

B. Historic context: Minnesota Masonry-Arch Highway Bridges, 1870-1945

NOTE: The original text of this context is included in "Minnesota Masonry-Arch Highway Bridges," National Register of Historic Places, Multiple Property Documentation Form, prepared by Jeffrey A. Hess, 1988, available in the Minnesota State Historic Preservation Office.

Minnesota Masonry-Arch Highway Bridges, 1870-1945

Background Considerations

On the basis of construction materials, masonry-arch bridges divide into three principal types: stone, brick, and composite. The last category is most commonly a combination of the first two, as in the case of a bridge combining brick voussoirs with stone spandrels and abutments. None of these types has been extensively studied in the United States. Usually, bridge historians simply give passing notice to major American examples, such as the 220-foot-span Cabin John Bridge near Washington B.C., the world's largest nineteenth-century stone arch. The masonry-arch genre itself, however, is customarily dismissed as an American anomaly. David Plowden, for example, suggests that from the very beginning the masonry arch was incompatible with the American outlook:

Psychologically Americans were as temperamentally unsuited to build with stone as it was economically unfeasible for them to do so. Stone bridges are by nature strong and require little or no maintenance. Their disadvantage is the time it takes to build them, piece by piece, each stone needing to be quarried, dressed and individually fitted. . . . With few exceptions, impatient America [did not] take the time to lay up a stone bridge where an alternative was available.¹

Plowden's comments carry a good deal of weight, since he is one of the few historians to devote a full chapter to the American masonry-arch bridge. He recognizes that Americans did build masonry arches, especially during the last twenty years of the nineteenth-century, when railroad companies turned to "dependable" stone to assuage the public's fear of iron-bridge failures. But Plowden views these structures as atavistic, "so very unlike the great metallic creations, products of the mills and the foundries, which reflected the raw industrial vitality of nineteenth-century America."²

Other historians have also discussed the retrogressive nature of American masonry-arch construction. In a major essay on American bridge design, Elizabeth B. Mock argues that American engineers failed to develop the true design capabilities of steel and reinforced-concrete precisely because they patterned their work after antiquated stone-arch aesthetics: "There [was] a curious reluctance to explore their ultimate possibilities and accept their full esthetic implications — a reluctance based on the idea that massiveness is itself a virtue, as it was in the days when stone was the only strong, permanent, therefore honorable material."³ For most historians, American masonry-arch construction ended with the nineteenth century, economically impractical and aesthetically obsolete. To quote Carl W. Condit: "Most bridges built after 1900 that appear to be stone are either concrete or steel structures with a stone facing added for ornamental effect. . . . The masonry-arch bridge ceased to lead an active life chiefly because of its high cost."⁴

This traditional view of American masonry-arch bridge construction has been challenged, quite recently, by statewide, historic, highway bridge surveys in Pennsylvania and Wisconsin, which examined all

surviving regional examples of the genre, instead of simply the most prominent. The authors of the Pennsylvania report declare: "Although both nineteenth and twentieth century bridge historians have stated that early stone masonry structures are poorly represented in America, this survey revealed a large number of early stone arch bridges." The report goes on to point out that at least 21 of the states surviving masonry-arch bridges were constructed during the period 1901 to 1920, "illustrating that the tradition for building stone highway bridges in Pennsylvania continued well into the twentieth century."⁵

The Wisconsin historic bridge survey also noted a surprising number of twentieth-century masonry arches: "Of the study's 49 bridges, comprising virtually all surviving, stone-arches in the state, 26 (53%) were positively identified as having been built during this period. Stylistic evidence links an additional ten (20%) to this group."⁶ In attempting to explain this phenomenon, the authors suggest that masonry-arch bridge construction was, at least in certain regions of the state, an economically competitive practice sanctioned by local "Good Roads" enthusiasts. They attribute the demise of masonry-arch construction largely to "administrative decisions" by the newly-established Wisconsin Highway Commission, which attempted to improve the quality of bridge building in the state through the use of standardized plans, especially for reinforced-concrete structures:

