction of a large amount of grade crossings in the mid-1920s, the program would become more important later in the decade.

Improving standards for bridge construction and design had been a major concern of the bureau from the beginning, and was consistent with a general desire in the highway bridge engineering profession to see greater efficiency and safety achieved through the use of standard designs and specifications for bridge construction. Such standardization

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37 Ibid., 155–157.

38 Ibid., 161–163.
eliminated inefficient and unsafe design practices, and made the bridges more interchangeable and therefore less varied and easier to maintain. W. H. Rabe, for example, wrote an extensive article in August 1924 claiming that the bureau had been an early champion of extending roadway widths on vehicular bridges to 24 feet. Typically older bridges were designed with 20-foot wide roadways and in many cases the roadways on very old bridges from the nineteenth and early twentieth centuries could be as narrow as 16–18 feet. Rabe argued that while it cost more to build wider bridges to accommodate the 24-foot wide roadways, the greater width made future roadway widening easier, and would prevent collisions with the trusses and guardrails of bridges, a type of event that in some cases caused structural damage to the bridge.39

In 1925, J. R. Burkey took over as chief of the bureau. Burkey would guide the bureau through a long period in the last half of the 1920s and the entirety of the 1930s when the bureau produced some of its finest bridge designs. Burkey, who seemed concerned with both practical and aesthetic matters when it came to bridges, penned an article in 1926, shortly after taking the reins of the bureau, promoting the adoption of better standards in the design of new bridges. Burkey’s article mentioned the 24-foot wide roadway championed in 1924 by W. H. Rabe, but also focused on several other issues. Burkey’s comments included promotion of the idea that bridges need to be designed in a way that allows flood water to pass through the bridge opening effectively. Burkey also promoted heavier floor beams for bridges, based on the idea that some trucks carried 80 percent of their weight on a single axle, which concentrates larger amounts of force at specific spots on the bridge deck as the truck is crossing. In addition, Burkey discussed the bureau’s efforts to produce standard bridge drawings for use in the construction of common bridge types throughout the state.40

Burkey also mentioned in the 1926 article that the bureau had been experimenting with new concrete mixtures that were stronger and that allowed the structural units of concrete bridges (beams, columns, arches) to be made thinner. Burkey commented that the practical benefit of this practice is that the dead load of concrete on the bridge itself is reduced since the members are smaller and thinner.41 What Burkey failed to point out in the article is that new concrete mixtures would also allow for lighter concrete arch bridges with thinner structural elements, a factor that would prove important in the aesthetics of the bureau’s highly acclaimed bridge designs of the late 1920s and 1930s.

A wide variety of bridges were designed by the bureau in the first half of the 1920s, but one of the most popular was the concrete through arch bridge, popularly known as the rainbow arch. A later example of a through arch bridge is shown in Figure 4. Where a typical open-spandrel concrete arch bridge, like the Conneaut Viaduct, carries the roadway on top of the bridge, on the rainbow arch, the roadway is carried through the arch, allowing the tops of the concrete arch ribs to rise above the road bed, producing an attractive visual effect that seems to have been almost universally admired in the 1920s, and that is still valued today. One such

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41 Ibid.
bridge was completed in June 1924 in Knox County, with its design a collaboration between W. H. Rabe and R. E. Levering of Knox County Government. This bridge replaced a metal bowstring truss span built in 1872. Although the bowstring bridge would be considered historic today, in 1924, the new concrete bridge was seen as an aesthetic and practical improvement over the old span.\textsuperscript{42}

Another major development of the mid-1920s was the passing of a gasoline tax in Ohio to fund road improvements. An initial bill passed the Ohio House of Representatives in March 1925, and later a gasoline tax bill was sent to the governor. The bill also gave the Ohio Department of Highways more responsibility over the state highway system, which would give the bureau more influence over bridge design across the state.\textsuperscript{43}


The Bureau in the Late 1920s: 1927–1929

The era of the late 1920s through the 1930s has been seen by Martin P. Burke and other scholars of Ohio’s historic bridges as a high point in highway bridge design in Ohio. Going into the mid-1920s, the bureau was headed by J. R. Burkey, who had taken the reins in 1925, with W. H. Rabe also continuing to play an important role. D. Henry Overman, who would later be recognized as one of the bureau’s outstanding bridge designers, had started his career with mapping and surveying work for the highway department, but was transferred to the bureau in 1925.

