

ARTFUL PASSAGES:

The Engineering Legacy of North Dakota Bridges

by Lauren L. McCroskey



Throughout building history, bridges have often been among the structures most compatible with the landscape. Bridges engage the earth like no other form of architecture, providing vital, often artistic links and crossings, while defying the most challenging topography. Apart from their engineering triumphs, North Dakota's bridges are an important index of events that shaped much of the building industry just before and after the turn of the century. Endowed in both their materials and design are the influences of industrial

history, frontier settlement, technological innovation, and state and federal policy.

Of the historic bridges that have endured, metal, concrete, and wood are the most prevalent on the prairie today. Stone or masonry bridges are rare, as is true in most areas of the American West. North Dakota's first bridge building followed the pattern of westward expansion, beginning with the great railroad building of the mid-nineteenth century. The relentless push of western settlement, assisted by railroad construction,

The state's only surviving example of the patented "Marsh Arch" bridge (opposite page) carries old Highway Ten across the Sheyenne River at the east end of Valley City. The decorative concrete work was inspired by Art Deco, while, internally, steel performs the structural work of holding the road deck in place. The bridge was built in 1925. This modest bridge (this page), constructed in Traill County as one of many Civilian Conservation Corp Projects, is a steel stringer embellished with a masonry abutment.



necessitated bridges that could carry tracks, and later roads, over varied terrain. This urgency rarely allowed for the old world pace of masonry construction so common in the eastern United States. An expensive material requiring patient assembly, stone was abandoned for the cheaper, ubiquitous, timber which could be quickly erected into trestles (an arrangement of pilings connected with lattice-like diagonal braces known as trusses).

The nation's mid-nineteenth century industrial boom greatly benefitted the evolving bridge industry. Refinements in the production of cast and wrought iron had already encouraged their use as major structural members and as decorative fronts for commercial buildings. The potential of these materials for bridge building was obvious. Iron trussing, adapted from European systems of the eighteenth century, could replicate the myriad types of timber trusses used in earlier bridge construction. With standardized units of greater strength and durability available, metal bridges were chosen over wood designs.

