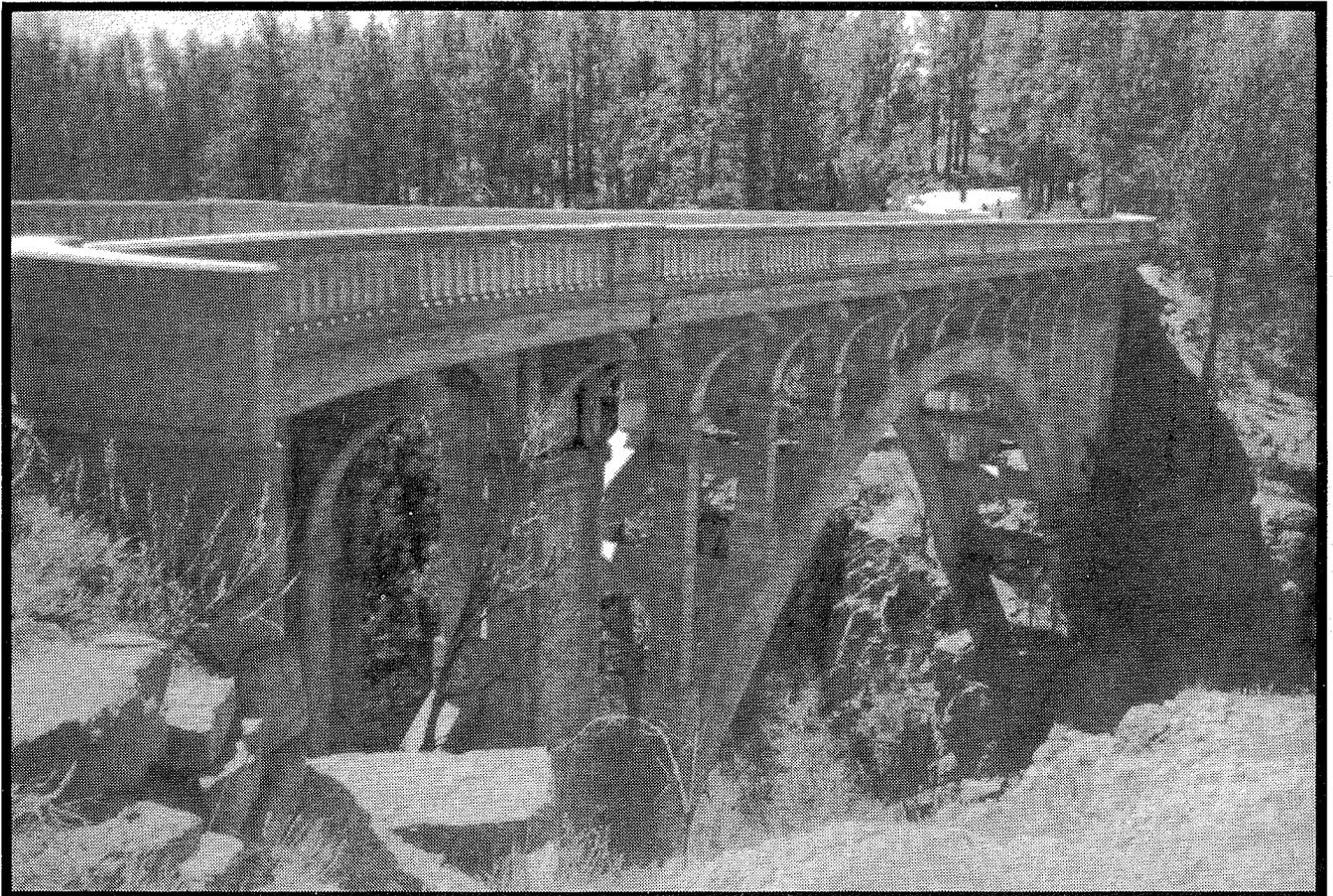


HISTORIC BRIDGES OF SOUTH DAKOTA



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All photos, except as noted, by Renewable Technologies, Inc.

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Caption for the front and back cover photographs: *The open-spandrel, concrete-arch, Beaver Creek Bridge on South Dakota Highway 87 in the Wind Cave National Park was designed to stimulate the visual experience of visitors to the Park. The bridge was constructed in 1929 and is listed in the National Register of Historic Places.*

Identifying South Dakota's Historic Bridges

The historic bridges of South Dakota link us to our past. When viewed in the larger context of public infrastructure development, bridges are essential to an understanding of the history of our local, state, and national transportation systems. Bridges enable us to understand engineering advancements, and represent our forbearers' concern for aesthetics, efficiency, and economy.

Our nation's historic bridges, however, were built to serve very different traffic conditions than those imposed on bridges today and, as a result, many have been designated as unsafe and obsolete. Concern for the safety of the motorist in the early 1970s resulted in a nationwide program of rehabilitation and replacement of unsafe and obsolete bridges. Coinciding with this program was a growing appreciation of our nation's cultural heritage, which was also represented in federal legislation. The National Historic Preservation Act of 1966 and its subsequent amendments require federal agencies to identify historic properties that will be affected by their actions and to preserve those properties whenever feasible.



Rainbow Bridge

The Rainbow Arch Bridge over Ree Creek at Miller was built by the Iowa Bridge Company in 1914 based on a patented design of J.B. Marsh of Des Moines. The South Dakota Department of Transportation has nominated the bridge to the National Register of Historic Places and will preserve the bridge at its present location.

With 6700 bridges, the South Dakota Department of Transportation (DOT) carries out an extensive program of inspection, maintenance, repair, rehabilitation, and replacement. Because a significant portion of the funds for the program are federal, the DOT must meet two Congressional mandates: provide a safe and efficient transportation system and preserve historically significant bridges. Faced with evaluating historical significance of a large number of bridges each year, the DOT undertook a statewide bridge survey to compile a list of bridges significant in the development of South Dakota's transportation system. The survey provides a statewide perspective under which to evaluate bridges for their eligibility for listing in the National Register of Historic Places, permitting the DOT to consider historic bridges as part of the overall bridge replacement planning process and to develop plans for the preservation of some structures and methods for mitigating the loss of others.