There is no doubt . . . that the adoption of standardized, reinforced-concrete construction facilitated the administration of a state-wide bridge program. But it also doomed regional, stone construction practices no matter what their merit. With the formation of the Wisconsin State Highway Commission in 1911, the era of stone-arch bridge construction in Wisconsin came to an end.⁷

The findings of the Wisconsin bridge survey seem particularly relevant for Minnesota, since these two neighboring states display considerable similarities in geography and history. The study of Minnesota masonry-arch bridges, however, is complicated by the lack of information on the subject in both primary and secondary sources. The most detailed study of Minnesota road and bridge construction is Arthur J. Larsen's [The Development of the Minnesota Road System](#) (1966), which relies heavily on nineteenth-century newspaper accounts. Although Larsen provides some information on truss-bridge development, he is completely silent on masonry-arch construction.⁸

Primary sources are also remarkably uncooperative. As Larsen points out, nineteenth-century bridge construction in Minnesota was largely funded and supervised by individual townships and cities.⁹ Counties occasionally aided these local governments with bridge projects, but county record keeping makes it difficult to determine how such funds were spent. Frequently, county disbursements are recorded simply as lump sum grants in the written "proceedings" of the board of county commissioners. A typical example is provided by Houston County, which appropriated money for bridge improvements to several townships in November 1900. The board's proceedings provide no further information about either the appropriations or the construction projects — except for the notation, "paid as per applications on file."¹⁰

Township archives can be equally disappointing. During the course of this survey, an attempt was made to study the records of the three townships with the highest concentrations of surviving masonry-arch bridges. One township had no records on file prior to 1920. The other two did have fairly extensive nineteenth-century holdings, especially in regard to town supervisors' proceedings. With only a few

exceptions, however, these records did not provide information concerning the location, type, cost, and builder of specific bridges. A typical entry simply listed an appropriation "for repairing Roads and Bridges through Town."¹¹

Since there is so little documentary data on Minnesota masonry-arch bridge construction, the surviving bridges themselves must serve as the principal source of information. At present, Minnesota has 45 structures that can be positively identified as masonry-arch highway bridges.¹² On the basis of general setting and morphology, these bridges fall into three major groups: country, city, and park. Since country bridges are the most numerous, we will consider them first.

Country Bridges

In the Wisconsin historic bridge survey, the authors of the final report introduce the category "country bridge" to describe those masonry-arch structures "built by either unincorporated towns or small rural villages" on "remote farm roads."¹³ This category seems well suited for 29 Minnesota bridges, which form the largest group (64%) of the state's surviving, highway, masonry arches (see Table 1). For the most part, the Minnesota bridges are quite similar to their Wisconsin counterparts. Typical features include: rubble masonry with mortar joints of at least one inch; one or two semicircular arches with spans between 10 and 15 feet; simple stone or metal railings (which often have been removed); and an overall structure width of about 18 to 20 feet. These bridges rely on their symmetry and proportions for whatever aesthetic statement they make; ornamentation of any type, including date stones, is extremely rare.

Construction information for these bridges is almost non-existent. On most structures, however, the arch soffit is coated with a thin concrete sheath bearing formwork impressions. This feature suggests that the arches were constructed in a manner traditionally used for rubble masonry since at least the eighteenth century. The general method has been described for a Wisconsin bridge-building family who erected numerous country stone arches in the early twentieth century:

The Meier family laid foundations in cement mortar and erected frame falsework, which had a barrel configuration conforming to the intrados of the arch. After the voussoirs were positioned on the falsework, to create the arch, an exterior course of the spandrel walls was built up. Mortar was then shoveled over the extrados of the arch, forming a thick bed between the spandrel facings. As the mortar seeped between the voussoirs, it deposited a thin layer on the centering, which solidified into a concrete sheath over the intrados of the arch. The bridge was finished with dirt fill between the spandrels for the roadway....¹⁴

All of the state's masonry-arch country bridges appear to be constructed of local stone. The close relationship between construction material and local geology is perhaps mostly clearly seen in the granite bridge of Meeker County (L90990) and the gneiss bridge of Renville County (94045); in both cases, the split fieldstone of the spandrel walls matches the glacial erratics scattered in adjacent fields.