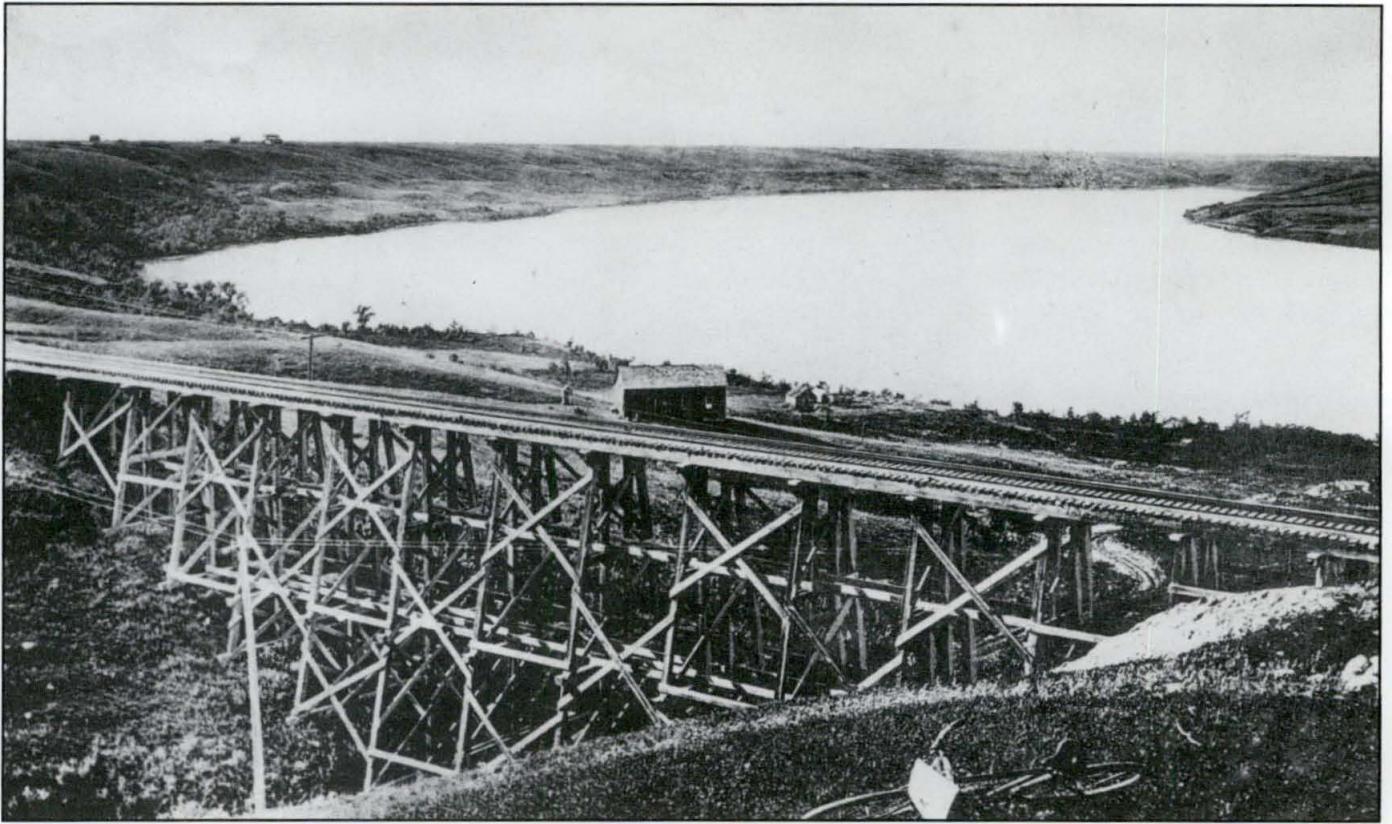
Short spans over relatively tame waters were the best candidates for cast-iron structures, however, and were available in stock designs from major bridge manufacturers. Slender trusses, combined with filigree-like embellishment of portals and laced metalwork, identify these bridges as the state's earliest examples. In Valley City, a most notable cast-iron design is the picturesque foot bridge located at the entrance to Valley City State University. A one-of-a-kind bridge for the state, the suspension span over the Sheyenne River was constructed in 1901 by the Fargo casting firm of Dibley and Robinson.

Through-trusses, identified by vertical and diagonal members which provide both side and overhead brac-

ing, were executed in iron during the 1870s to 1880s and, after the 1890s, constructed of iron and steel or steel alone. A through-truss type uncommon for North Dakota was the gently arched span of the west end bridge that crossed the vast network of tracks in Mandan. The bridge, demolished in 1991, was an unusual example of metal trussing for the state, featuring a striking, offset alignment of east and west trusses. After 1910 the pony truss, with low, diagonal trusses that appear almost like railings, swept the state and was the only metal truss design used for several years.

Around 1870, iron was fortified through the alloy of manganese, nickel and other elements to produce a superior performance material—steel. While neighboring states began to exploit new trends in steel bridge design, it was not until just after the turn of the century that North Dakota county commissions mandated steel construction to replace iron and wood combinations. Metal bridges of this period were derived from standardized plans; many were available from bridge manufacturing firms in the upper midwest and east, which supplied the bulk of metal bridge materials and designs. The one notable exception, the Liberty Memorial Bridge which connects Bismarck and Mandan, is a sophisticated span of three trusses designed under a special commission by a renowned national figure of bridge design, C. A. P. Turner of Minneapolis.

Built in 1922, "The Liberty Memorial Bridge," so named to honor soldiers of WW I, was also the first vehicle bridge to span the Missouri River, thereby uniting the east and west halves of the state. Due to the expenses incurred from this project, state highway officials later favored the economy of in-state designs or stock designs produced by bridge companies for future projects.



This lattice pile trestle from the northwestern region of the state, built in the late nineteenth century, illustrates the railroad's initial reliance on timber framework for long bridges.

Around 1920, the principles of wooden trestle construction, once the most common bridge material in North Dakota, were re-examined for use in shorter spans for vehicle traffic. Finding that timber construction was relatively inexpensive by comparison to the newer iron and steel construction (and more durable than previously thought), county commissions began to make wood the obvious choice in times of fiscal constraint. (Wood trestles of similar design continue to be used today, and from a distance, are often barely distinguishable from their nineteenth-century counterparts).