Beginning in 1980, many state highway departments began to conduct historic bridge surveys. For the most part, bridge inventories identify those bridges that meet the National Register criteria on the statewide or local level for their importance in the establishment of transportation networks, their engineering significance, or their associations with important engineers and bridge builders. Research is not conducted to determine whether bridges are of local significance for associations other than those related to transportation or engineering, or whether they would contribute to a larger National Register nomination such as a rural or urban historic district.

The many statewide surveys have resulted in a number of publications, but there has been no attempt to synthesize the results on a nationwide basis. Clearly, truss bridges and concrete arch bridges received the greatest attention in the early surveys, with the result that other bridge types important to establishing effective, comprehensive transportation networks were neglected. Also, as we near the end of a decade of research, the influence of the National Register's general guideline of not accepting properties less than 50 years old has limited the available information. Early inventories spent little time evaluating the many bridges built by the New Deal programs of the 1930s. As a result of more recent statewide projects, such as the South Dakota Historic Bridge Inventory, we now have a better understanding of the role bridges built during the 1930s and smaller bridges -- concrete, timber stringer, and steel I-beam -- played in the development of our present transportation infrastructure.

Although many states have placed particular emphasis on those bridges that are the first, the oldest, the longest, or the only remaining examples of a type, those criteria do not necessarily reflect the wide range of structures that illustrate the broad patterns of bridge building in a given state. The construction of bridges in South Dakota closely followed the national trends and practices of neighboring agriculturally-based states: the commissioners in the various counties selected bridge designs from the leading out-of-state bridge building companies of the time. Because of its late date of settlement and lack of a major industrial base, South Dakota was not an early leader in bridge design and construction. Even though the Missouri River presented an inconvenience to east-west travel and commerce, its

spanning waited until bridge design was more a science than an experiment. It was not until 1919, when the South Dakota State Highway Commission hired a nationally-recognized civil engineer to head the Bridge Department, that the designs of the State's bridges took on a uniqueness of their own. These designs, however, were not wholly new engineering accomplishments, but more often refinements of current practice for economic and aesthetic reasons.

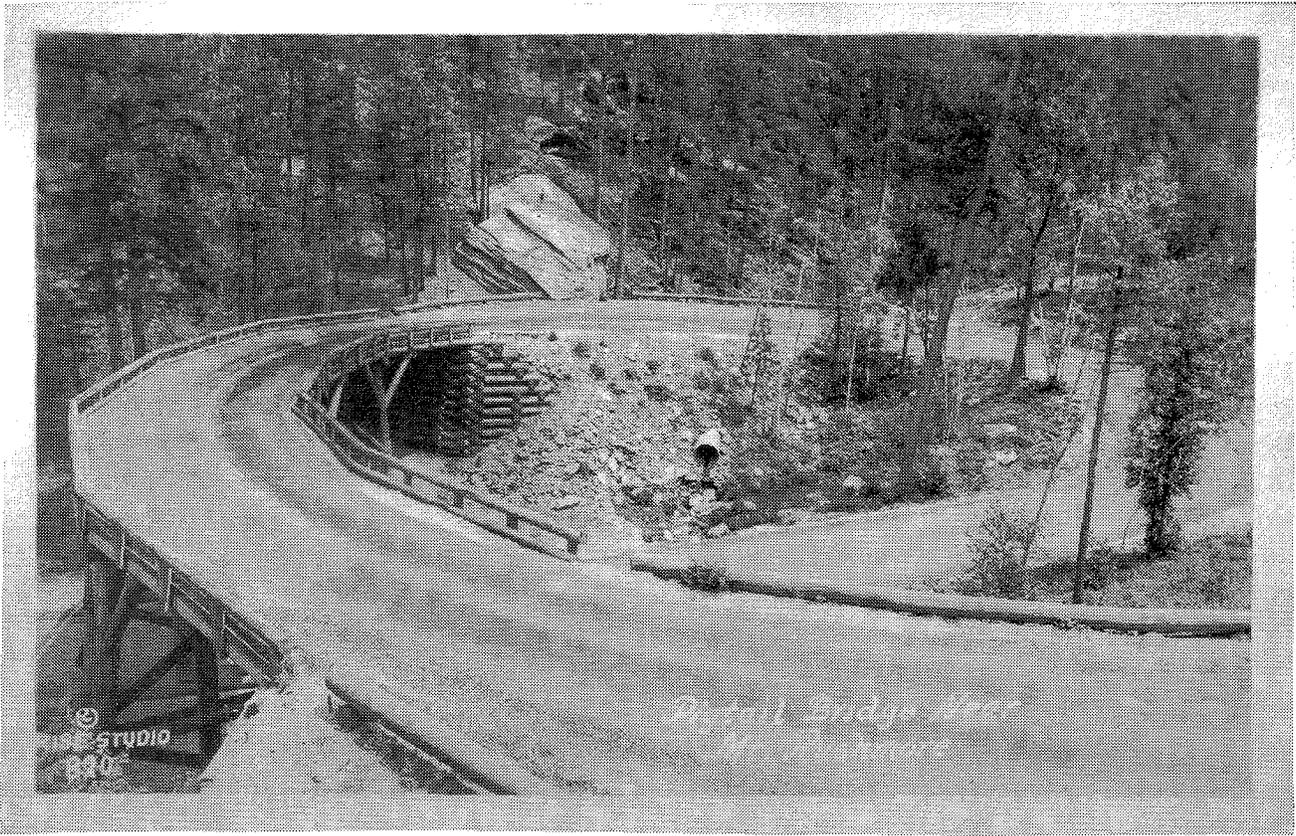
This does not mean that South Dakota is lacking in bridges of historical significance. The inventory of South Dakota's historic bridges identified more than 150 that meet the criteria for listing in the National Register of Historic Places. These bridges represent important broad patterns of South Dakota's settlement and development. A large number of the bridges were built during the first two decades of this century when South Dakota's counties responded to the public's increasing pressure for good roads. With the arrival of the automobile, farmers desiring easier access to markets and businessmen seeking a widening circle of rural trade demanded improved roads. The use of steam traction engines by farmers also required bridges capable of carrying their heavier weight.

Other historic bridges are more closely associated with particular economic developments such as irrigation projects or tourism. After 1916, federal legislation consolidated the responsibility for bridge design at the state level and resulted in standardized plans for use throughout the state. The New Deal programs of the 1930s are represented by bridges designed to be labor-intensive with minimum material costs. Bridges of the 1930s also resulted from a nationwide program to address the separation of railroad and automobile crossings.