This time period saw the construction of a large number of major bridges in Ohio. The late 1920s were a time of highway expansion as a result of the proliferation of the automobile and new federal financial support for state highway systems, so many new highway bridges were built during this time. The 1925 gasoline tax in Ohio brought additional state funding for roads, some of which was used for bridge construction. Whereas many major highway bridges earlier in the 1920s had been constructed under the authority of county governments, starting about 1927, the State of Ohio began taking responsibility for more of the major bridge projects. The State’s increased role in major projects also meant that a greater number of the large bridges were designed by engineers at the bureau.

Bridge technologies were changing during this period as well. Concrete arch bridges, including both the open and closed-spandrel types, were becoming more widely accepted by bridge engineers and were beginning to supplant the steel truss bridges that had often been used earlier in the century.

This development led the bureau to design a series of aesthetically distinguished bridges, including several elegant stone-faced closed-spandrel bridges, and several large multi-span concrete rib-arch viaducts that are recognized for their light, graceful appearance and attractive proportions. D. Henry Overman was involved as a primary designer, supervisor, or a designer of aesthetic details like railings and light standards, for a large number of these bridges. Other designers who had a strong role in the design of bridges during this period were Marty X. Wisda, C. P. Smith, and W. E. Burroughs. Several of the open-spandrel concrete arches were built in the 1920s, but this bridge type would continue to be important for the bureau into the 1930s.

This bridge is typical of the reinforced concrete through arch bridges designed by the bureau in the late 1920s and built at many locations in Ohio. These bridges were very popular with the public and are still widely admired for their aesthetic qualities.
Many large bridges or viaducts in Ohio designed in or before 1927, including numerous open-spandrel concrete arch bridges, were county engineer projects and tended to be designed by private engineers or engineering firms. These included Cincinnati’s Park Avenue Bridge, built in 1917 and designed by J. R. Biedinger, and Luther Fawcett’s Lantern Falls Bridge, constructed by Mahoning County in 1920. Cleveland engineer Wendell P. Brown designed several of these bridges, including the 1922–1924 Conneaut Viaduct, and the Main Street Bridge at Niles, Ohio, which was designed by Brown in 1927, but remained unbuilt until the early 1930s as a result of numerous property lawsuits that slowed down the project.

The transition to stronger bureau involvement in design and construction of the state’s most prominent large highway bridges has its roots in the 1922–1924 construction of the Conneaut Viaduct, but seems to have reached fruition with the design of the Ashtabula Viaduct in 1927 (Figure 5). This bridge carried U.S. Route 20 over the Ashtabula River. The huge structure crossed over a wide river valley, and required approach spans on each end of the bridge, plus seven large open-spandrel concrete rib-arch spans taking the bridge across the valley floor. The project originated with a vote in 1922 by the Ashtabula County Commissioners asking for state aid in building a viaduct crossing the Ashtabula River valley on U.S. Route 20, which was one of the nation’s busiest highways at the time. A combination of federal, state, and county funding was used to build the bridge. The design of the bridge was completed under the direction of J. R. Burkey. However, the actual design appears to have been a collaborative effort, with design work completed by staff members of the bureau and by personnel affiliated with the Ashtabula County Engineer.44

History of the Bureau of Bridges

HISTORIC CONTEXT FOR THE OHIO DEPARTMENT OF HIGHWAYS BUREAU OF BRIDGES

Figure 6. Elastic Model of Ashtabula Viaduct Arch, Deck, and Spandrel Columns
Ohio Department of Highways Report for 1917–1928, (provided by State Library of Ohio)
This model was used by D. Henry Overman to perform structural tests to determine how the arches and spandrel columns of the viaduct would perform when loaded with the concrete bridge deck. The tests were related to the Ashtabula Viaduct’s status as a pioneering example of an integral bridge, which was an important engineering advance for the bureau.

At the bureau, D. Henry Overman was put in charge of drawing and detailing the typical arch span for the Ashtabula Viaduct, and he checked the design of the arch ribs. Overman was also in charge of testing elastic models of the bridge to test the structural effects of loading the arch ribs with the bridge’s concrete deck slab (Figure 6). Construction of the viaduct was underway by March 1927 and the structure was completed by October 1928.

Writing in November 1927, as the Ashtabula Viaduct’s construction was nearing completion, J. R. Burkey in typical fashion praises the bridge for both its aesthetic and practical qualities. In particular, Burkey points out the tall, slender character of the bridge’s spandrel columns and other vertical supports. Burkey claims that the design of the supports allowed for better response to temperature changes in the roadway deck they supported, but he also added that the thin character of the spandrel columns “adds a boldness to the appearance of the structure.”

