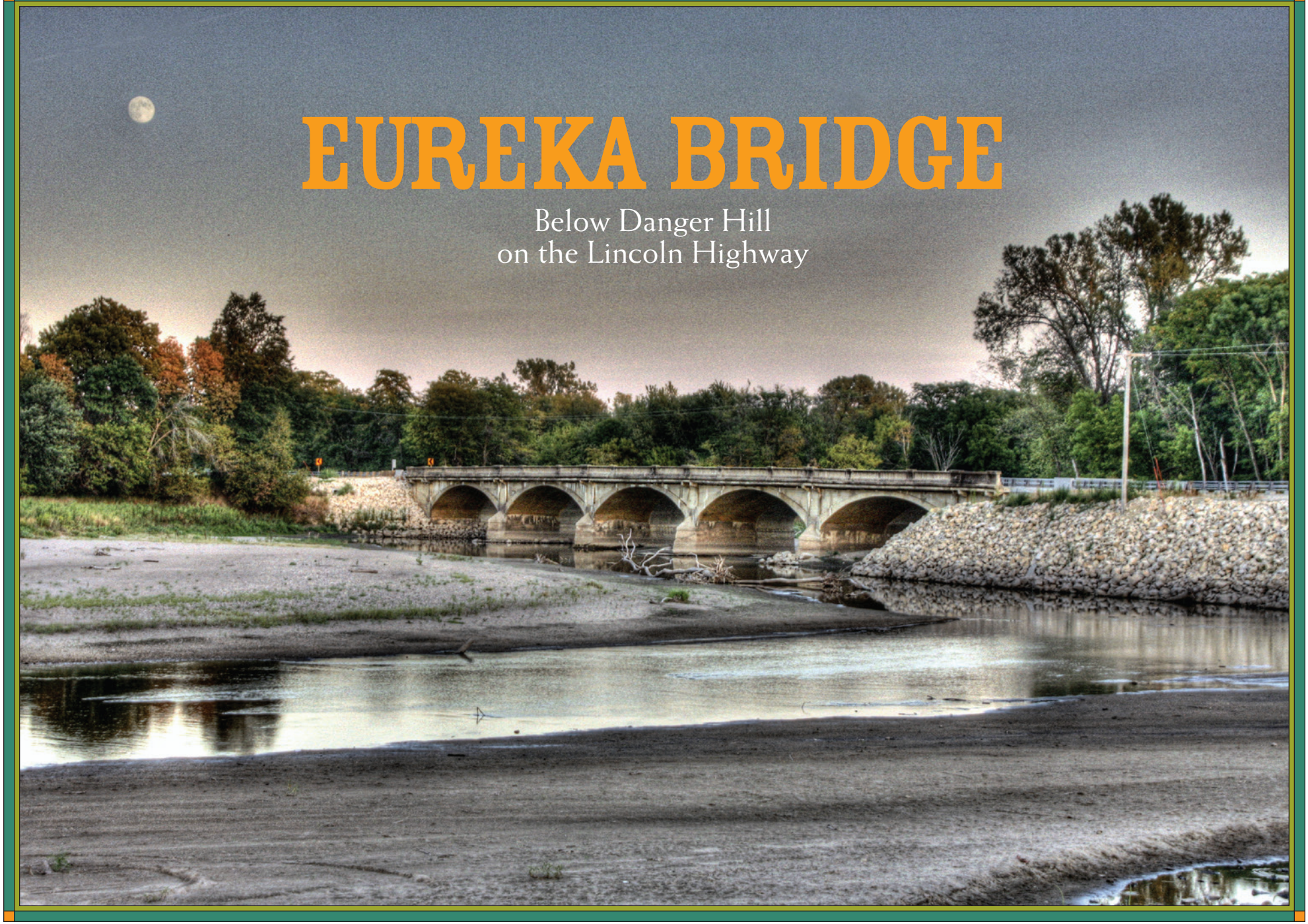
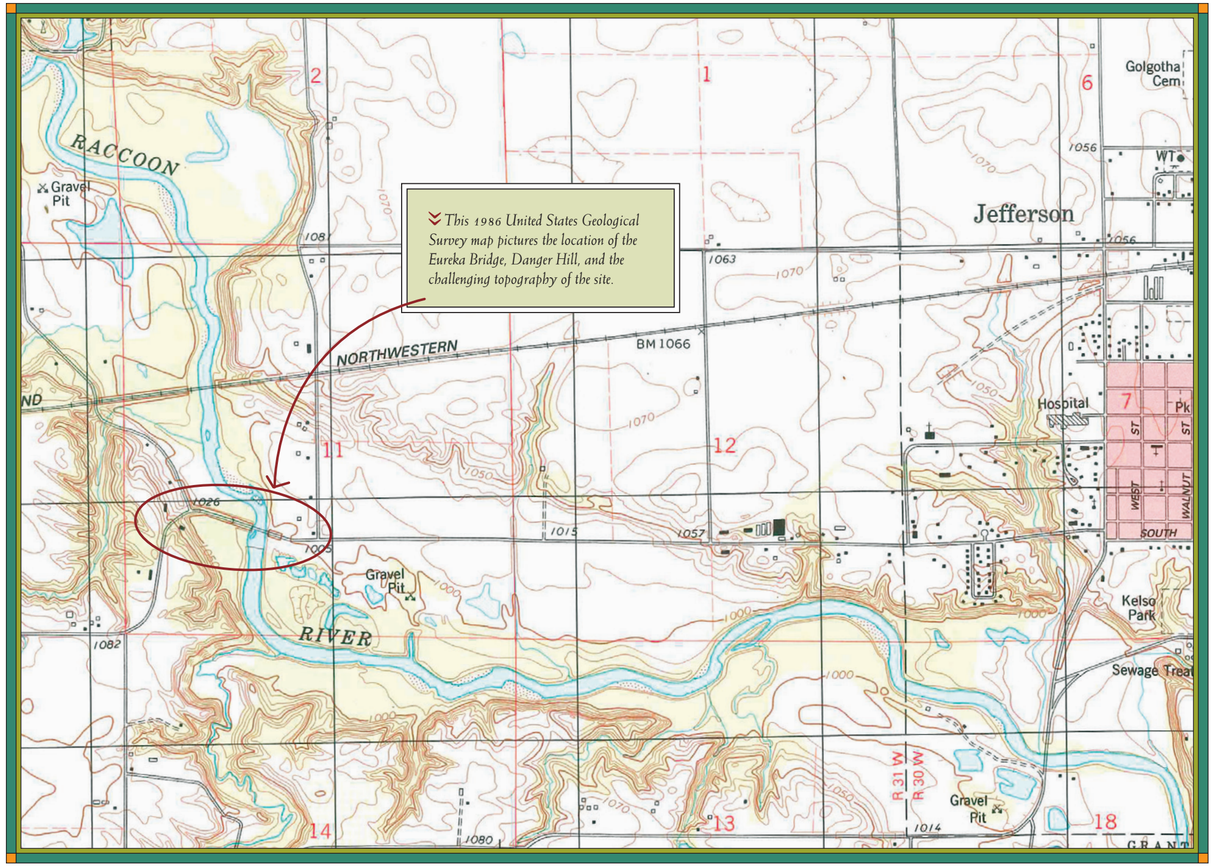

EUREKA BRIDGE
Below Danger Hill
on the Lincoln Highway




# EUREKA BRIDGE

## Below Danger Hill on the Lincoln Highway

*Spanning time and space, the structural utility and classic beauty of the Eureka Bridge were recently rehabilitated for continued public service. This booklet tells the story.*

WILLIAM COLGAN PAGE
Public Historian

*Published by the Greene County Engineer's Office, U.S. Army Corps of Engineers, Iowa State Historic Preservation Office, and the Iowa Department for Transportation.*

2014

*Eureka Bridge or Eureka Mill Bridge*

# TIMELINE

**1912**
Iron bridge

**CIRCA 1888**
Iron bridge built

**1912**
Present bridge built
(reinforced concrete)

**2012**
Present bridge
rehabilitated and widened
(south side)

**CIRCA 1871**
Wood bridge built

**CIRCA 1871**
Eureka Mill
(bridge's namesake)
established

**1890**
Eureka Mill
destroyed
by fire

**1903**
Iron bridge
extended

**1924**
Present bridge widened
(both sides)

1870 1880 1890 1900 1910 1920 1930 2010 2020

# INTRODUCTION

Today, many American motorists take bridges—and the feats of their engineering—for granted. Many new highway and interstate bridges feature high bulkhead walls, and motorists are often unaware when they cross a river or stream. The 2007 failure of the Interstate 35W Bridge over the Mississippi River in Minneapolis startled the nation and left a sober reminder that bridges play a vital role in American life. Bridges bring people, places, and products together. Many people consider bridges among the most beautiful structures constructed by man.