Table 1
Minnesota Masonry-Arch Country Bridges On Public Highways
(N = 29)

MNDOT No	County	Date	Material	Arches	Span*	Rise*	Lngh*	Wdth*
90569	Blue Earth	?	A-L, Cs	1	15	8	16	16
L4770	Fillmore	C. 1907	R-L	1	10	4	12	21
L4823	Fillmore	?	R-L	1	11	4	14	20
L4838	Fillmore	C. 1903	R-L	1	12	6	15	20
L4878	Fillmore	C. 1904	R-L	1	10	5	12	20
L4879	Fillmore	C. 1905	R-L	1	10	5	12	20
L4894	Fillmore	C. 1898	R-L	2	20	10	90	23**
L4896	Fillmore	C. 1904	R-L,M	1	12.5	6	17	31
7979	Fillmore	C. 1904	R-L	2	14.5	6	35	20
7980	Fillmore	C. 1904	R-L	2	14.5	7	33	20
L9080	Fillmore	C. 1903	R-L	1	10	3	12	19.5
L3910	Goodhue	C. 1920	R-L, Cs	1	11	5	15	18
L3972	Houston	1909	R-L, Ca	1	10	4	13	29
L4009	Houston	C. 1915	A-L	1	12.5	6	16	18
L4013	Houston	1915	A-L	1	12.5	6	15	18
L90990	Meeker	1908	R-F	1	11.5	5	14	18
L6170	Olmsted	C. 1911	R-L	1	14	7	16	21
94045	Renville	C. 1934	R-F	1	10	5	12	54
L3040	Scott	1878	A-L	1	15	7.5	24	14
L1091	Wabasha	C. 1910	R-L	2	11	5	30	17
L1113	Wabasha	C. 1910	R-L	2	10.5	4.5	28	16***
L1122	Wabasha	C. 1910	R-L, Cs	2	12	6	26	16.5
L1132	Wabasha	C. 1910	R-L, Cs	1	10	4.5	13	18
92833	Wabasha	C. 1910	R-L, Cs	1	11	5	16	18
93741	Wabasha	C. 1920	R-L, Ca	1	10	5	15	34
L8167	Washington	C. 1920	R-L, Cb	1	10	3.5	26	75
L1408	Winona	1898	R-L	1	38	—	39	22
L1409	Winona	1895	A-L	1	45	12	46	17
L1423	Winona	C. 1910	R-L	1	12	5	15	18

* Dimensions in feet

** Originally 4 arches; 2 arches replaced by Pratt pony truss in 1942

*** On abandoned road; closed to vehicular traffic

A = Ashlar

Cs = Concrete-Slab Addition

Ca = Concrete-Arch Addition

L = Limestone

Cb = Concrete Box-Culvert Addition

M = Corrugated-Metal Arch Addition

Perhaps the most notable aspect of Minnesota's masonry-arch, country bridges is their geographic clustering. Twenty-four bridges, representing 83% of the entire group, are located in five contiguous counties (Goodhue, Olmsted, Winona, Houston, and Fillmore) in the south-eastern corner of the state. The numerous valleys of this area are lined with limestone outcroppings, which have long supplied local farmers with building material. By 1935, the inactive quarry sites alone numbered 112.¹⁵ Neighboring portions of Wisconsin and Iowa display similar limestone formations, which also seems to have been quarried for stone-arch bridges, suggesting a regional tradition for this type of construction. In 1916, for example, a student of Wisconsin bridges noted "a large number of stone arches" in "some of the western counties [where] stone is readily available and the arch is well adapted to the numerous deep dry runs found in this section."¹⁶ In Winneshiek County, Iowa, — located immediately south of Fillmore County, Minnesota — county officials began constructing rural, stone-arch bridges as early as 1870, completing 20 within four years.¹⁷

The prevalence of masonry-arch bridges in nineteenth-century, rural Minnesota is unknown. Only three of the state's surviving, country arches have authenticated nineteenth-century construction dates. From the available evidence, it appears that almost all of the remainder are of twentieth-century origin, primarily from the period 1900 to 1920.¹⁸ These findings closely parallel the data for Wisconsin country stone arches, most of which were built during the early twentieth century as part of the "Good Roads Movement" — a coalition of politicians, farmers, bicyclists, and motorists intent on improving the comfort, safety, and load-bearing capacities of rural roads and bridges.¹⁹