In discussing the structural characteristics of the Ashtabula Viaduct in the 1927 article, Burkey also stated, in reference to the spandrel columns, that “By this type of construction, which avoids all sliding expansion joints, it is believed that the structure will be free from the local disintegration and failure which has so frequently attended the type of sliding joint commonly used in the past.” This portion of the article referred to a very important structural aspect of the Ashtabula Viaduct that was pioneered by the bureau, and that would influence later bridge designs by the bureau and many other governmental organizations and private engineers. According to engineer and bridge historian Martin P. Burke, the type of bridge design known as integral originated with the Ashtabula Viaduct. Integral bridge design means that the bridges have “…no movable joints in their decks or between their decks and flexible end supports.”

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45 Martin P. Burke, ”Engineering Artistry in the U.S. Depression,” 12.
Brown and Herr, Historic American Engineering Record, 10.
46 Brown and Herr, Historic American Engineering Record, 10.
48 Ibid.
Burkey had discussed this issue in other published articles as early as 1926. Bridge historian and engineer Martin P. Burke has stated that the decision to use flexible columns supporting a continuous slab for the bridge deck, instead of rigid columns supporting a deck slab that was jointed and therefore not continuous, raised several structural concerns. These concerns were centered on whether or not the columns would be flexible enough to withstand the stresses they would undergo, and whether or not the action between the arch ribs and the slab of the deck would have negative effects on the overall ability of the bridge to withstand moving loads on the deck. Field observations made during construction of the bridge and the elastic model tests carried out by Overman were part of Burkey’s response to these concerns (see Figure 6 on page 20).

Integral designs were used by the bureau for future open-spandrel concrete arch bridges, but this type of design was also used for continuous steel and continuous concrete slab bridges designed by the bureau. The Teen’s Run Bridge on Ohio Route 7 near Eureka, Ohio, was an early prototype of integral construction using reinforced concrete, and was something of a prototype for hundreds of other concrete slab integral bridges designed by the bureau in the coming decades.

J. R. Burkey’s November 1927 article also emphasized the variety of structural types used by the bureau at the time. He mentioned that during 1927 the bureau had designed “…slab spans, deck beams, deck girders, thru girders, cantilevers, barrel arches…” and in addition to that, also open-spandrel concrete structures and steel bridges. Although Burkey’s focus often tends to be on concrete structures, he did report that the bureau had been designing a large number of steel bridges, and cites the Leading Creek Bridge on State Route 7 in southeast Ohio as an example where the bureau used solid rolled steel sections for the main truss members along the side of the roadway to give additional “sturdiness and durability.”

Also important for the bureau was the 1928 Napoleon Bridge, a stone-veneered seven-span filled-spandrel concrete arch structure. D. Henry Overman’s name was included on the bridge’s bronze dedication plaque, and shortly after its completion he was promoted to Principal Designing Engineer of Bridges. This promotion placed Overman in a supervisory position for bridge design projects, and made him the main assistant to Rabe, the bureau’s Chief Designing Engineer of Bridges.

Another important late 1920s project of the bureau was the design of the Fitchville Bridge, an open-spandrel concrete rib arch bridge carrying U.S. Route 250 over the Vermillion River in Huron County. This bridge had a single 100-foot open-spandrel concrete arch and a series of concrete girder approach spans (Figure 7). The bridge was built from June 1928 to July 1929. Construction drawings were drafted by D. Henry Overman and Marty X. Wisda of the bureau in May

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50 Ibid., p. 13.
51 Ibid., p. 16.
53 Ibid., p. 16.
1928. Construction drawings show that Overman designed the arch, spandrel columns, and railings, while Wisda’s name appears on the sheets for the abutments.\(^{56}\)

\[\text{Figure 7. Fitchville Bridge, built 1928–1929, 2012 view} \]

\[\text{Hardlines Design Company Photograph by Jeff Bates} \]

*This somewhat smaller open-spandrel concrete rib-arch bridge was one of the bureau’s design projects of the late 1920s. The bridge is a good early example of D. Henry Overman’s open-spandrel concrete arch design work. The bridge replaced an 1880s metal bridge that had been damaged beyond repair due to a truck collision.*

The Bureau in the Great Depression: 1930–1937

Shortly after the completion of the Fitchville Bridge, the stock market crash of October 1929 led the United States into the economic decline that became the Great Depression of the 1930s. As the depression deepened in the 1930s, the State of Ohio began to look on highway improvement and the construction of new bridges as a way to bring jobs to the state’s many unemployed individuals. As a result, the 1930s were a time of major bridge construction for the bureau. In addition, since the bridge and highway construction was geared toward job creation, the bureau was free to design bridges that required labor-intensive construction methods. This led to the design and construction of many aesthetically distinguished bridges during the 1930s. The bureau continued on through the Great Depression years under the leadership of Chief Engineer J. R. Burkey, who would stay on as head of the bureau until nearly the end of the 1930s.