The identification of those bridges eligible for listing in the National Register provides each state highway department the tool to proceed with developing preservation procedures. Some states have included preservation plans as a part of the inventory; others have chosen to address historic bridges on a case-by-case basis. In all cases, the preferred alternative from the preservation perspective is to maintain a historic bridge at its original location, serving its original function. Sometimes this can be done by strengthening the structural system to carry additional loads or by using narrow bridges in a one-way couplet system. New bridges can be built on a different alignment, leaving the historic bridge in place to serve other uses such as pedestrian or bicycle traffic, or left as a ruin on the landscape. If preservation in place is not feasible, a bridge can be moved to another location to serve lighter traffic, or disassembled and stored for future use. When no preservation possibilities exist, historic bridges are routinely documented and recorded to the standards of the Historic American Engineering Record. The information is deposited in the Library of Congress and the state historical society for use by researchers.

Introduction

When we think of historic bridges in South Dakota, the famous pigtail bridges leading to Mount Rushmore may first come to mind. These bridges, designed in the late 1920s,

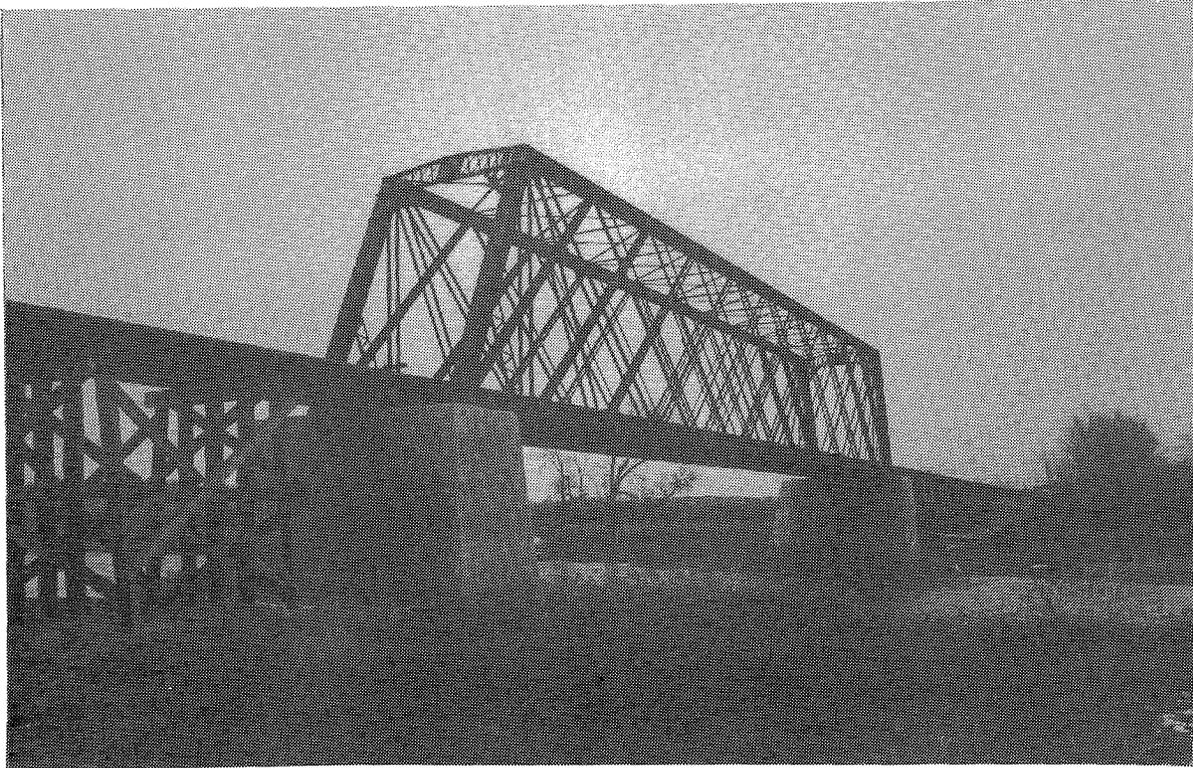


Pigtail Bridges

The pigtail bridges in the Black Hills were advocated by US Senator Peter Norbeck to enhance the picturesque qualities of the Park. (historic postcard courtesy of John Adler)

resulted from former Governor and U.S. Senator Peter Norbeck's goal to build a highway not for speed, but to enhance the scenic beauty of the Park. A much simpler and less costly system of roads and bridges could have been devised to bring tourists to Mount Rushmore, but Norbeck wanted to enhance the sense of anticipation as tourists approached the monument. It has been suggested that the bridges were his version of a spiral staircase. According to early park rangers, the pigtail bridges were photographed more often than any other attraction in the Park except Mount Rushmore itself.

Bridges have, of course, served a more central purpose in South Dakota's history than simply to animate the encounters tourists have with our landscape. Bridges play a vital role in the life of the state; they allow the landscape to work for us rather than against us. For the most part, South Dakota's land is suitable for agricultural production, supporting a largely rural population. Consequently, South Dakotans have always needed the ability to ship agricultural products to consumers and to import manufactured goods into the state. Were it not for bridges, rivers and other barriers would isolate people and make trade difficult.



Lassig

This bridge over the Big Sioux River near Brandon was built in 1887, and is the only bridge in South Dakota known to survive from before statehood in 1889.

Early Bridges

South Dakotans have been building bridges since the military first established forts in the state. Substantial bridges arrived in South Dakota when permanent Euro-American settlement began, stimulated by the coming of the railroads. In fact, the only bridge in the state known to survive from before South Dakota's statehood in 1889 is a railroad bridge. The bridge was built by the Lassig Bridge and Iron Works of Chicago in 1887 to carry the tracks of the Chicago, St. Paul, Minneapolis and Omaha Railway over the Big Sioux River northwest of Brandon.