In Minnesota, the Good Roads Movement was formally inaugurated in St. Paul in January 1893, with a two-day convention that attracted over 400 delegates from around the state. Two years later, the cause received the professional support of the state's civil engineers, who formed the Minnesota Surveyors and Engineers Society (MSES), at least partly to lobby for increased state spending for highway improvements.²⁰ At the society's first annual meeting, Good Roads enthusiast, and subsequent MSES president, Omar H. Case, addressed his engineering brethren on the wisdom of replacing short-span wooden bridges with more durable stone arches:

Good roads, for a comparison, is like a good chain; no better, no stronger than its weakest link. And so with the road, the poor culvert, the bad bridge spoils the whole construction. Now I am going to commence with the smallest of these water ways and show the waste of material; material that has been thrown away as it were, together with the labor; as they are a temporary makeshift in any event. I refer to the plank and timber constructions. You have seen them all over the country. This serves the purpose for a little while, but the traffic and loads it has to bear gradually forces it into the ground or out of shape and at last there is nothing of it visible, only water, muddy water — nothing more — and a very bad place in the road. Now for the remedy Where stone are plenty, and along most streams in Minnesota they are plenty, I would advise building arch bridges.²¹

At the time of his remarks, Case was official county surveyor of Fillmore County, and it is quite possible that his views encouraged county officials to appropriate funds for several rural stone arches in July 1899.²² Case himself was a resident of Fountain Township in Fillmore County. Unfortunately, the records for this township prior to 1920 are no longer extant.²³ But records for Carimona Township, bordering Fountain on the south, are available, and they document that, in March 1901, the town supervisors

"resolved that the sum of Two Hundred and Fifty Dollars be raised . . . for stone arch culverts ... to take the place of wood structures so as to do away with wood structures whenever stone can be used to advantage."²⁴ The Carimona Township supervisors were probably well acquainted with Case's views on stone-arch construction, since they hired him during this general period to do survey work. Whatever the nature of Case's influence, there is no disputing the fact that the 10 surviving stone-arch bridges of Fillmore County represent the greatest concentration of early twentieth-century masonry-arch bridges in the state.

The first significant victory of the Minnesota Good Roads Movement occurred in 1898. In that year, the electorate approved a state tax for county bridge construction to be expended under the supervision of a state highway commission, which was officially organized in 1905.²⁵ In Wisconsin the formation of a state highway commission signaled the end of stone-arch bridge construction, since the administrators attempted to standardize short-span bridge construction through the use of reinforced concrete.²⁶ In contrast, the Minnesota State Highway Commission seems to have countenanced masonry-arch structures under certain circumstances. In its first codification of rules and regulations, published in 1907, the Minnesota agency declared that the masonry arch was an acceptable type of construction for "small bridges" with "openings of four to eight feet."²⁷ Although the commission's project summaries for 1907 and 1908 occasionally mention "stone and "stone arch" culverts, it is clear that the agency, like its Wisconsin counterpart, preferred to promote standardized, short-span, concrete construction: "We have prepared blue prints for plain and reinforced concrete culverts in sizes from 2 ft. to 10 ft. square and have furnished them to all town and county officials when called for."²⁸

In 1912, the Minnesota State Highway Commission updated its specifications and removed all reference to masonry-arch construction. Nevertheless, it continued to design masonry-arch structures when it was economically feasible to do so. Consider, for example, the following history of two bridges in Rushford Township, Fillmore County, as chronicled in a diary of communications between the commission's central "bridge department" in St. Paul and its field engineer in Fillmore County, J. J. Davy:

- Jan 24, [19]12. Application received. S[tate] R[oad] #2 over "run" [in] Sec[tion] 34 T[ownship] 104 R[ange] 8. Span 20 ft. Steel and concrete....
- Feb 7, [19]12 Letter to Davy to make survey.
- Feb 15, [19]12 Davy advises that these bridges are not necessary, that stone culverts will do. Wants to know if any objection would be made if he put in a 10' span (or 12' stone arch). Plenty of good rock. [District engineer] Forbes' attention was called on this subject while there and he agrees with Davy.²⁹