One significant event that would have a long-lasting effect on the bridge inspection and record keeping procedures of the bureau was a condition survey of all of the state’s bridges. This survey had been ordered by J. R. Burkey in 1930 and commenced in June 1930 at a cost of about $30,000. The survey was to last for approximately one year, ending around June 1931. The project involved an inspection of each of the state’s bridges, as well as the completion of a data sheet for each bridge that would allow the staff to know a bridge’s location, size, capacity, and conditions in a single glance.

This survey appears to be the origin of the familiar bridge record cards that are well-known resources to anyone involved in documenting the state’s historic highway bridges. An example of a bureau bridge card is shown in Figure 5 on page 19. Another image of a bridge card and the storage place for the cards is shown below in Figure 8.

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57 Ibid., 13.
Immediately on the heels of the 1930–1931 bridge survey was a major event for the bureau that was directly related to the Great Depression: the winter relief bridge program of 1931–1932. In response to the tremendous amount of unemployment triggered by the fallout from the 1929 stock market crash, state and local governments attempted to create public works programs to boost employment, in the years before the advent of Franklin D. Roosevelt’s New Deal in 1933. In Ohio, Governor George White and Ohio Department of Highways Director O. W. Merrill approved a plan in early September 1931 to provide work for the unemployed by replacing many of the state’s old and inadequate highway bridges. Approximately $3.5 million in funding was provided by the state for this program, which had the goal of providing employment by replacing 380 deteriorated or deficient bridges with new structures.

The program apparently caused something of a crisis at the bureau. Bureau staff first had to select the 380 structures that were most critical for replacement under the relief program. The bridges to be replaced needed to be in critically bad condition, but they also had to be located near areas where large amounts of unemployed workers lived. Once selection was completed, a major push ensued to design the 380 bridges, a somewhat overwhelming task for the bureau’s bridge designers. Special precautions had to be taken since the bridges were to be built in the winter, which usually does not offer particularly favorable conditions for construction. After bids were received for the initial 380 bridges, the bureau decided that the funds available were not sufficient, and the number of bridges to be built was cut to 300. Actual construction costs came in lower than the estimates, and in the end 347 bridges were built as a result of the winter relief program.\(^{59}\)

Most of the winter relief bridges were smaller spans that could be designed and built quickly, but the bureau also designed some major bridges in the early 1930s, especially open-spandrel concrete rib-arch structures. The Brecksville Bridge, designed in 1930, contained five open-spandrel rib-arch spans and stood much higher than the Ashtabula Viaduct. The great height of the bridge gives it a graceful appearance and it is one of the first of the major open-spandrel concrete arch bridges designed by the bureau in the 1930s.\(^{60}\)

A second major open-spandrel concrete arch viaduct designed by the bureau in the early 1930s was the Broad Road Viaduct of 1931. This bridge was much lower in height than the Brecksville Bridge so its proportions were not as vertical. The bridge featured seven open-spandrel concrete rib-arch spans and was 1,670 feet in length; considerably longer than the Ashtabula Viaduct or the Brecksville Bridge. Both the Brecksville Bridge and the Broad Road Viaduct were largely the work of bureau designer W. S. Hindman, assisted by other staff members at the bureau.\(^{61}\)

Another open-spandrel concrete rib arch bridge designed by the bureau during the early 1930s was the 1932 Blaine Hill Viaduct (Figure 9). This multi-span open-spandrel reinforced concrete rib-arch bridge was constructed in Belmont County

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\(^{60}\) Ibid., 15.

\(^{61}\) Ibid.
in southeast Ohio. The viaduct carried U.S. Route 40 over Wheeling Creek and tracks of the B&O Railroad. The bridge included four open-spandrel concrete arch spans varying in size from 95.5 feet for the smallest span, to 132.5 feet for the longest of the four. The height of the tallest span from the foundations to the roadway deck was 90 feet. The complete length of the viaduct was 753.5 feet. The bridge was designed by D. Henry Overman and A. J. Freimuth for the bureau. Later in the 1930s, Overman’s name would become strongly associated with the bureau’s open-spandrel concrete arch bridges. The viaduct was rehabilitated in 1986 with the deck and railings replaced. A railing design with recessed blind arch panels was used to mimic the design of the original railing. The bridge is still standing today.