This booklet tells how the Eureka Bridge contributes to this story. The Eureka Bridge is located 2.8 miles west of the City of Jefferson, the county seat of Greene County, Iowa. The bridge's surrounding topography is hilly and was formed by the North Raccoon River eroding the countryside in a diagonal pattern from the northwest to the southeast. Although the river is generally gentle, heavy rains in the spring and early summer can cause it to rampage, as attested by many historic floods, "freshets," or "June rises," as Victorians called them. Situated below a dangerous hill and at a tight bend in the river, the Eureka Mill crossing has posed challenges to transportation since the original settlement of Greene County.

The present structure still bears the name of the Eureka flour and feed mill established circa 1871 nearby. During the 19th century, the structure was known as the "Eureka Mill Bridge." A wooden structure, replaced by an iron structure in 1888, bridged the river at this site before the construction of the present reinforced-concrete bridge in 1912. The iron bridge served as an important link along the nation's first trans-continental route for motorists. The 1912 bridge provided improved service along this route, whose name changed in 1913 to the Lincoln Highway.

JOHN P. ZELLER, PHOTO

Into the early 21st century, the Eureka Bridge remained adequate for legal loads, but its roadway width of only 20 feet lacked the current 30-foot minimum required by the Iowa Department of Transportation for farm-to-market paved roads. In short, by 2008 the bridge was functionally obsolete and structurally deficient. As the Greene County Engineer explored ways to address this problem, it became evident that the cost to build a new bridge would be less expensive than to retrofit the existing bridge for current standards. However, the costs to relocate and pave the roadway—also required for a new bridge construction—would dramatically increase the project's expense.

Within this context, the rehabilitation of the existing bridge made economic sense. (Shuck-Britson, Inc.)

At the same time, the historic character of the Eureka Bridge came into play. In 1992, the bridge had been listed on the National Register of Historic Places as a contributing resource in "The Lincoln Highway: Raccoon River Rural Segment Historic District." The nomination of this linear historic district reflected the emerging national interest in the Lincoln Highway as an historical phenomenon. As a result, Greene County's plan to widen the Eureka Bridge prompted action, under the National Historic Preservation Act, to assess the potential impact on its historic integrity. An agreement between the Iowa Department of Transportation, U.S. Army Corps of Engineers, Iowa State Historic Preservation Office, and Greene County Engineer's Office was reached to rehabilitate the Eureka Bridge to meet current highway standards while preserving its historic integrity. The firm of Shuck-Britson, Inc., of Des Moines, Iowa, was selected to prepare this design.

The U.S. Army Corps of Engineers, Iowa State Historic Preservation Office, and the County of Greene County, Iowa, executed a Memorandum of Agreement in 2009 to authorize and guide this project. The Iowa Department of Transportation and the Iowa Lincoln Highway Association concurred in this agreement. This booklet complies with one stipulation of that agreement. Its author is solely responsible for the historical interpretation and any errors contained in it.

Construction of the bridge's rehabilitation began in 2009. It was completed and opened to the public in 2011.

*2011 Rehabilitated Eureka Bridge*

## FACT SHEET

| | |
|---|---|
| Official name | Eureka Bridge |
| Alternate names | Eureka Mill Bridge<br>Raccoon River Bridge |
| Carries | Greene County E53<br>(Old Highway 30) |
| Crosses | North Raccoon River |
| Locale | Jefferson, Iowa |
| Maintained by | Greene County, Iowa |
| ID number | FHWA 162260 |
| Design | Reinforced concrete arch |
| Total length | 458' |
| Width | 30' |
| Clearance below | Approximately 18' |
| 2011 Redesign | Shuck-Britson, Inc.,<br>Des Moines, Iowa |
| Rehabilitation construction | A. M. Cohron & Son, Inc.,<br>Atlantic, Iowa |
| Opened | 2011 |
| Coordinates | 42° 00' 43.12" N<br>94° 25' 44.72" W |



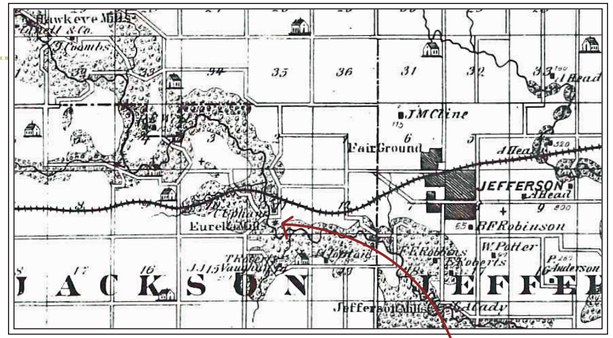
## A DIFFICULT RIVER TO CROSS

The Eureka Bridge spans a difficult river crossing. Situated in a valley at the foot of a steep western slope, a tightly curved roadway, and over a river prone to flooding, a series of bridges has met these challenges—to greater or lesser degrees—for almost 150 years. Each successive bridge has featured technological advancements over its predecessors, most evident their building materials: wood, iron, and reinforced concrete.

The first bridge at this point over the North Raccoon River, a wooden structure, dates to about 1871. Little is known about this bridge. Before this time, wagons forded the river. The 1870s saw the erection of a series of bridges in Greene County, and the need for bridges constituted one of the county's greatest expenditures in the 19th century. The prioritization of sites for their construction naturally engendered public debate.

The *A. T. Andreas Illustrated Atlas of the State of Iowa* shows the local roads in Greene County in 1875. Already a complicated network had evolved. While most of the county's roads conform to the points of the compass, considerable irregularity occurs along the meandering course of the North Raccoon River and its tributaries, where hilly topography and heavy timber complicate transportation. A local newspaper later described this part of Greene County as a "maze of the hills and hollows of the mighty 'Coon." (*Jefferson Bee,* April 17, 1912)

The first Eureka Bridge took its name from the Eureka Mill, a water-powered flour mill established in the summer of 1868 by Lock and Deemer and located a little downstream from the




*This 1875 map pictures a part of Jackson Township in Greene County, Iowa, its rugged terrain, and "Eureka Mills" with its owner Cyrus Upham, shown by a star on the east side of the river just below the Eureka Bridge. (A. T. Andreas: 43)*

present bridge. (*Iowa State Register,* February 18, 1869) In 1872, a local newspaper reported:

> the Eureka Mills are now doing splendid work, and the white, light, healthy bread on many tables attest to the fact that the millers know how to give the farmer just recompense for his toil—good flavor—for good wheat. (*Jefferson Bee,* September 6, 1872)

The ownership of the mill among various partners changed fairly quickly. Flour mills provided a necessary service for pioneer families, and the Eureka Mill, like others, attracted wagon traffic. In 1886, a road to the mill was completed at the cost of $700.00. Many small mills like this already had ceased to be profitable,


*Flooding in 1912 on the North Raccoon River brought down the east span of the Eureka Bridge and precipitated planning for a new bridge design. By the end of the year, the present bridge was in place. (Iowa Department of Transportation)*

steam engines having revolutionized the milling industry. Small mills increasingly fell to giant competitors, like General Mills of Minneapolis. Insurance companies noticed an increasing number of fires at small mills. Whatever the cause or reason, a fire in 1890, or thereabout, destroyed the Eureka Mill (*Jefferson Bee*, January 21, 1890), and it was abandoned.