As the railroads expanded their networks of tracks, so did the settlers expand their networks of roads, which provided the links between farms and shipping points along the rail lines. While the tracks tended to follow the contours of the land, most rural roads in South Dakota were built along section lines. To make the grid of section-line roads useful, bridges needed to be built where they crossed rivers and streams. In the 1880s and 1890s, the counties typically built relatively crude, wood bridges across the smaller creeks. These structures were often washed out by floods, but were easily rebuilt by nearby farmers, who offered their labor for bridge work in lieu of paying road taxes. Larger river crossings,

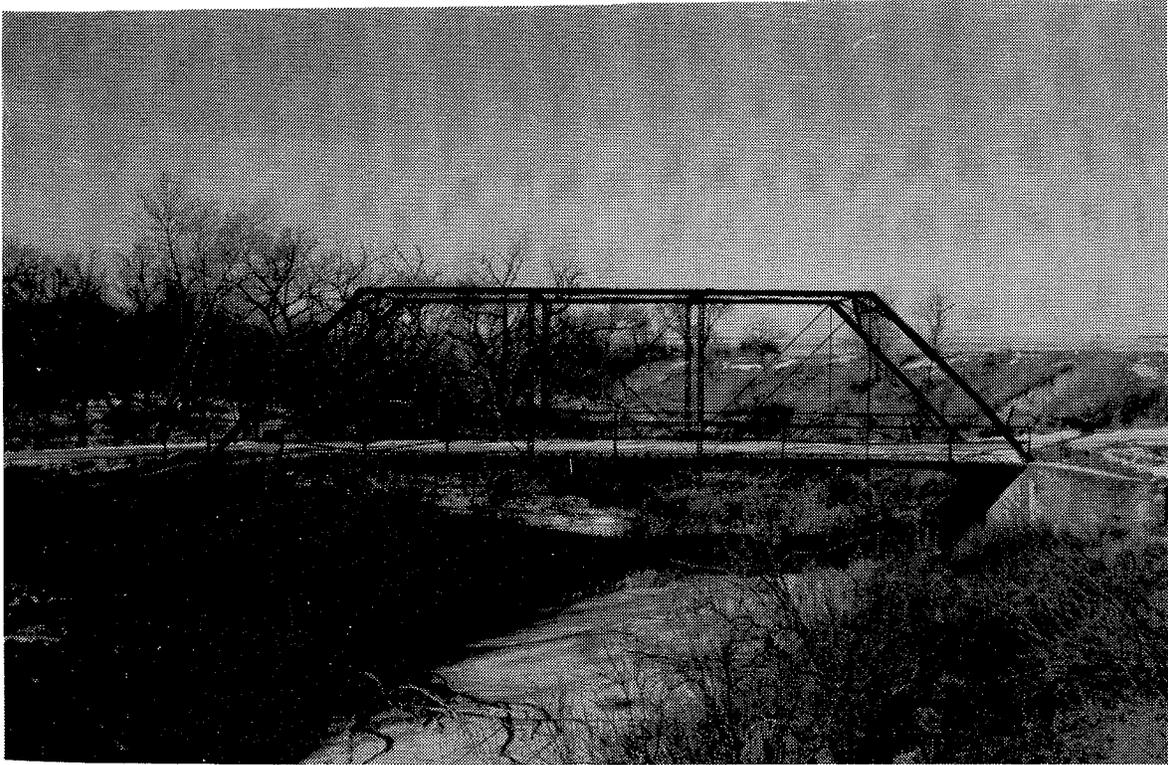


Early Crude Bridge

In the early days of settlement in South Dakota, bridges were rather crude affairs. (courtesy of South Dakota Cultural Heritage Center)

however, required more costly structures, and for these the counties wanted permanence. The railroads provided access to the materials needed to construct permanent bridges, first wrought iron and later steel, which were shipped from industrial centers in the east and midwest.

Although some of South Dakota's counties were contracting with firms from outside of the Territory to build county bridges in the 1880s, none of these structures survive, and South Dakota's oldest vehicular bridges now date from the early 1890s. One of the oldest surviving bridges is the Hall Bridge in Spink County. It was originally built at a nearby site over the James River by the Wrought Iron Bridge Company of Canton, Ohio, in 1893.



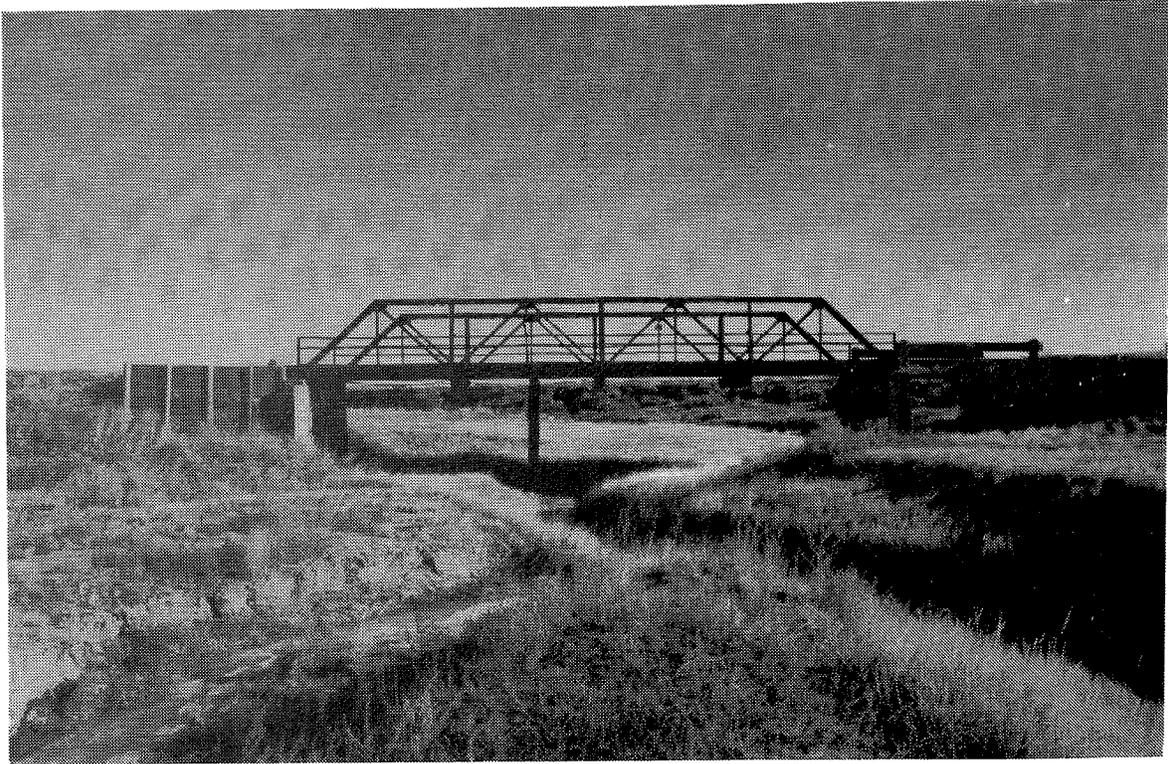
Hall Bridge

The 1893 Hall Bridge in Spink County is a typical pin-connected Pratt through truss.