By law, the Minnesota State Highway Commission was required to design all bridges on state roads, which explains its involvement with the two Fillmore County bridges mentioned above. The commission also was legally obligated to prepare and approve bridge plans for county and township projects when local officials so requested.³⁰ To fulfill these latter responsibilities, the commission assigned a field engineer to almost every county seat and prepared a series of standard bridge plans, including "plans for beam spans, plate girders, low trusses and high trusses, reinforced concrete slab and girder bridges."³¹ Although the documentary evidence is sketchy, it is possible that the commission also attempted to standardize at least some elements of stone-arch design.

In January 1915, the Houston County Board of Commissioners requested the commission's field engineer A. J. Rasmussen "to make a survey and draw plans" for a stone-arch bridge in Black Hammer Township.³² Rasmussen's bridge (L4013) displays highly distinctive, well-defined impost ledges about six inches in width. Although the ledges are aesthetically pleasing features that accentuate the spring of the arch, their purpose was probably purely functional, serving as supports for the arch centering. Although it is not surprising that a nearby bridge in Black Hammer Township (L4009) incorporates the same kind of construction, it is remarkable that the design repeats itself, during this same period, on masonry-arch, country bridges in Fillmore County (L4770) and Wabasha County (L1122, 93741). These examples strongly suggest regional familiarity with a standard design, whether supplied by the state highway commission or developed by the field engineers themselves by sharing information.

City Bridges

Minnesota has 12 surviving masonry-arch bridges that can be characterized as "city bridges." They were built during the approximate period 1885 to 1915 by the following four municipalities: Carver, Duluth, Minneapolis, and St. Paul (see Table 2). When these cities constructed their masonry arches, each was a regional trade center, and, with the exception of Carver, each has remained so to the present day. Since city bridges generally experienced heavier traffic loads than their country cousins, they embodied more substantial engineering. And since they attracted more public notice, they were more likely to be treated as statements of civic pride.

Table 2
Minnesota Masonry-Arch City Bridges on Public Highways
(N = 12)

MnDot No.	City	Date	Material	Arches	Span*	Rise*	Lngh*	Width*
L2526	Carver	C. 1885	R-S, Cs	1	16	8	18	37
L2722	Carver	C. 1885	R-S	1	11	5.5	14	21
L2783	Carver	C. 1885	A-S, M	1	13	6.5	19	52
4559	Mpls.	1890	A-L, Ca	1	25	—	35	68
90444	Mpls	1892	A--S, Ca, Cs	1	28	14	40	42
Colo. St.	St. Paul	1888	B, A-L, G	1	70.5	11	105	58**
90386	Ramsey	1884	A-L	2	41, 30	—	90	124
90410	St. Paul	1894	A-L	1	10	5	30	24
88156	Duluth	?	B, Ga, S	1	13	6.5	19	112
88548	Duluth	C. 1915	B,Ga,S, C	1	16	8	22	50
91143	Duluth	C. 1915	B, Ga, S, M	1	10	5	15	64
93402	Duluth	C. 1915	B, Ga, S, Ca	1	10	5	15	230

* Dimensions in feet

** Closed to vehicular traffic

A = Ashlar

Ga = Gabbro

B = Brick

L = Limestone

Ca = Concrete-Arch Addition

M = Corrugated-Metal Arch Addition

Cs = Concrete-Slab Addition

G = Granite

R = Rubble

S = Sandstone

In both Wisconsin and Minnesota, city bridges were originally constructed, or subsequently modified, to accommodate at least one, and more often a combination, of the following features: a minimum width of 30 feet, pedestrian sidewalks, and some degree of ornamentation. Combined with an urban setting, these features serve to distinguish this group from Minnesota country bridges.³³ The one exception is the Sixth Street Bridge (L2722) in Carver, which would be perfectly at home on a rural back road.