In the meantime, overland transportation had increased in the 1880s from Jefferson to Scranton and points beyond, necessitating a bridge to span the North Raccoon River. In response, Greene County replaced the wood bridge with an iron through truss bridge over the North Raccoon River at this spot.

Over time, the North Raccoon River eroded the east embankment of this iron bridge at this tight S-shaped curve in the river. To solve this problem, the county extended the east end of this bridge with a 100-foot iron span in 1903. The safety of the structure remained problematical, so in 1909 or 1910, Henry Haag improved it by constructing a new pier at mid-river. Floodwater subsequently damaged this pier in 1911.

Then, in 1912, a flood wrecked havoc all along the North Raccoon River to Des Moines. As ice began to break up on March 30, the river's powerful current pushed an ice cake—estimated to be 50 to 75 feet square and about two feet thick—onto the east side of the Eureka Bridge's central pier. The pier shifted to the west, the iron span collapsed, and the power of the river's current carried it downstream, where it lodged on the abandoned dam of the Eureka Mill. The same freshet caused widespread damage to other bridges throughout the region. By April, Greene County was divided from east to west with every bridge across the North Raccoon River out-of-service.

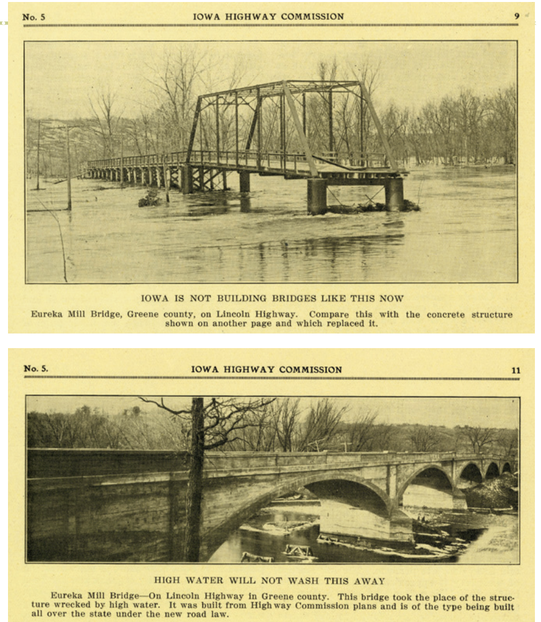
The need for a crossing at Eureka was urgent. Indeed, by 1911, the number of automobiles and motorcycles in Greene County, Iowa, exceeded 345. Residents of the City of Jefferson owned about one-third, according to a story in the April 1, 1912, *Jefferson Bee*. These "autoists," as the newspaper described them, already had organized a local auto club and actively worked to improve the county's roads. Both the residents and the officials of Greene County took pride in the Trans-Continental Route through their county. The collapse of the bridge therefore came as a shock. "Located as it is, upon the Trans Continental highway," a local newspaper reported, the bridge "is a very important crossing, and there is a demand for quick and active work to replace it." The newspaper further urged the auto club to "provide signs for the new highway, in order that proper directions be had by the traveling public." (*Jefferson Bee*, April 17, 1912)



The collapse of the iron Eureka Bridge also affected the farm community. According to bridge standards at the time: "Loads considered were a 15-ton Steam Traction Engine going from farm to farm at threshing time or a uniform load such as a drove of cattle occupying every available square foot of roadway between the rails and from end to end of bridge." (Blumenschein) The loss of the Eureka Bridge put local agriculture at risk.

In quick response to the 1912 collapse, Thomas H. MacDonald, chief engineer of the Iowa Highway Commission, visited Greene County, and, along with county supervisors, assessed the situation. MacDonald returned to Jefferson on April 11, 1912, and further discussed bridge matters with the county supervisors, and inspected the Eureka Bridge on site. (*Ibid.*, May 1, 1912) MacDonald's direct involvement in this project calls attention to the priority he placed upon it. Construction drawings for a new bridge were prepared by the end of April, and contract data were complete by mid-May.

The Iowa Highway Commission presented Greene County two possible designs to replace the Eureka Bridge. One design featured an iron 4-span pony truss. The other featured a multi-span, earth-filled, arched bridge of reinforced concrete with paneled detailing on its closure walls and guardrails. The Board of Supervisors chose the latter. The board rejected the bids on the first letting of the contract for the bridge as too high. Upon the second letting, the Marsh Engineering Company submitted the low bid of $13,300 (the cost of pilings and foundation work to be borne by the county) and received the award contract. Curiously, the *Jefferson Bee* reported that the bridge would be 210-foot long with three arches (*Jefferson Bee*, May 22, 1912), although in fact it was planned and built to be 422-foot long with five arches.


No. 5 IOWA HIGHWAY COMMISSION 9

IOWA IS NOT BUILDING BRIDGES LIKE THIS NOW

Eureka Mill Bridge, Greene county, on Lincoln Highway. Compare this with the concrete structure shown on another page and which replaced it.

No. 5. IOWA HIGHWAY COMMISSION 11

HIGH WATER WILL NOT WASH THIS AWAY

Eureka Mill Bridge—On Lincoln Highway in Greene county. This bridge took the place of the structure wrecked by high water. It was built from Highway Commission plans and is of the type being built all over the state under the new road law.

*The Iowa Highway Commission published these views of the old and new Eureka Bridge to showcase its reinforced concrete technology. The heavy mass of the concrete structure gives visual credence to the claim that "High Water Will Not Wash This Away." Indeed, the bridge has stood at this spot for more than a century. "Eureka Mill Bridge" was another name sometimes used for the bridge. The decision to feature the Eureka Bridge in this publication shows the highway commission's pride in its significance. (Iowa State Highway Commission Service Bulletin: 9, 11)*

Construction of the new bridge began soon after the execution of the contract. Construction was labor intensive and required a large crew of men, using steam power for sawing, hoisting, and pile driving. About 1,600 cubic yards of earth were excavated from the west bank of the river to fill the voids above the arches. This excavation also straightened, widened, and channeled the river so that it would pass under four of the new bridge's arches instead of just its two eastern ones. This reduced the power of the river at this point and relieved water pressure on each of the bridge's piers. (*Ibid.*, November 20, 1912) On December 30, 1912, the new Eureka Bridge officially opened, "the largest cement bridge on any country road in Iowa." (*Jefferson Bee,* January 1, 1913)

Justifiably proud of the new and monumental Eureka Bridge, a local newspaper reported that the Eureka Bridge was:

> The largest cement bridge in Iowa, outside of the city bridges of Des Moines, Cedar Rapids and Waterloo. . . seventh in size in the cement class and the largest one on the Trans-Continental route. (*Ibid.*, April 2, 1912)

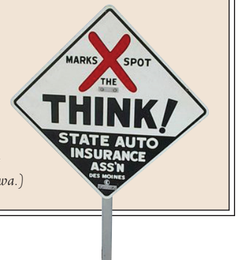
In 1914, the Iowa Highway Commission showcased the Eureka Bridge in an official publication and asserted that its design was "of the type being built all over the state under the new road law." (*Iowa State Highway Commission Service Bulletin,* 1914: 9, 11)

## DANGER HILL

Danger Hill is intimately linked historically with the Eureka Bridge. Situated immediately to the west of the bridge, Danger Hill abruptly rises more than 150 feet above the river valley. When ascending the hill, the roadway requires a tight S-curve to navigate the steep grade. When descending the hill, the physics of velocity, acceleration, and trajectory result in powerful motion and potential danger.