Bridge Types

Schematic illustrations of bridge types common to South Dakota can be found on the inside page of the back cover.

In the 1890s, most spans the length of the Hall Bridge were pin-connected Pratt through trusses. The "pin-connected" part of this descriptive name for the truss type means that all of the members of the truss are connected with large pins rather than being riveted. To call a bridge a Pratt truss means that the arrangement of the members follows a particular pattern, which was patented in 1844 by Thomas and Caleb Pratt. In a Pratt truss, the vertical members are meant to be compressed and the diagonal members are meant to be intension, or to be stretched. You can see in any truss which members are meant to be in compression: they are relatively thick and are meant to support a load as would a post or a column. You can see which members are meant to be in tension, because they are quite thin and are intended only to stretch like a rubber band. And to call a span a through truss means that the deck, or the roadway of the bridge passes through, or between, the trusses, rather than resting on the top chord, in which case it would be called a deck truss.



Warren Pony Truss

Clarkson's Bridge in Harding County is a typical riveted Warren pony truss.

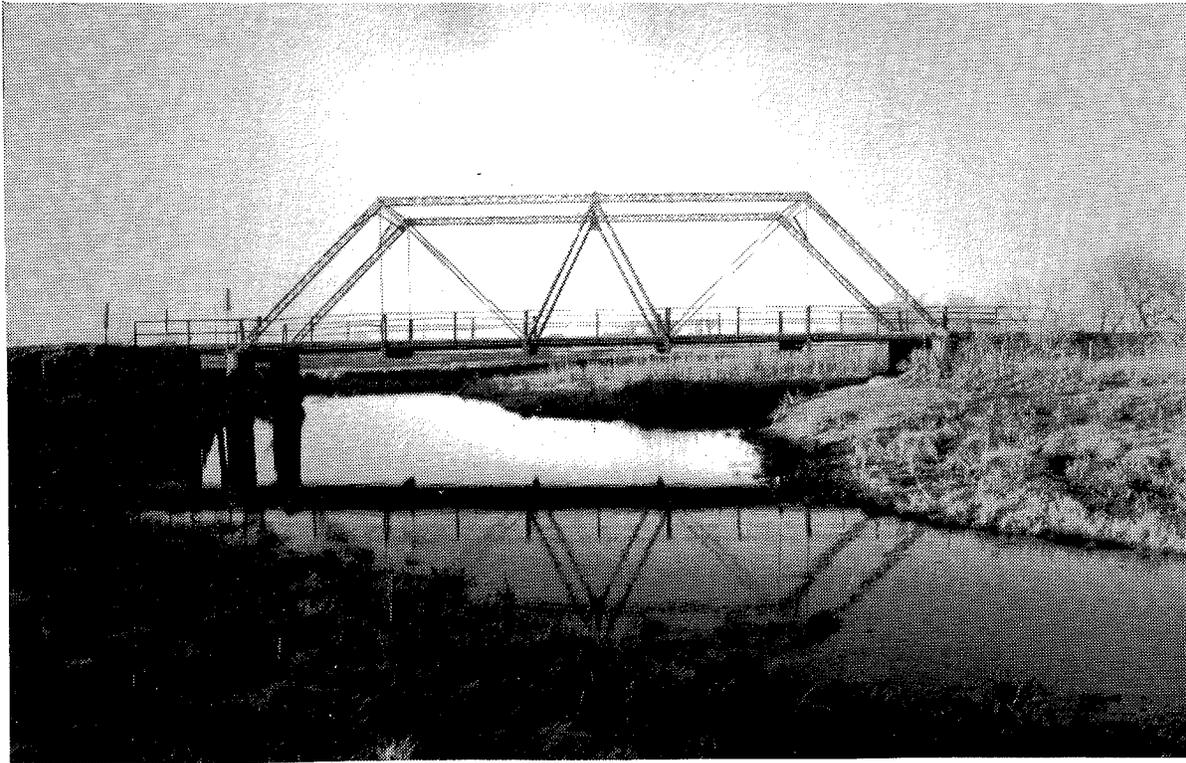
Bridge members may be arranged in many ways. Each design is generally named for the person or company, like the Pratts, who developed or patented the configuration. Another common configuration was patented by James Warren in England in 1848 and is called a Warren truss. You can recognize a Warren truss by the diagonal members. They are designed to be in compression and therefore are relatively thick. Furthermore, the diagonal members are arranged in a "W" pattern, coincidentally corresponding to the first initial of James Warren's last name.



Pony Truss

Although pony trusses have no overhead bracing, some such as this one in Perkins County, built by the Canton Bridge Company of Canton, Ohio, have decorative finials. (photo by Wayne Rosby)

After the turn of the century, counties began to pay more attention to building permanent bridges over smaller creeks. As a result, the most numerous of the truss bridges in South Dakota are pony trusses of both the Pratt and Warren varieties. Pony trusses are a variety of the through truss category in that the roadway passes through, or between, the trusses, but pony trusses are small enough not to require overhead bracing to resist the force of winds.



Castlewood Bridge

The 1894 Castlewood Bridge in Hamlin County is a very unusual truss type. Note that the two panels at each end are configured like a Pratt, while the middle panel is configured like a Warren.

One bridge still standing in Hamlin County demonstrates that the 1890s was a period of experimentation in truss bridge design. The 80-foot main span of the Castlewood Bridge, built over the Big Sioux River in 1894 by the King Bridge Company of Cleveland, Ohio, is a very rare truss type. The Castlewood Bridge is an odd hybrid of the Pratt and Warren trusses. The outside two panels at each end are like the typical Pratt truss, having diagonal members in tension only. But the middle panel is not that of a Pratt, where you would expect to find vertical members in compression and diagonal members in tension. Instead, the middle panel of the Castlewood Bridge has no vertical members, and its diagonal members are meant to serve in both tension and compression. This type of truss does not appear in any of the standard reference guides which describe truss types. The only other bridge of this type known to exist in the United States is another 80-foot span over the Yellow Bank River in Lac Qui Parle County, Minnesota. It was built by the King Bridge Company one year before the Castlewood Bridge. The two bridges probably represent an effort on the part of the King Bridge Company to eliminate the vertical members at the middle panel and thereby save money, because a determining factor in the cost of a bridge was the weight of the metal used in its construction.