One of the most aesthetically distinguished of the bureau’s early 1930s open-spandrel concrete rib-arch bridges and one that received extensive attention from D. Henry Overman was the 1932 Brookpark Viaduct, which sits southeast of Cleveland, and carries State Route 17 (Brookpark Road) over the Rocky River Valley. The viaduct is 1,918 feet long and features eight open-spandrel concrete rib arch spans with tall parabolic arches. The bridge features thin, graceful arch ribs and thin vertical spandrel columns. One remarkable feature of the bridge is that the two ribs of each arch span have no transverse lateral braces above the springing line of the arch, to tie the arches together. The lack of transverse braces gives each arch span a “…neat, clean, and uncluttered appearance” that distinguishes it from other open-spandrel concrete rib arch structures. The Brookpark Viaduct was clearly something of an aesthetic high point among the many open-spandrel concrete arch bridges designed by the bureau in the first half of the 1930s.

While the substructure of this bridge has an elegant abstract design, Overman selected a series of Neo-Gothic motifs for

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63 Ohio Department of Transportation. Historic Open-spandrel Concrete Arch Bridge File. On file at the Ohio Department of Transportation, Office of Environmental Services.

the portions of the bridge above the deck, including the pylons and railings (Figure 10). The intricate designs were seen as appropriate for the bridge since it was a major public facility, and the large amount of labor needed to create the Neo-Gothic designs in concrete increased employment.65

![Figure 10. Drawings of Railings and Pylons, Brookpark Viaduct, 1932](ODOT OES Historic Bridge Construction Drawing Files)

*The drawing represents D. Henry Overman’s fairly elaborate Neo-Gothic railing and pylon designs for the deck of the viaduct. These railings were removed when the deck was widened.*

At the same time that these major open-spandrel rib-arch bridges were being designed and constructed in the early 1930s, the bureau was also leading the nation in the design and application of continuous construction and welded splices and steel bridge construction. In 1931 the first continuous girder bridge was built in Ohio: a three-span, continuous steel girder bridge that carries U.S. Route 52 over Issaacs Creek in Adams County. The bridge was designed by bureau engineers Harry Hawley and Erv Nofer. Other early notable examples of continuous beam and girder bridges include the 1932–1933 three-span continuous steel girder bridge that carries State Route 125 over Ohio Brush Creek in Adams County (designed by bureau engineers Kiser E. Dumbauld, Howard M. Scott, and Stan R. Rudin), and the 1933 three-span continuous steel beam bridge that carries State Route 78 over Sunday Creek in Athens County (designed by bureau engineers Amedeus J. Friemoth, Costas S. Demos, and Stan R. Rudin). The continuous concept proved so accepted, that the last non-continuous steel beam bridge was constructed in Ohio 1932.66

The year 1934 was an important time for the bureau, since three major aesthetically significant bridges were designed by the bureau that year. The first of the three bridges was the Findlay Bridge, which was designed by the bureau in 1934 and dedicated on July 7, 1935. The bridge had three spans and a continuous steel beam and girder structure. The bridge was unusually wide, featuring a 50-foot roadway and 8-foot sidewalks. The bridge was primarily designed by C. P Smith and S. R. Rockoff of the bureau, but D. Henry Overman designed the railings, lighting pylons, and other decorative features. The railing was composed of poured concrete with metal inset panels that had a brass and black-painted metal design featuring a quatrefoil pattern with four arrows pointing outward, and a rosette in the center (Figure 11).

65 Ibid., 19.

In addition to a concern for decorative features like railings and lighting pylons, Overman was also concerned that the bridge’s steel structural elements have a clean look uninterrupted by features like stiffeners, joints, fasteners, and bearings. These elements are largely concealed on the Findlay Bridge, which may reflect Overman’s influence and involvement in the design. This tendency may have carried over from Overman’s extensive work with reinforced concrete, which tends to have smooth, uninterrupted surfaces and lines.\(^{67}\)

The structural design and construction procedures for the bridge are also of interest. On this subject, Martin P. Burke has written:

The structural design and erection procedures for the primary members of this bridge followed the procedures that had been developed and adopted as a standard by the Ohio Department of Highways in 1931 or earlier, coincidentally or most likely, internationally, when Henry Overman became the Principal Designing Engineer of Bridges in 1930. To avoid deck joints in multiple-span bridges, simply supported members were field spliced at piers. To achieve full continuity for both dead and live load, members being spliced together were lifted and lowered at adjacent supports while splices were made. Interior beams and girders were spliced with both riveted and welded connections. The welded connections used for these girders are unusual and probably significant.\(^{68}\)