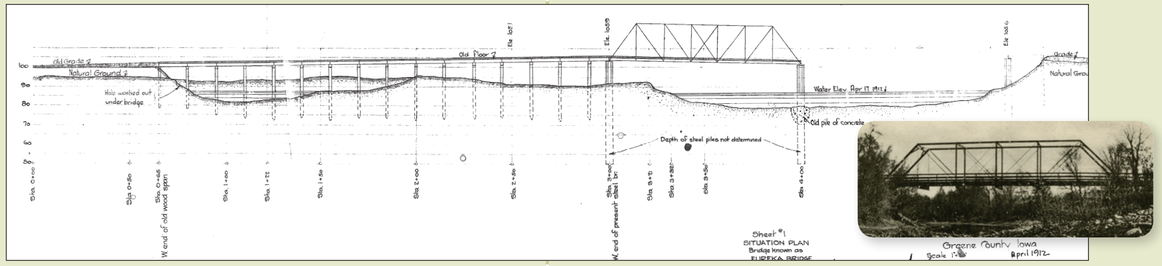
Many stories survive in Greene County to document that Danger Hill lived up to its name. Climbing the hill could pose a challenge even in clement weather. The Model T Ford had no fuel pump. The gas tank, located beneath the driver's seat, fed fuel to the motor by gravity. A steep grade like Danger Hill could displace this flow so that these cars sometimes could navigate the hill only by driving up it in reverse. (Don Van Gilder) Ice and snow presented challenges of other sorts to any vehicle.

Driving down the hill posed another danger. By the 1950s, a forest of death markers had appeared by the east end of the bridge, a testament to motorists who lost control of their vehicles and a sober warning to others. (*Ibid.*) In the late 1940s, Fred Owens and his young daughter (who vividly remembers the incident) narrowly avoided such a fate. Driving down Danger Hill, Owens suddenly noticed in his rear view mirror a tractor-trailer rapidly approaching his gravel truck, its driver frantically signaling that he had lost his brakes. Owens managed to stay in front of the truck all the way to Jefferson, where the run-away truck finally came to a stop. (Jayne Owens)

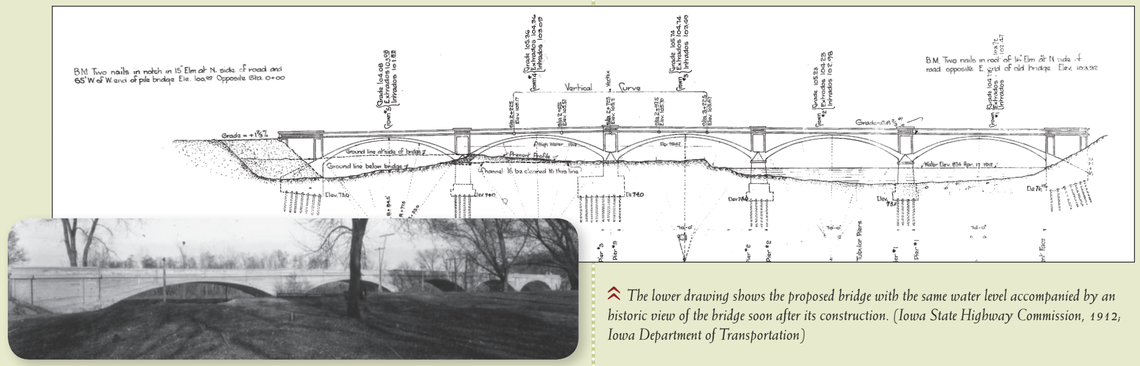



» *These small, roadside signs appeared alongside dangerous points on Iowa highways in the 1950s and marked sites of vehicular fatalities. Each sign represented one death, and, as at the east side of the Eureka Bridge, a cluster of these markers made particularly dangerous spots self-evident to motorists. The other side of the sign read "Drive Safely." (Image courtesy of Ted Lussem, Brooks-Lussem-Clem Insurance, Urbandale, Iowa.)*






» *This "Situation Plan," as it is called, provides two views of the Eureka Bridge in 1912. The upper drawing documents the damaged bridge and the flood water level on April 17, 1912.*




» *The lower drawing shows the proposed bridge with the same water level accompanied by an historic view of the bridge soon after its construction. (Iowa State Highway Commission, 1912; Iowa Department of Transportation)*

Recent research tempers the enthusiastic claim that the Eureka Bridge represented a common type of bridge then under construction in Iowa. According to Kenneth F. Dunker of the Iowa Department of Transportation, no arch bridge standards, even for a single span, were uncovered in research at that agency, although standard plans for pony trusses, through trusses, and other bridge types survive in its archives. "Any arch bridges designed by the highway commission must have been individually designed (or some standards have been lost)." (Dunker) An historical survey of bridge standards, prepared in 1949 by E. W. Blumenschein, Engineer of Bridge Design at the Iowa State Highway Commission and discovered recently in the Iowa Department of Transportation archives by Dunker and Hank Zalatel, corroborates this finding. (Blumenschein) Further, Clayton B. Frazer, whose extensive study of Iowa bridges has placed the Eureka Bridge within the context of other such historic structures, concludes:

> Numerous single-span concrete arches can be found in rural Iowa, but multiple-span examples are a relative rarity. (Frazer, 1995)

In short, the Eureka Bridge was and remains a rare bridge type in Iowa.

The design and construction of the new Eureka Bridge required only nine months to complete. The speed of this accomplishment highlights the importance the Iowa Highway Commission placed on this particular project and more generally on the agency's commitment to Iowa's segment of the Trans-Continental Route. Thomas H. MacDonald (1881-1957) played a key role in the construction of the new Eureka Bridge. His forceful leadership and demand for quick action pushed its early completion. These

*Thomas H. MacDonald circa 1915. (Iowa Department of Transportation)*

qualities rapidly gained for him national recognition and appointment to powerful federal offices. Within seven years of the Eureka Bridge's construction, MacDonald had moved to Washington, D. C., where, from 1919 to 1939, he served as chief of the U.S. Bureau of Public Roads and from 1939 to 1953 as its commissioner. According to Robert Moses in 1949: "There is no better example of nonpolitical, effective, and prudent Federal, State and local cooperation than that afforded by the Public Roads Administration for almost 30 years under the respected leadership of Commissioner Thomas H. MacDonald." (Lind: 103) Today, the agency MacDonald led is known as the Federal Highway Administration.

## "THE GREAT AMERICAN ROAD"

The construction of the Eureka Bridge occurred against the backdrop of public agitation all across America during the early 20th century to improve the nation's roads. Known as the Good Roads Movement, individuals, commercial clubs and organizations, business and industry, and local, state, and federal agencies joined forces to promote and fund the construction of roads, bridges, and other over-the-road transportation improvements.



Already by 1912, the Trans-Continental Route had mapped a corridor across the nation, with Greene County on the route. According to one local newspaper, Greene County boasted 300 miles of graded, drained, and graveled roads at that time, championed to no small extent by Henry Haag, a Jefferson banker. (*Jefferson Bee,* March 13, 1912) One year later, the governor of Iowa appointed James W. Holden of nearby Scranton to the Iowa Highway Commission, another recognition of Greene County's strategic importance and leadership in good roads.

Organized highways such as the Trans-Continental Route flourished in Iowa during the early 20th century, as local boosters sought to attract businesses and visitors to their communities. By 1912, road markers blazed more than two-dozen different routes across Iowa. (See back cover.) They featured simple graphic designs, often painted on telephone poles—a red-colored band indicating, for example, the route from Waterloo to Keokuk. The White Pole Route, another of these routes, was called "The Great White Way," its promoters unabashedly appropriating the name of New York City's theater district on Broadway.