Until the 1920s, metal bridge building had gone relatively unchallenged in the state. But with unprecedented automobile traffic and the conversion of many state roads to the federal highway system, pioneer structures were stressed beyond their structural limitations. More modern forms of engineering were sought, increasingly, and bridge designers eyed the newest material in civil engineering—reinforced concrete.

Unlike the bare latticework of iron and steel trussing, reinforced concrete concealed and protected much of the structural work of the steel frame, while affording greater opportunity for artistic expression. The country's first reinforced concrete bridges, built around the turn of the century, mimicked traditional masonry design

with heavy arching and massive piers. Gradually, successful use of lighter, thinner ribs and other reinforcements freed the structural components from such thick skins. The concrete medium was also well-suited to the architectural styles of the day, including Art Deco and the classical revival.

In North Dakota fine examples of concrete bridge designs, such as the Rainbow Arch bridge at the east edge of Valley City, marked the emerging passion for cross-country auto travel. First designated Route 10, the highway became known as the National Park Highway or "Red Trail," and was touted as a key link in the Atlantic-Pacific passage, as well as the northern route to Yellowstone Park. The true arch bridge is also a design of national import, incorporating two segmental arches with an infill of vertical beams and decorative railings.

Minot's Eastwood Park concrete arch bridge is the state's only variant on the patented, true arch theme. Its two arches are purely decorative, the structural work having been delegated to the cantilever supports beneath the deck. Designer T. W. Sprake, an engineer with the state's highway department, won the bid for the Minot project. By modifying the true arch system with false arches, he was able to pare down costs and avoid royalty payments for the patented "Marsh Arch" design.

Centered in the lacy portals of the cast-iron footbridge approaching Valley City State University is a plate engraved, "1901, Dibley and Robinson, Fargo." The firm, later named the Fargo Bridge and Iron Company, was one of two Fargo operations favored with metal highway bridge contracts in the early part of the century. The foot bridge is the only remaining bridge of any type surviving from the firm's "Dibley and Robinson" era.



The original span that connected Grand Forks, North Dakota, with its Minnesota neighbor gained stylistic definition from the decorative name plate on the portal and from the lacing between structural members. Such early through-truss bridges are distinguished from later examples by their slender metal components.



This three-arch masonry bridge across an ephemeral stream in the southwest quarter of the state was most likely another product of Depression-era federal relief work programs. The exact location of the bridge, in the vicinity of Scranton, is unknown.





Two polygonal through-tresses provided an engaging bridge design set against the scenic backdrop of the Little Missouri River. No longer standing, portions of the bridge and its trusses were likely recycled in a later project elsewhere in the state.

During the era of federal relief programs, national policy governing the use of federal bridge funds became less restrictive with the repeal of the prerequisite "matching funds" clause. No longer obligated to buttress federal monies with state funds, North Dakota could draw freely from Federal Highway Department coffers. Many of these Depression era bridges, products of Works Progress Administration and Civilian Conservation Corps programs, reflect contemporary Art Moderne designs in their often rustic compositions of masonry or timber.

The philosophical goals of the federal relief era warranted construction methods that were both satisfying to workers and less tedious than metal bridge construction. The emphasis on labor intensive craftsmanship meant, in some instances, a brief revival of European masonry bridge design which had been absent from the state's pioneer era of bridge construction. Mundane, contemporary steel stringer decks, for example, were

given a picturesque and timeless quality with stone wings and abutments.

Many of North Dakota's bridges are now valued as important engineering achievements and as landmarks of transportation history. In the future, the only salvation for delicate, aging bridges may be in less stressful service as pedestrian and light vehicle bridges. Preservation of more durable examples, which will continue to meet modern traffic demands, will require adaptive-minded policy and the same innovative spirit that generated their then-revolutionary designs. **ND**

Information for this article was drawn in part from "Historic Bridges of North Dakota," produced by Renewable Technologies Incorporated, on file at the State Historical Society of North Dakota.