Diversion Channel Over Crow Creek

The Bureau of Reclamation had the Canton Bridge Company build this and four other 72-foot, pin-connected Pratt through trusses over its diversion canal near Belle Fourche in 1906 and 1907.

Development of an Early Road and Bridge System

As settlement in South Dakota increased, so did the demand for reliable bridges. A set of bridges in Butte County depicts this direct association between agricultural development and the need for bridges. Through the turn of the 20th century, Butte County was only sparsely settled, its semi-arid land suitable only for livestock grazing. In 1903, the United States Department of the Interior began surveying the area for a possible irrigation project to be undertaken by the newly created Reclamation Service. The U.S. Secretary of the Interior approved plans for what would be known as the Belle Fourche Irrigation Project in 1904. The project involved a diversion dam on the Belle Fourche River, a storage dam and reservoir, a diversion canal to channel water to the storage reservoir, and an extensive network of canals to convey water to the lands to be irrigated. The system of canals created new barriers to roads, necessitating bridges. The Reclamation Service therefore contracted with the Canton Bridge Company of Canton, Ohio, to build five 72-foot pin-connected Pratt through truss bridges over the diversion canal in 1906 and 1907.



Bismarck Bridge

The Bismarck Bridge over the Belle Fourche River in Butte County is a rare example of a Pennsylvania through truss in South Dakota.

The availability of water for irrigation stimulated a boom in the settlement of Butte County. That, in turn, led to the construction of several other large bridges over the Belle Fourche River, as well as numerous smaller bridges over creeks and canals. The largest of these new bridges was the 1912 Bismarck Bridge, built by the Canton Bridge Company. It was named for a ford at the same location, which had been used during the 19th century to transport supplies between the rail head at Bismarck, North Dakota, and the mines in the Black Hills.

As the counties built more bridges, they also moved toward a new system of awarding the contracts for the construction of bridges. Rather than putting a single bridge or a small group of bridges up for bid, the county commissioners asked bridge builders to submit bids based on unit prices: so much for abutments, another amount for piling, a price per linear foot for approaches, another price per linear foot for steel truss spans, and so on. The commissioners, then, awarded an annual contract to the firm which submitted the lowest bid, and at various times throughout the year, would order bridges based on the unit prices in the contract.

Bridge builders throughout the United States were known to have established "pooling" arrangements. Under this illegal practice, each bridge company was allowed to submit the



Iowa Placque

This nameplate of the Iowa Bridge Company is on a bridge in Beadle County. One will probably see more nameplates for this company than for any other bridge builder in South Dakota.

low bid in certain counties. Such patterns, in which almost every county in South Dakota seemed to be dominated by a different bridge builder, began to be evident in the late 19th century. But as counties moved to the practice of awarding annual bridge contracts, the pattern became very strong.

Bridge Builders

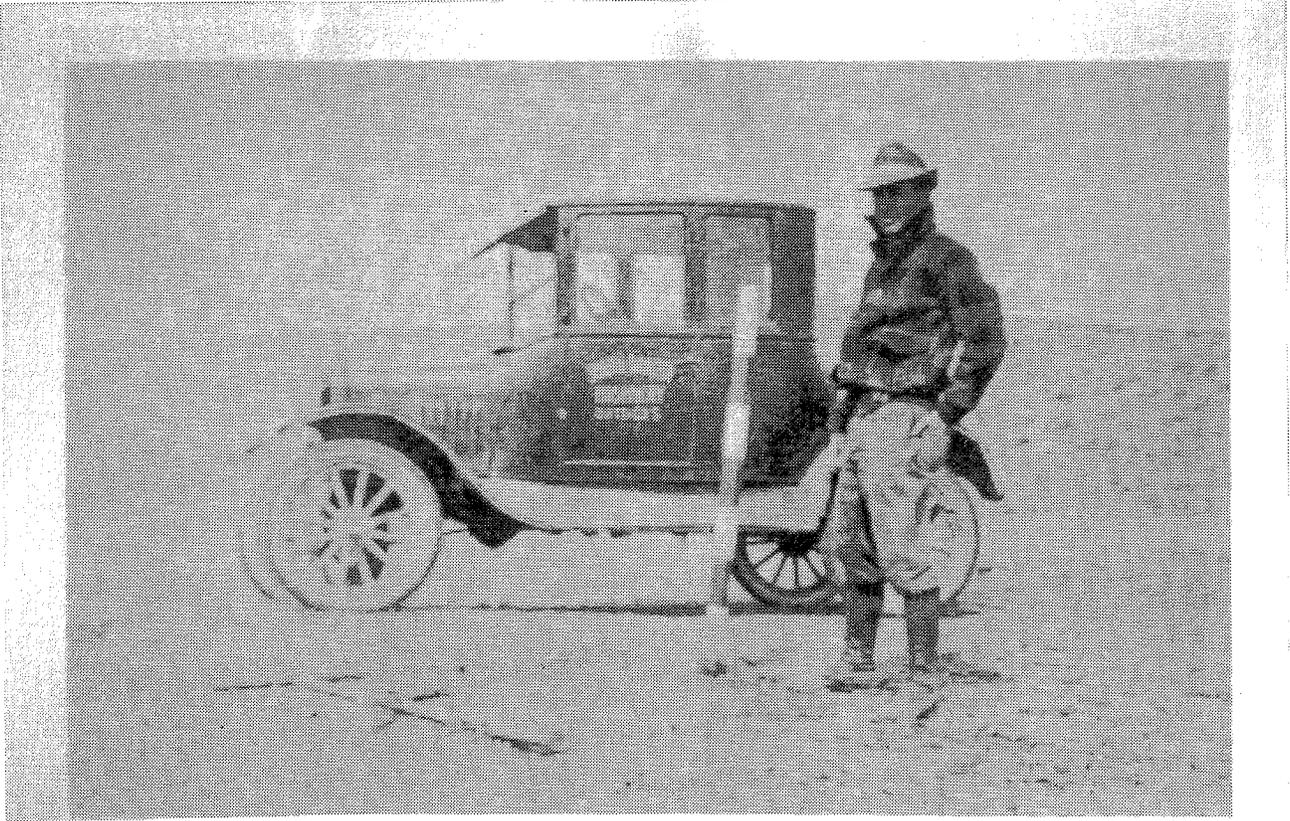
The most prolific bridge building company in South Dakota under the annual contract system was the Iowa Bridge Company of Des Moines. The Iowa Bridge Company built many bridges during the first two decades of the 20th century, especially in counties along the corridor served by the Milwaukee Road's north-south line through the eastern part of the state. Whether the Iowa Bridge Company dominated so many contiguous counties because it was a major member of a pool, or because it was successful competing against the pools is not known.