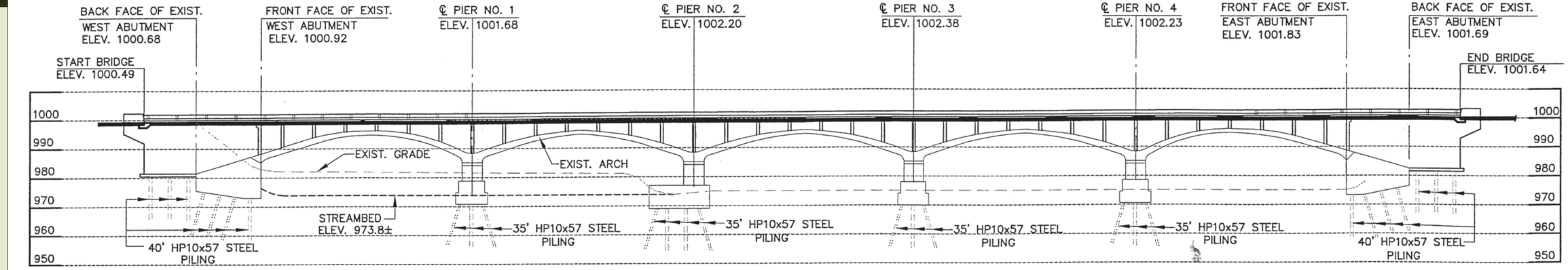
In 1913, the Lincoln Highway Association was organized to promote greater scale improvement to the transcontinental route. Greene County took its responsibility as a link along the route seriously. Iowa roads were notorious for mud and ruts in the spring. Greene County was among the first five counties in Iowa to dedicate its road funding from federal, state, and local governments to improve the Lincoln Highway with gravel. (*The Road-Maker,* Vol.12, No. 5, May 1918) The construction of the Eureka Bridge in 1912 provides another example of this commitment. The Lincoln Highway subsequently was paved with concrete in Greene County.

Recently dubbed "the Great American Road," the Lincoln Highway proved a boon to Iowa and to Greene County. (Wallis: 161-162) The highway promoted economic development all along its route. Gasoline stations and garages, tourist camps and cabins, motels, and roadside cafes arose along the corridor for motorist convenience. Cities, towns, and villages benefited alike from this business.

As traffic burgeoned on the nation's roads, the need to improve them also increased. By 1923, the16-foot roadway width of the Eureka Bridge had raised safety concerns because of the volume of traffic it carried. In response, the Iowa Highway Commission decided to widen the bridge. The project removed the bridge's deck and parapet guardrails, installed paired brackets above each of its arches on both sides of the bridge, and built a new 20-foot wide cantilevered deck supported by these brackets—all of reinforced concrete. Baluster-designed guardrails replaced the bridge's former concrete-paneled guardrails on both its sides. The widened Eureka Bridge opened in 1924 and remained in service for almost 90 years.


*The Lincoln Highway Association was a membership organization. Some members displayed insignia like this 3½×2 inch enamel badge on their automobiles. (Author's Collection)*

» Looking to the northwest, this image is a composite of wide-angle photos stitched together by computer and picturing the south side of the Eureka Bridge. All this side of the bridge is new, constructed to widen its deck. (John P. Zeller photo, 2012)




« Shown in section, this 2008 drawing of the Eureka Bridge reveals its new steel pilings below the waterline and new vertical spandrel walls above its arches. The bridge's closure walls, shown in the photograph above, mask the spandrels so that the internal support system of the bridge's deck remains unseen. The construction of closure walls is an elegance rather than a necessity. The closure walls on the Eureka Bridge increase its monumentality and intimate solid stone construction as in Ancient Rome. (Sbuck-Britson, Inc.)

In 1958-1959, the Iowa Highway Commission rerouted U.S. Highway 30 (numbers had replaced names for highways in 1926), and bypassed small cities and towns along its route. In Greene County, the highway was relocated about two miles to the north of the Eureka Bridge. This reduced the traffic over the Eureka Bridge, which continued in use as County Road E53. The bridge remained adequate for legal loads into the 21st century but lacked the 30-foot minimum width required by the Iowa DOT for farm-to-market paved roads.

## BRIDGES, MATERIALS, AND DESIGNS

For millennia, man has built bridges to facilitate communication. Wood, stone, concrete, iron, steel, and other materials have been used for bridges over the ages. During the Industrial Revolution, bridge building assumed previously unheard of importance, as rapidly expanding railroads sought methods to carry heavy loads over surface impediments. The advent of the automobile in the 20th century increased the need and number of bridges in the United States. Throughout these ages, bridges have linked people, commerce, and ideas together. Many people consider bridges among the most beautiful structures constructed by man.

Different materials possess different physical qualities. Each has benefits and limitations. Wood is inexpensive but decays. Stone can carry heavy loads and is durable, but it is difficult to work and expensive. In the mid-19th century, iron offered new design opportunities for bridges but proved subject to fatigue and corrosion. In the late 19th century, the advent of steel revolutionized bridge construction, but this too was expensive. Concrete is an ancient building material for bridges perfected by the Romans before the birth of Christ. Concrete is an amalgam of cement, aggregate, and water and is inexpensive to manufacture. Iron or steel rods are frequently positioned internally within concrete structures to reinforce them and increase their strength.

Bridge design has varied considerably over the ages as different types of bridges have evolved. Nature built the first bridge when a log fell over a void between two landmasses. This elementary type of bridge, called a simple beam bridge, continues to be built today. Throughout the United States, the nation's interstate highway system frequently uses this simple bridge, often supported by piers, to span space. Modern civil engineers additionally have created highly sophisticated bridges to raise and lower, to move from side-to-side, to span great distances, and to withstand severe conditions of weight, weather, and other stress.

All of this goes to reinforce what E. W. Blumenschein, Engineer of Bridge Design at the Iowa State Highway Commission, wrote in 1949:

> Every succeeding decade imposes a somewhat different traffic need. It also imposes a new economic approach as scarcities or surpluses develop in different materials, or as the relative costs of materials and wages change. New products and new methods call for constant revision. The federal government which contributes heavily on the financial side also throws its technical ideas into the pot to help keep it boiling. There is nothing static about highway bridge standards. (Blumenschein: 3)



## MARSH ENGINEERING COMPANY

The Eureka Bridge calls attention to the Marsh Engineering Company, the firm that built the bridge, and its contributions to bridge building in Iowa. The company was a family business, with James B. Marsh serving as president and F. E. Marsh, his son, serving as company manager.

After graduating from Iowa State College and working as a sales representative for various Midwestern bridge construction companies, James B. Marsh (1856-1936) launched out on his own and established the Marsh Bridge Company, serving as its chief designer. He specialized in reinforced concrete designs. During this heyday of bridge construction during the late 19th century, competition was fierce, collusion was rife among bridge contractors, alleged patent infringements were common, and legal entanglements frequently ensued. Marsh's company initially prospered, then faltered, then fell into receivership in 1909 following the failure of one of his designs under construction. Marsh carried on through it all, established the Marsh Engineering Company with his son, and continued to design reinforced concrete bridges. Today, James B. Marsh is best remembered for the reinforced concrete through arch bridge, which bears his name, the "Marsh Rainbow Arch."

» *Under construction in 1912, the south side of the Eureka Bridge bears a banner reading "Erected by Marsh Engineering Co. Material Supplied by D. Milligan Co. Hawkeye [illegible] Cement [illegible]." (Iowa Department of Transportation)*

Frank E. Marsh (1880-1925) served as the manager of the Marsh Engineering Company and hands-on man for the firm's construction projects. Based in Des Moines, the company frequently built bridges designed by the elder Marsh, who operated as its chief bridge designer. Although a resident of Des Moines, Frank lived in Jefferson, Iowa, while the Eureka Bridge was under construction.

Although James B. Marsh is known to have collaborated with the Iowa Highway Commission on bridge specifications (Hippen: 9), the design of the Eureka Bridge appears to have originated with that agency rather than with Marsh. The original drawings for the Eureka Bridge bear the Iowa Highway Commission signature.