In 1934, around the same time as the bureau was designing the Findlay Bridge, the bureau staff was also designing the Dublin Bridge, located northwest of Columbus in Franklin County. This closed-spandrel concrete rib-arch bridge carries U.S. Route 33 and State Route 161 over the Scioto River and also over State Route 257. The bridge has six arched spans with the largest of the spans measuring 100 feet. Each arch span has three ribs.\(^{69}\)

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\(^{67}\) Ibid., 22–23.

\(^{68}\) Ibid., 22.

\(^{69}\) Ibid., 24.
In terms of aesthetics, the bridge was faced with irregular sandstone blocks. Each outer arch face was lined with stone voussoirs, and the design also included parapet balconies, cutwaters, and beltcourses. The railing was crenellated, giving the bridge a somewhat Medieval character that seems to have been favored by Overman for stone-faced bridges. The stones were carefully selected for color and pattern, and exposed concrete also received careful surface treatments to harmonize with the color and texture of the stone as much as possible.\footnote{Ibid., 26.} The bridge has had its deck widened considerably, but the original arched substructure of the bridge with its stone veneer still survives.

Of the three outstanding bridges designed by the bureau in 1934, the most well-known is the Lorain Avenue Viaduct in Cleveland (Figure 12 and Figure 13). The bridge carries State Route 10 (Lorain Avenue) over the Rocky River Valley, and is 1,261 feet long. The overall appearance of this bridge resembles, in form, one of the light and graceful open-spandrel concrete rib-arch designs that the bureau produced in the late 1920s and early 1930s, but the bridge’s arched structure is composed of steel rather than concrete. The bulk of the bridge is composed of four steel parabolic steel arch spans. Because of the depth of the river valley, the bridge is high and has sweeping vertical proportions, with the central arch ribs rising 97 feet above the valley floor.\footnote{Ibid., 5–6.}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{lorain_avenue_viaduct}
\caption{Photograph of the Lorain Avenue Viaduct, ca. 1934–1937}
\end{figure}
\begin{flushright}
\end{flushright}
\begin{flushright}
The photo shows off the viaduct’s soaring parabolic arches and light spandrel columns.
\end{flushright}
The bridge was designed with aesthetics as a major consideration since the valley the bridge crossed was part of the Cleveland Metropolitan Park System. The bridge was designed to eliminate the need for diagonal (lateral) braces. The absence of these braces emphasizes the main structural lines of the bridge and gives a cleaner, more pleasing design. The structure has an unusually light, graceful appearance and is one of the most aesthetically successful of the bureau’s arched bridges of the 1930s. The structure received the Most Beautiful Steel Bridge award for its class in the 1935 bridge awards given by the American Institute of Steel Construction. To complement the sleek appearance of the arches and spandrel columns, a modernistic design was chosen for the railings, in contrast with the traditional Neo-Gothic railing designed by Overman for the Brook Park Viaduct.\(^\text{72}\)

The bureau’s work of the mid-to-late 1930s received extensive recognition for engineering as well as aesthetics. For example, in his book on bridges of the 1926–1936 years, well-known Ohio engineer Wilbur Watson specifically mentions J. R. Burkey in connection with these achievements, stating:

> The work done by the State of Ohio, under Mr. J. R. Burkey, Bridge Engineer, is, we think, worthy of special note. The Lorain Road Viaduct near Cleveland is the work of that department and the two structures now illustrated, the Bascule bridge at Port Clinton and the Brook Park Viaduct near Cleveland, show a

\(^{72}\) Ibid., 6–9.
commendable effort to make these widely different types attractive as well as utilitarian.\footnote{Wilbur Watson, \textit{A Decade of Bridges, 1926–1936} (Cleveland, Ohio: J. H. Jansen, 1937), 56.}

In addition to praise from Watson, J. R. Burkey also received a commendation from the Ohio State University for his work as chief of the bureau in November 1935. The text of the committee recommendation for the commendation refers to the efficiency of the bureau under Burkey’s guidance and also refers to J. R. Burkey as “…generally recognized as one of the best highway engineers in the country.”\footnote{Ohio State University. “Burkey Commended.” \textit{Ohio State University Monthly}, November 1935, p. 10.}