Bridge Constructed by Mike Gales, Plankinton, South Dakota

Like this bridge built by Michael Gales in Aurora County in 1916, most bridges built by South Dakota-based contractors were rather modest in size.

Although most of the bridge building companies which received annual bridge contracts were from out-of-state, some South Dakota firms also competed successfully. One example is Mike Gales of Plankinton. Aurora County seems to have received truly competitive bids in the early 20th century, awarding contracts for a single bridge or a small group of bridges to various companies. In 1911, Mike Gales, a German immigrant, Aurora County farmer, and former county commissioner and county treasurer, submitted the low bid for a group of six bridges. The following year, the county adopted the system of awarding annual contracts. Gales continued to receive the annual contracts in Aurora County through the end of the decade.



John E. Kirkham

John E. Kirkham was South Dakota's first Bridge Engineer.

South Dakota State Highway Commission Bridge Department

In 1919, the South Dakota State Highway Commission established a bridge department, hired a bridge engineer, and gave him responsibility for designing all state and county bridges and supervising the bidding process. The first bridge engineer was John E. Kirkham, a professor of engineering at Iowa State University in Ames and consulting engineer to the Iowa State Highway Commission, which was one of the most innovative state highway departments in the country at the time. One of Kirkham's first goals was to release the counties from the controlling grip of the private bridge building companies. He accomplished this in part by developing a series of standardized bridge plans which were especially suited to South Dakota's conditions of climate, terrain, and rural traffic needs. He called one of his designs, a concrete viaduct, the "Beadle County Special," and recommended that bridges such as this, when used at locations which were dry except for a few weeks in the spring, would save the counties money in the long run, when compared to the turn-of-the-century practice of building cheap wooden bridges at these sites which needed frequent maintenance or replacement.



Pony Truss Designed by State Bridge Engineer Kirkham

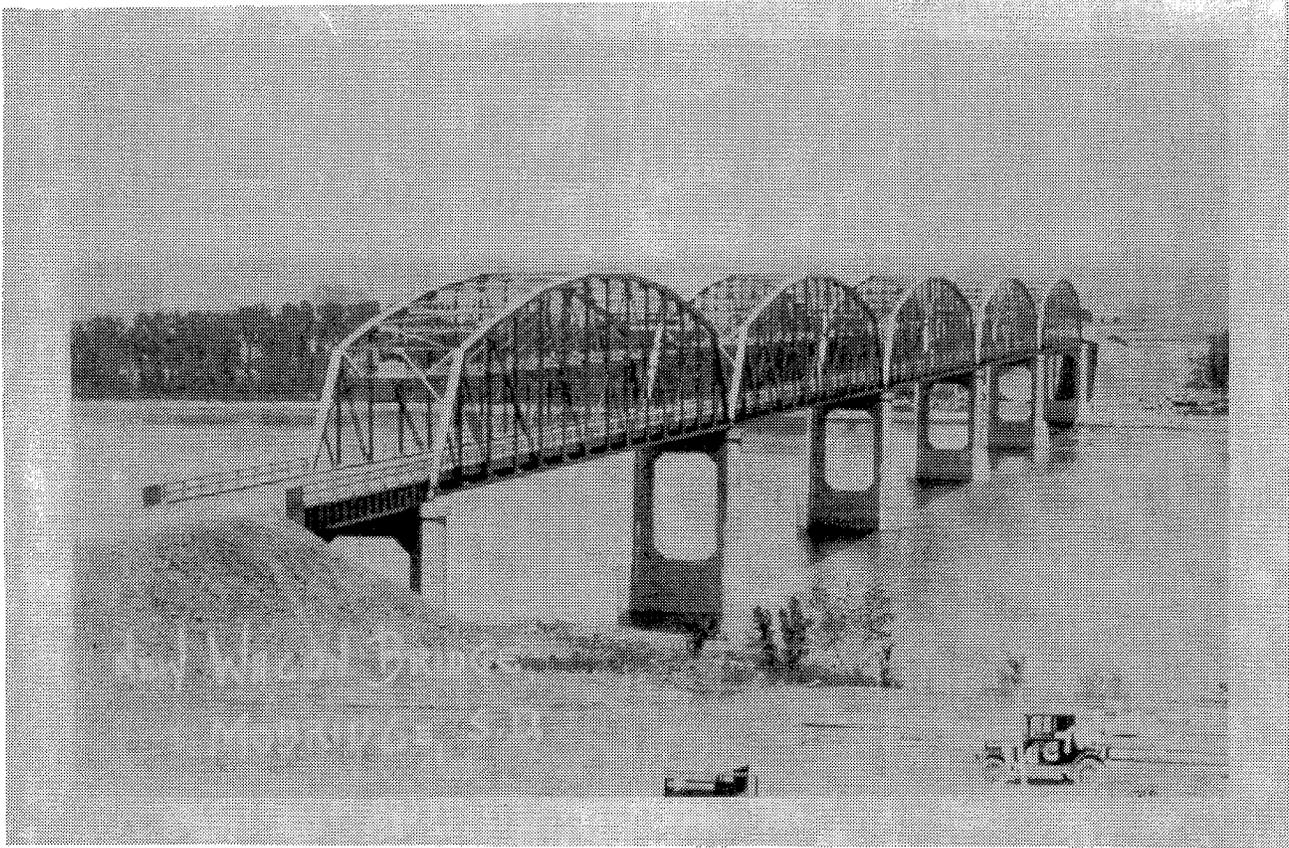
State Highway Commission Bridge Engineer John E. Kirkham designed this pony truss for use in South Dakota. It is unlike those found in other states. Note how the vertical end posts of the truss are visually very compatible with the concrete end guards.