« *Written on back of this postcard photographed by F. W. Farreich of Jefferson, Iowa: "Picture of group of workmen who helped build the cement bridge at Eureka Mills 3 miles west of Jefferson in 1912 of which the writer was a member. A. E. Mooney." The view pictures the Marsh Engineering Company's construction crew with the man with the bowler hat and hands in pockets likely Frank E. Marsh, the company's manager. Mooney is unidentified. (Iowa Department of Transportation)*

## ANCIENT ROME IN RURAL IOWA

In addition to its utility for transportation, the Eureka Bridge possesses considerable aesthetic appeal. The color of its concrete immediately calls attention to its presence in the river valley and accents its rural surroundings. The bridge's five arches create a visual rhythm framed by the strong horizontal line of its guardrail. These elements, combined with the bridge's length, impart a feeling of unimpeded speed. The voids created by the bridge's arches relieve the design of any sense of oppressive weight, while the massive piers impart great strength to the composition. These architectural features endow the bridge with captivating beauty.

Historians have noted that beauty figures strongly in the appeal of bridges. Writing of another type, the Iowa-designed rainbow arch bridge, James C. Hippen noted: "The esthetic appeal of the Rainbow Arch was always a selling point. Arches appealed to the public, and concrete was the ideal material for building arches." (Hippen: 9). A circa 1910 advertising card of the Miller-Taylor Construction Co. of Mason City, Iowa, advanced the same line. "Build Beautiful Bridges" (*Ibid.*: 4) it insisted, a slogan likely used more widely than by that firm alone.

These considerations figured intentionally in the design of the Eureka Bridge. Erected during the early years of the 20th century, this bridge fits perfectly within the City Beautiful Movement, an era of public improvement in the United States when Classical Revival architecture flourished. Chicago's Columbian World's Exposition in 1893 popularized this revival and pointed the way: light-colored building materials, smooth surfaces, and classically-influenced features and details. The Greene County Courthouse in Jefferson is the best example of this architectural style in Greene County. Katharine Lee Bates had this look in mind when she wrote in *America the Beautiful*: "Thine alabaster cities gleam, Undimmed by human tears."

Of course the source for Classical Revival architecture was the ancient world of Greece and Rome, often filtered through the Renaissance. The Romans particularly excelled at public works and their invention of the arch revolutionized construction methods. Within this context the Eureka Bridge demonstrates that Classical Revival styling and the City Beautiful Movement could be transplanted successfully to the Iowa countryside.

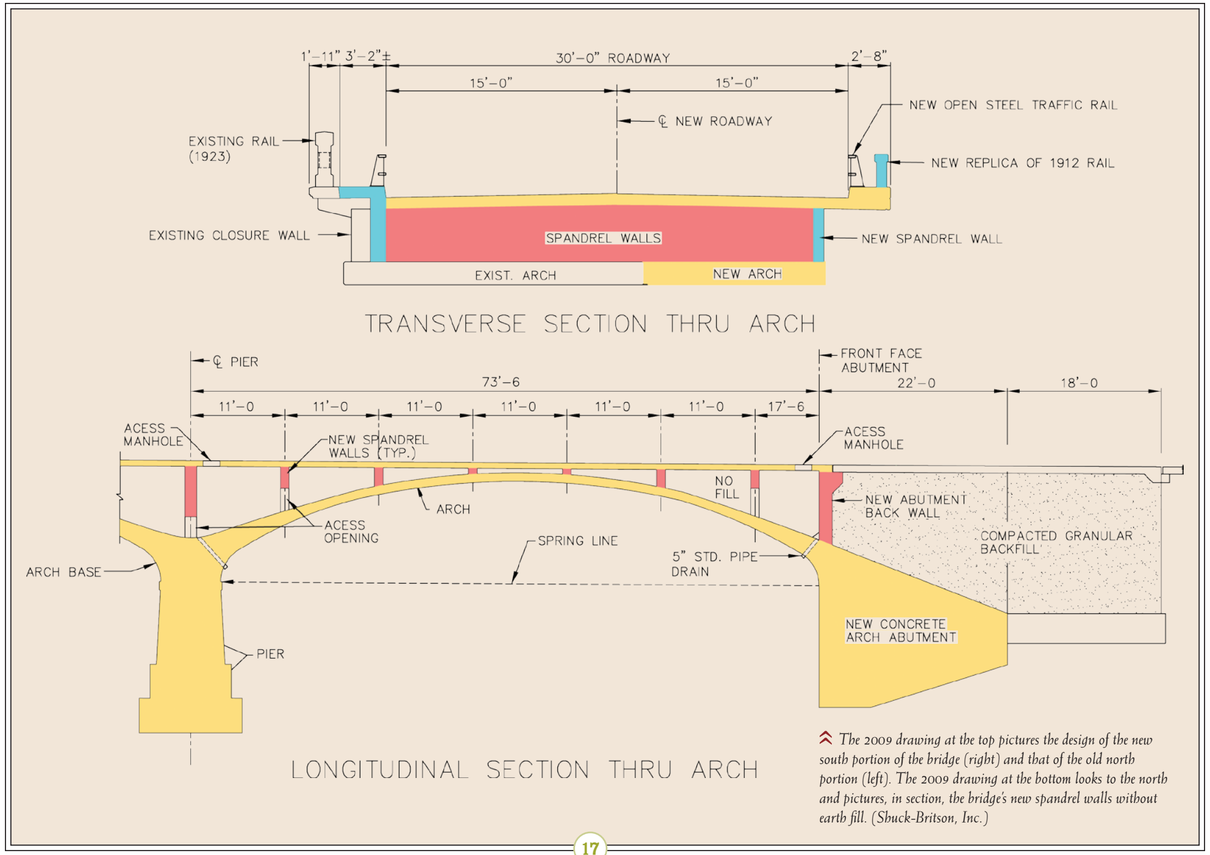
## CONTEMPORARY CHALLENGES AND CHAMPIONS

Today, the Eureka Bridge stands as a testament to Greene County's commitment to historic preservation and the engineering effort that successfully rehabilitated it for current use.

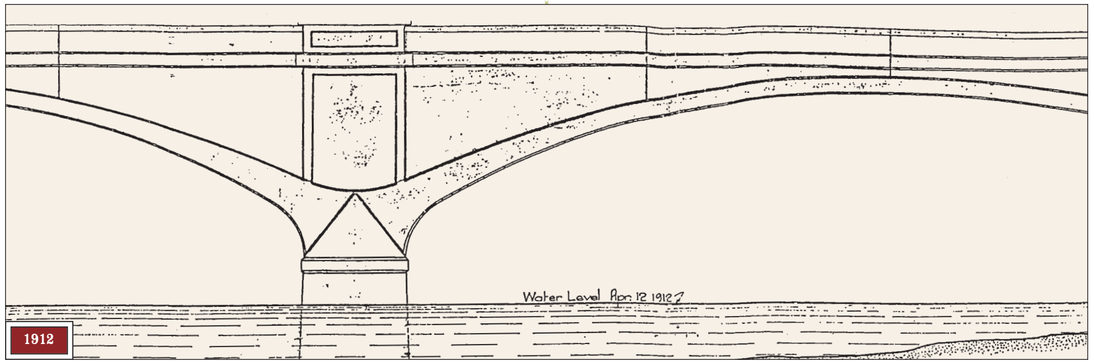
With the decision to preserve the Eureka Bridge and avoid an adverse effect on its integrity, the challenge became to find an engineering team up to the task. The Greene County Board of Supervisors and Greene County Engineer chose the Des Moines firm of Shuck-Britson, Inc., to design the bridge and Snyder & Associates of Ankeny, Iowa, to design the roadway.

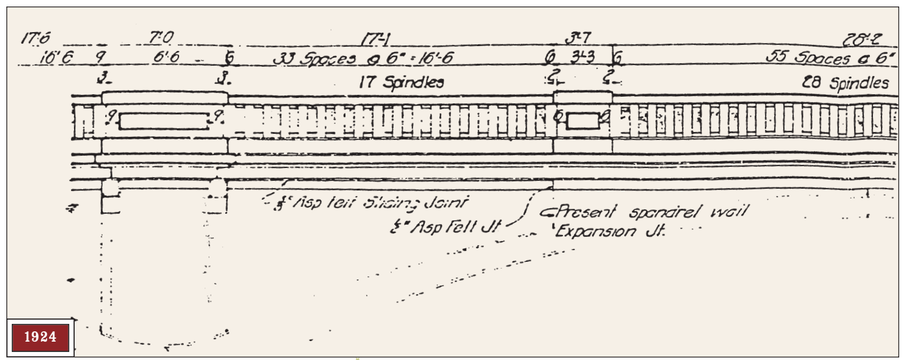
Faced with multiple factors, the design team decided to widen the bridge's deck to the south. This alleviated certain road alignment and right-of-way issues. It also preserved the 1924 guardrail on the north side of the bridge as a physical expression of its evolution.