In 1935–1936, the bureau followed up the award-winning design for the Lorain Avenue Viaduct with a return to open-spandrel concrete rib-arch design. The Foster Bridge, located near Cincinnati, Ohio, carried U.S. Route 22 and State Route 3 over the Little Miami River and also over a series of railroad lines and local roads (Figure 14). The overall design for the bridge was similar in form to the bureau’s earlier open-spandrel rib-arch bridges in the late 1920s and the first half of the 1930s. Like the earlier spans, this bridge shows a great sense of attention to aesthetics.\footnote{Ibid., 28–30.}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{foster_bridge_photo}
\caption{Aerial Construction Photograph of the Foster Bridge, ca. 1935–1936}
\end{figure}

\textit{The Foster Bridge was another major open-spandrel concrete rib arch structure designed by the bureau in the mid-1930s.}

Also built in 1936 was the Defiance Bridge, which carried State Routes 15 and 18 across the Auglaize River. The continuous steel girder structure had five spans, with two spans of 72 feet, and three spans of 90 feet. Like the Findlay Bridge, the latest in steel construction technology was used to attain a fully continuous superstructure with no intermediate deck joints.\footnote{Ibid., 30–32.} Figure 15 shows the entire bureau’s staff ca. 1937, while Figure 16 shows the organizational structure of the bureau. Examples of bridges designed by the bureau during the 1930s are shown in Figure 17.
The illustrations showcase the variety of bridge types that the bureau used for smaller spans during the 1930s. Several reinforced concrete bridge types are shown as well as timber and steel structures.
The Bureau in the Late 1930s and World War II: 1938–1945

After the highway expansion of the late 1920s and the numerous large projects of the 1930s, the World War II years were much slower for bridge building. During the war, resources were concentrated on the war effort, both in terms of materials and labor. Bridges were built mainly when needed to assure that war-related materials made their way to their destinations. Projects were completed, but at a much slower pace than in the 1920s and 1930s. Steel was a strategic material needed for many wartime items and was hard to come by for bridge building. With many men serving in the U.S. Armed Forces and many other working age men and women employed in wartime production factories, labor was not easy to come by either.

The beginning of this era also brought about a change in leadership of the bureau. J. R. Burkey, who had joined the bureau in 1911 and had served as bureau chief since 1925, ended his leadership of the bureau in 1939, taking a position as a consulting engineer with Union Metal Manufacturing Company, where he would stay until his retirement. The era began with the economic revival of the late 1930s and early 1940s that was brought on by increased industrial activity related to the pre-war buildup of the U.S. Armed Forces before the United States entered the war. One of the bureau’s major projects during this time was the design of a continuous steel truss bridge carrying U.S. Routes 35 and 50 over the Scioto River in Ross County. Another bureau initiative of the late 1930s and early 1940s was the completion of a new design specification book for bridges, and, in 1940, a new set of standard bridge design drawings. The revisions to the specifications provided updates that reflected recent advances in highway construction technology, structural design, and safety features. The bureau also continued its program of research, investigating the use of dampers to reduce vertical vibrations in bridge spans, the study of the role of bridge floors in the stiffness of bridge spans, and investigations into the capacity of pilings and the use of subsoil exploration in preparation for bridge construction. The bureau also continued to review bridge plans prepared by county engineers in Ohio, to assure that the plans met current state design standards.

In terms of organization, during this era the bureau was directed by the chief engineer of bridges, and the staff consisted of an assistant chief engineer, a railroad crossing engineer, a field bridge engineer, a chief designing engineer, several designing engineers and assisting engineers, and draftsmen. By this time the Ohio Department of Highways had been divided into the 12-district system that exists now, and each of the twelve districts had its own bridge engineer who was in charge of field work in that district.

The entrance of the United States into World War II in December 1941 brought many changes to the bureau. One of the most immediate was the temporary departure of D. Henry

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77 The Columbus Dispatch. “J. R. Burkey, Engineer, Dies at 79.” January 18, 1961, p. 26A.