Another of Kirkham's innovations was a pony truss design which replaced the conventional riveted Pratt and Warren pony trusses being built by the bridge companies. Kirkham argued that the usual boxed upper chord, made up of several pieces of steel, was unnecessary. His designs called for a single web upper chord making the superstructure lighter and, therefore, less expensive. Kirkham also kept aesthetics in mind, designing his pony trusses with vertical end posts so there would be a more pleasing match between the truss and the concrete approach guards.

Missouri River Bridges

Until 1924, South Dakota had no vehicular bridges across the Missouri River, although railroad bridges were built at Pierre and Mobridge in 1907. People wishing to move wagons, livestock, freight, or cars between the two halves of the state had to use ferries, wait until winter weather froze the river, or use the seasonal pontoon bridges which existed at a few locations.

The first highway bridge constructed across the Missouri River in South Dakota was the privately-financed Meridian Bridge connecting Yankton with Nebraska. The bridge drew its name from the Meridian Highway, an internationally organized route linking Mexico City



Missouri River Bridge

The highway bridge at Mobridge was the first of five to be completed by the State Highway Commission over the Missouri River in the 1920s. (courtesy of South Dakota Cultural Heritage Center)

with Winnipeg. Construction of the bridge began in 1920, but problems in raising capital delayed completion until 1924. Designed by bridge engineers Harrington, Howard and Ash of Kansas City, the bridge included provisions for both vehicular and rail traffic. The bridge included a vertical lift span to meet requirements of the federal government for unrestricted traffic on the Missouri River. The City of Yankton purchased the bridge in 1946. After the

City had recovered the purchase-price by collecting tolls, the bridge was opened free to users in 1953, the same year the never-used railroad deck was converted to accommodate highway traffic.

The biggest challenge to the early South Dakota State Highway Commission Bridge Department was to design bridges to cross the Missouri River, linking the two halves of the state together. In 1919, Governor Norbeck began to advocate for a special tax to pay for Missouri River bridges. Two years later, the South Dakota legislature levied such a tax, believing it would take twelve years to raise enough money for the desired bridges. In 1923, Kirkham created quite a sensation in the press when he claimed he could build five Missouri River bridges for a total of \$2,000,000, despite skeptics' claims that each bridge would cost



Watertown Bridge

The five-span arch bridge in Watertown is typical of projects built during the New Deal era.

well over \$1,000,000. The Mobridge Bridge was the first of the five to be completed in 1924, and by 1927, the bridges at Wheeler, Chamberlain, Pierre, and Forest City were also complete. Kirkham's estimates had proved nearly correct: all five bridges were built for a total of \$2.1 million. Because of subsequent construction of dams and reservoirs along the Missouri River in South Dakota, all the original Missouri River bridges have either been replaced or altered. The only structure still standing from the 1920s is the Chamberlain Bridge. It has been altered over the years, and is now comprised of the four original



White River Bridge

South Dakota's older bridges, such as this three-span, riveted Parker through truss over the White River in Lyman County, can be important historical to the historical development of the state. (photo by Brian Bernhard)

Chamberlain Bridge spans, plus the six Wheeler Bridge spans, which were moved to the Chamberlain site in 1953. By placing the old spans side-by-side, the designers of the new bridge created a four-lane structure.

Residents adjacent to other major rivers also continued to petition for bridges, believing that improved transportation links would enhance the economic prospects of their area. Promoters hoped the Buffalo Gap Bridge, built over the Cheyenne River in 1932, would spur growth in the region by providing a direct link to the Pine Ridge Indian Reservation. At the bridge's opening ceremonies, attended by numerous dignitaries, South Dakota's poet laureate Badger Clark extolled the virtues of the new bridge in a work composed specifically for the occasion. Yet populations on both sides of the river have dwindled since that time, indicating that bridges alone are not sufficient to stimulate growth.

Bridge construction in South Dakota decreased steadily from 1923 until the beginnings of the Great Depression as the counties completed their highway and road networks. President Franklin Roosevelt's New Deal programs of the 1930s, particularly the Works Progress Administration (WPA) and the railroad/highway separation projects, resulted in the construction of a large number of bridges in the state. The public works projects, in which labor was maximized to employ as many men as possible, resulted in some bridges of extremely fine craftsmanship. The graceful, five-span, multi-plate arch bridge in Watertown over the Big Sioux River is an outstanding example of the public works bridge projects. The designers specified randomly laid pink and gray granite for the spandrels and railings, in place of the more conventional use of concrete. Turner County, which constructed hundreds of stone arch bridges, found the projects to be especially popular with work relief laborers over the more monotonous projects such as moving earth and graveling roads.

Conclusion

Like the historic bridges of other states, South Dakota's historic bridges reflect the state's development and environmental characteristics. South Dakota's agricultural base and the manner in which its land was sub-divided (all section lines were declared public roads) meant that many relatively small bridges would be needed. Most of the land was settled after iron and steel became the most important building materials for bridges, and after railroads made it possible to ship bridge components to the state from industrial centers. Consequently, South Dakota's bridges represent building technologies from the "Age of Steel." States which have important navigable waterways, such as Illinois and Ohio, typically have historic moveable bridges, structures that can be moved out of the way of boats and barges. Although river traffic historically occurred on several South Dakota rivers, the Missouri River is the only river on which navigation remained important into the 20th century, so the state's only moveable bridge is on the Missouri. States which have a moist climate and where wood was a common bridge material, such as Pennsylvania and Oregon, often have historic covered bridges. South Dakota is a relatively arid state, and has no covered bridges. The advent of reinforced concrete and the ability to manufacture steel I-beams of great depth led to a slow, but inevitable abandonment of the use of steel trusses. These characteristics are all reflected in South Dakota's surviving historic bridges.

The historical significance of South Dakota's bridges notwithstanding, they do not necessarily represent current characteristics of the state. Deterioration, plus subsequent changes in the landscape, modes of travel, and patterns of population density have led to the removal of many historic bridges, and will continue to do so in the years to come. Yet, even as they continue to carry traffic, these old bridges serve us and future generations with another valuable purpose: they are spans to our past. And through projects, such as the archival record being created by documenting bridges which are demolished and the statewide bridge survey, future researchers will be able to understand the origins and development of South Dakota's transportation system. As long as historic bridges grace South Dakota's landscape, they offer all of us the chance to learn more about our transportation history.

Get out of your car and touch one of these bridges, study how it was built, and imagine what forces resulted in its construction.