*The 2009 drawing at the top pictures the design of the new south portion of the bridge (right) and that of the old north portion (left). The 2009 drawing at the bottom looks to the north and pictures, in section, the bridge's new spandrel walls without earth fill. (Shuck-Britson, Inc.)*




*The design of the 1912 and the 1924 guardrails differed. The 1912 design featured solid panel guardrails.*

*The 1924 design featured a guardrail with open balustrades ("spindles").*

*The recent rehabilitation of the bridge left the 1924 railing in place on the north side of the bridge and reconstructed the 1912 railing on its south side. (Iowa State Highway Commission, 1912; ibid., 1923)*



This decision created other design issues. Should the closure walls be removed to increase the bridge's waterway opening? This idea was discarded in favor of preserving the bridge's original appearance. Next, the engineers studied how to widen the deck of the bridge. The superstructure of the 1912 bridge rested on four piers between abutments on the east and west. To widen the bridge, these abutments and piers were extended to the south. Six clusters of steel pilings, driven into the earth at 35- and 40-foot depths, extended the original pilings to support the new abutments, piers, and the bridge's superstructure. Additionally, the construction of new steel and concrete pilings abutting each of the piers on the north strengthened their load-bearing capacity. These new pilings remain invisible beneath the water.

Engineering analysis also focused on the earth-filled superstructure of the 1912 bridge. This analysis determined that an alternate deck support system would increase the live load capacity of the bridge. As a result, the rehabilitation project removed the fill and the concrete deck that it supported and implemented the alternate design solution. Eight new transverse walls (called "spandrels") were built above each of the bridge's existing five arches and set perpendicular to the roadway 11-feet on center. This design provided the support for a new structural concrete slab, which was built to serve as the bridge deck. This design decreased the bridge's dead load by removing the significant weight of the earth fill and thus increased its live load capacity. The earth fill removed from the bridge was subsequently moved to a county park on the west bank of the river, where it formed a roadway access to the park.

Because of its high visibility, the bridge's guardrails required careful consideration. As originally built in 1912, the bridge featured a poured concrete guardrail of panel design on each side of the deck. Widening the bridge in 1924 removed both of these guardrails and replaced them with poured concrete guardrails of balustrade design. The decision to widen the bridge to the south enabled the preservation of the 1924 balustrade on the north. A discussion then ensued about the design for the south guardrail. The team, in conjunction with recommendations by the Iowa State Historic Preservation Office, decided to replicate the bridge's original panel-designed poured concrete guardrail. As a result, the south elevation of the bridge today resembles its original 1912 appearance. To comply with highway crash standards, steel

*The Eureka Bridge seen today from the west.*

guardrails were installed on the rehabilitated bridge's deck adjacent to and inside both concrete guardrails. These 2-foot high guards do not intrude on the exterior view of the bridge.

Designing the bridge went hand-in-hand with an analysis of roadway conditions. The road needed to be brought up to current design standards. Several alignment and curve adjustments were analyzed within the existing roadway constraints in order to devise a solution to this challenge. This analysis resulted in the modification of roadway curves, the bridge's increased width, and the addition of guardrails..

All of the bridge and roadway design and construction described above had to comply with the American Association of State Highway and Transportation Officials (AASHTO), Iowa Department of Transportation (IOWA DOT), and the Iowa Department of Natural Resources (IOWA DNR) design criteria.

## IOWA HISTORIC BRIDGES

Over the years, the State of Iowa has erected many hundreds of bridges in an amazing number of designs and variations. These designs resulted from the advent of new building materials, advancements in technology, and inventive engineering. The Iowa Department of Transportation maintains a website, *Historic Bridges of Iowa*, which describes and illustrates many of Iowa's surviving historic bridges. Visit <www.iowa.dot.gov/historicbridges>.

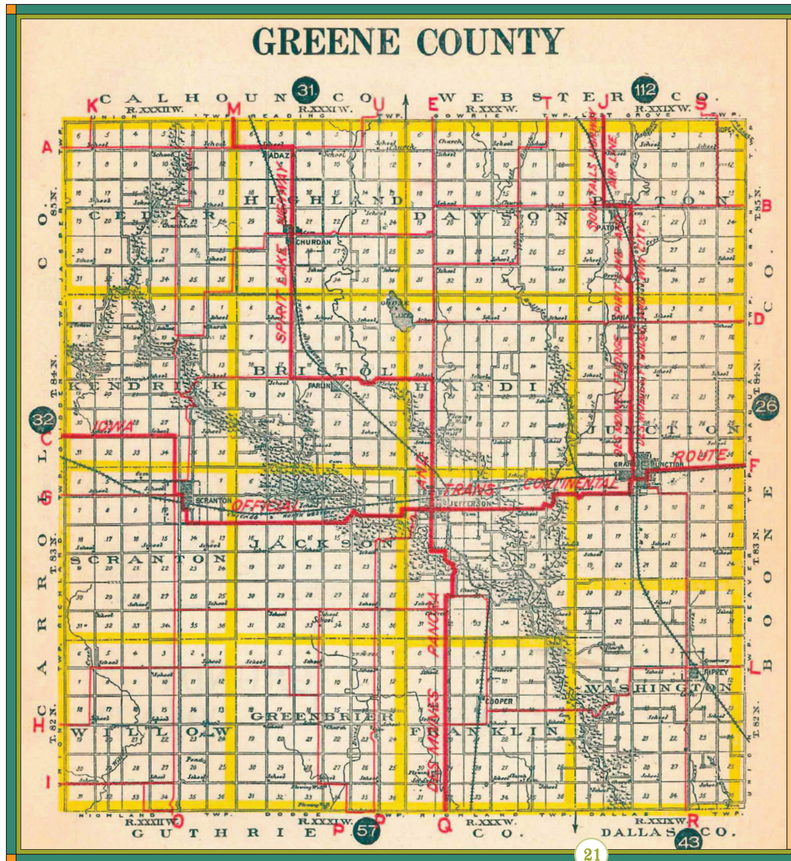
Even the briefest perusal of these tomes conveys to the layperson the staggering effort they require to ensure public safety, cost efficiency, and durable service.

As a result today, the north side of the bridge retains its appearance as in 1924 with sets of paired braces supporting a cantilevered deck and balustrade guardrail. The south side of the bridge replicates its sleek surfaces as in 1912.

## CONCLUSION

Americans in the late 20th century generally have taken infrastructure improvements, like highways and bridges, for granted. All of this is changing. Public Broadcasting Service's "American Experience" series, documenting the Brooklyn Bridge, Hoover Dam, and Panama Canal, among others, has revealed the brilliance of American inventiveness and the heroism of American labor in their construction. A growing enthusiasm for historic highways—the Lincoln Highway is a good example—adds fuel to this newfound interest in public works. These gigantic undertakings required vast sums of money and supreme effort to build and contributed enormous benefits to the nation. Untold opportunities remain to research and explore these themes in American history. The Eureka Bridge in Greene County, Iowa, provides a microcosm of this phenomenon. It demonstrates how 20th century engineering created a bridge of utilitarian function and aesthetic appeal, and how one hundred years later the citizens of Greene County with the aid of 21st century engineering preserved its historical significance for future generations to admire and enjoy.