79 Ibid., 46–48.

Overman. Overman enlisted in the Navy and served in the U.S. Navy engineering battalion during the entire war. Overman was absent from the bureau from around the beginning of U.S. involvement in the war until his return in 1945 as the war was drawing to a close.\textsuperscript{81}

The war years were also a difficult time for the bureau because of lack of resources for construction and repair of bridges. The 1939–1943 five-year report for the Ohio Department of Highways indicated that the bureau’s wartime problems were fairly severe. Replacement and, in some cases, repair of old bridges had been delayed because of the war effort, and many old bridges that were at the end of their useful lifespan were in poor condition as a result of age and increased wear and tear related to heavier automobile traffic. Bridge replacements were, for the most part, only undertaken in cases where the existing bridge was extremely weak or in danger of structural failure. Plans for replacement bridges had to be drawn up to avoid the use of steel, which was a critical wartime material, and timber, which had been used in large quantities for wartime and industrial purposes and was therefore very hard to obtain.\textsuperscript{82}

The bureau used some creativity to solve the problem of deteriorated bridges during this time. For example, some bridges were in usable condition, but could no longer handle the traffic capacity at their original locations. Instead of demolishing these bridges, the structures were dismantled and moved to locations where the existing bridge was heavily deteriorated and in need of replacement. In this way, an old, deteriorated bridge could be replaced with the use of minimal new construction materials because of the re-use of an existing structure.\textsuperscript{83}

One example is a camelback steel truss bridge that was too narrow for its original highway location due to increased traffic that was moved to a site on State Route 75 in Coshocton County. The new site was in need of a replacement bridge, and the camelback truss was wide enough to meet the roadway standards for that particular road.\textsuperscript{84}

Grade separations were also an issue for the bureau during the war years. In cases where the railroad tracks were to pass over a highway, the railroads were in charge of designing the overpass structures, but the bureau was responsible for designing overpasses where the highway was carried over the railroad. Seventy grade separation projects were designed by the bureau and placed under contract between 1939 and 1943. Another 25 grade separations were designed by the bureau, but had not yet been placed under contract by 1943.\textsuperscript{85}

As of 1943, the bureau was already looking ahead to the postwar era. The highway department’s 1939–1943 five-year report indicated that over 100 bridges had been designed before the war, but never constructed because of wartime needs. These bridges were identified in the annual report as being “completely designed structures for immediate postwar construction.”\textsuperscript{86} The department was beginning to look ahead

\textsuperscript{81} Martin P. Burke, “Engineering Artistry in the U.S. Depression,” 33.
\textsuperscript{83} Ibid.
\textsuperscript{84} Ibid., 45.
\textsuperscript{85} Ibid., 43–44.
\textsuperscript{86} Ibid., 44.
to the large task of replacing and repairing the large number of bridges that were in deteriorated condition at the end of World War II. This, and the beginnings of the interstate highway system, would be some of the major tasks of the bureau as it entered the postwar era.
Epilogue - The End of the Burkey-Rabe-Overman Era

The bureau was very busy after World War II. The war had interrupted the steady process of replacement of old and functionally obsolete bridges, and the bureau had an extensive backlog of structures that required repair and replacement at the end of 1945. In addition, engineering technologies continued to develop, so several new structural options were available after the war that were less expensive and cheaper to build. Wartime restrictions on steel and other materials were lifted, so steel girder bridges could again be built. Some structural types, such as open-spandrel concrete arches, faded during the postwar era and were replaced by other less expensive structural types. The 1950s and 1960s would also bring the development of the interstate highway system, one of the largest highway undertakings in the history of the United States.

As the 1950s and 1960s unfolded, leadership of the bureau was passed onto a new generation as the leaders of the 1920s and 1930s retired. Some of the major figures who shaped the bureau in the 1920s and 1930s left the bureau before the onset of the postwar period, while others remained on through the 1950s. Some important staff members had departed the bureau before the beginning of World War II, most notably J. R. Burkey, who had retired from his position as chief of the bureau in 1939 in favor of a private-sector job. Burkey eventually retired from his job as a consulting engineer and died in January 1961 at the age of 79.

D. Henry Overman returned to the bureau after his World War II service with the U.S. Navy and served as its chief from 1956 until his retirement on May 1, 1964. Overman spent his retirement visiting and photographing prominent bridges in other states, and died in 1972.

Although it is now long in the past, the achievements of Burkey, Rabe, Overman, and the bureau as a whole during the 1920s and 1930s continue to be recognized by scholars of historic bridges. The Lorain Avenue Viaduct and other prominent works of the bureau from the 1920s and 1930s remain as a lasting monument to the bureau and its engineers.
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APPENDIX A. BUREAU OF BRIDGES ARCH BRIDGE ENGINEERS: 1925–1940
### Arch Bridge Engineers of the Bureau of Bridges, 1925–1940
Reproduced from Burke, 1992, Appendix B

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<th>Name</th>
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<td>JRB</td>
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<td>WEB</td>
</tr>
<tr>
<td>Butler, J. H. (John)</td>
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