« Huebinger's Pocket Automobile Guide for Iowa, *from which this page is taken, pioneered highway maps for "automobilists" across Iowa in 1912. The publication provided a map for each of the state's counties. This map of Greene County from its 1913 edition pictures the "Iowa Official Trans-Continental Route" bisecting the county east-to-west and crossing the newly completed Eureka Bridge. The upward-pointed blip along the route (left of center) locates the bridge's heavily wooded and irregular topographical setting along the highway's otherwise unimpeded course across the county.* (Huebinger's Pocket Automobile Guide for Iowa, *1913 edition, p. 55)*

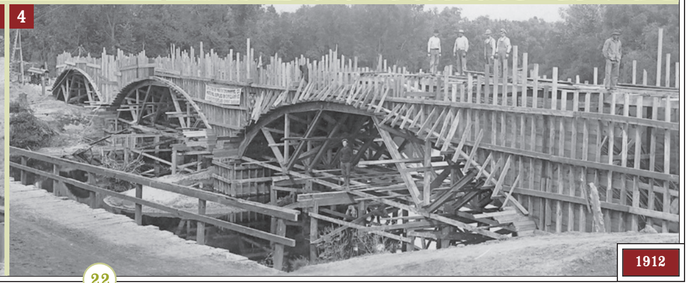
# BRIDGE BUILDING: THEN & NOW

*These two sets of photographs reveal changes and similarities in bridge building techniques used for the Eureka Bridge between the early 20th century and the early 21st century. In 1912, a steam engine (1,3) powers a pile driver to sink pilings for the bridge's substructure and a sawmill to cut locally harvested timber for the bridge's concrete forms. A forest of falsework (2) provides support to form the concrete arches and walls (4), strengthened by reinforcing bars (2). In 1912, workers mixed small batches of concrete, pushed them by hand in wheelbarrows, and one-by-one poured them into the forms. Workers likely lived in tents on the site during construction (1). Now, in contrast, a diesel-powered crane (7) with considerable mobility and lift capacity eases the work. Forms for the bridge's arches are assembled on its deck using steel instead of wood and lowered into place by the crane instead of built on the ground (7, 8). Diesel-powered trucks bring ready-mixed concrete to the site and pour it in big runs. But the rehabilitation of the Eureka Bridge also used historic building techniques. The forms for its spandrel and closure walls employed wood falsework similar to 1912 (7). Overall, these photographs convey an impression of labor-intensive work in 1912, using raw building materials, compared to mechanized work in 2010-2011, using building materials and services brought in from the outside. (Iowa Department of Transportation; Shuck-Britson, Inc.)*

1

2

3



4

1912



5

6

7

8

2011

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## SOURCES AND FURTHER READING

The following list identifies some sources of interest for the general public concerning bridges and the Eureka Bridge in particular. A vast body of information, much of it archived at the Iowa Department of Transportation, much of it highly technical, and much of it as yet un-researched, exists concerning Iowa's highways and bridges. The Marlin R. Ingalls study, cited below, demonstrates how scholarship can employ this data.

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*This publication is dedicated to the memory of Monte E. Burr, P.E.*

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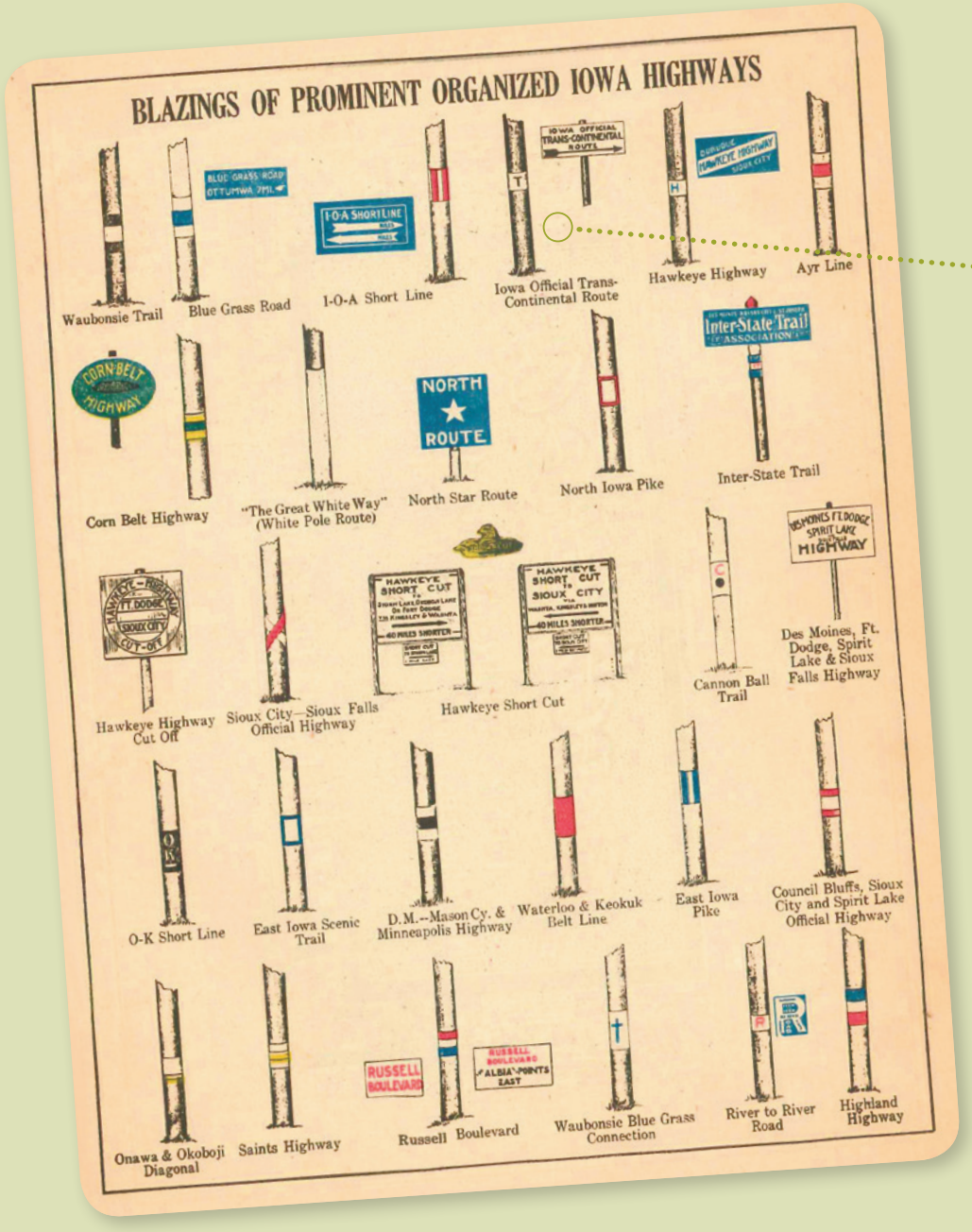


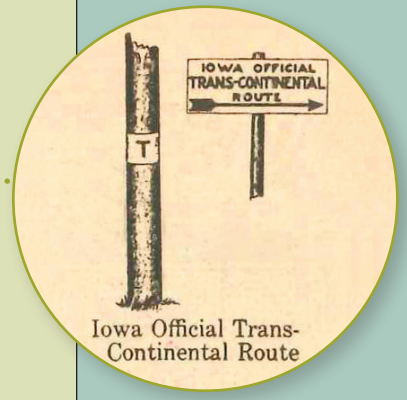


*Many designated highways crisscrossed Iowa in the early 20th century. In this state, the Lincoln Highway originally bore the name "Iowa Official Trans-Continental Route." A pole with a black "T" on a white band marked this route. (Top row, third from right) A signboard with the full name and directional arrow sometimes served the same purpose. Community boosters hoped that designated highways would increase overland traffic and local economies. In the late 20th century, improving a highway route between St. Paul, Minnesota, and St. Louis, Missouri, and naming it "Avenue of the Saints" revived the idea.* (Huebinger's Pocket Automobile Guide for Iowa, *1913 edition, p. 9*)