Among Minnesota cities, Minneapolis apparently was the most prolific builder of masonry-arch bridges. At the beginning of the twentieth century, approximately one-third of the city's 59 bridges were single-span stone arches, located primarily on University Creek in the "southeast" section and on Bassett's Creek, just north of downtown.³⁴ Stone-arch bridge construction began as early as 1871, when city engineer H.H. Corson designed a one-arch span for Washington Avenue North over Bassett's Creek. Costing approximately \$5,000, the bridge consisted of a 22-foot clear span with a 40-foot-wide roadway flanked by four-foot-high parapets. Despite its modest proportions, the local press called it "the only large stone arch bridge in the State."³⁵ Subsequent bridges seem to have been of similar scale, with the notable exception of a five-arch limestone structure over the Mississippi River, which carried Hennepin Avenue from the "East Side" to Nicollet Island.

When the Hennepin Avenue Stone Arch Bridge was completed in 1878 for about \$50,000, the city engineer declared that "in point of durability [it] is equal to any bridge spanning the Mississippi River, and in connection with the suspension bridge has formed a link that [will] bring the two divisions of our flourishing city into [a] closer union than can be accomplished by any other means."³⁶ City officials were

apparently so pleased with this structure that they urged the construction of a companion stone-arch bridge from Nicollet Island to the "West Side," when the Suspension Bridge came up for replacement in the early 1880s. This proposal was eventually rejected in favor of a steel-arch design, for fear that the stone-arch piers would damage the city's milling interests by destabilizing the adjacent Falls of St. Anthony.³⁷ Despite the strong masonry-arch tradition in Minneapolis, only two single-span bridges of this type remain (4559, 90444), and both have been substantially altered by concrete additions.

St. Paul possessed fewer masonry-arch bridges than Minneapolis, but was more fortunate in their preservation. According to annual reports of the city engineer, St. Paul constructed only four municipal, masonry-arch highway bridges during the nineteenth century: the first on East Seventh Street in 1884, the second on Colorado Street in 1888, the third on the Mendota Road in 1894, and the fourth on the Afton Road in 1897.³⁸ The first three still survive, all in excellent condition. Measuring 10 feet in span and 24 feet in width, the Mendota Road Bridge (90410) has the general dimensions of a country bridge, but its detailing is more refined, including such Neoclassical embellishments as an enlarged, protruding keystone and a stringcourse at roadway level.

The Colorado Street Bridge, which was closed to vehicular traffic several years ago, is one of the state's most important masonry arches. Its technical virtuositities include a 70-foot clear span and a 1-to-6.7 rise-to-span ratio, making it the state's longest and flattest masonry arch. These features are all the more remarkable, since the bridge is a skewed, composite structure. Completed for a cost exceeding \$27,000, the Colorado Street Bridge consists of granite abutments; limestone spandrel walls and ring stones; and brick and limestone voussoirs sheathed in a brick soffit. The bridge's centering was left in place for a full year to ensure the proper bonding of materials.³⁹

From an engineering standpoint, the most interesting of the St. Paul bridges is the 1884, double-arch, East Seventh Street Bridge, which spanned five tracks of the St. Paul and Duluth Railroad just east of the city's "Lowertown" warehouse district. The structure was designed by William Albert Truesdell of the St. Paul City Engineers' Office.⁴⁰ Just prior to his employment with the city, Truesdell had worked as a railroad engineer, and for the general configuration of the East Seventh Street Bridge, he selected a standard stone-arch plan used by railroads throughout the nation during the last quarter of the nineteenth century. The basic features included a semicircular arch; rock-faced, coursed-ashlar masonry; and stepped wing walls perpendicularly joining the spandrel walls.⁴¹

Despite its similarity to other railroad stone arches, the East Seventh Bridge was in no way a stock-plan structure. Since Seventh Street intersected the railroad right-of-way at a 63-degree angle, the bridge required a highly skewed design. In developing plans for a skewed-arch structure, Truesdell had to take into consideration the fact that "very few of our masons in St. Paul had ever seen one, and no one knew anything about the stone cutting necessary." To simplify the stonework, he adopted the "helicoidal method" of skewed-arch construction, in which "the voussoirs are laid in spiral courses, parallel with each other, and are one of size and shape throughout the whole arch except the ring stones." According to this plan, "one set of patterns answers for all of the voussoirs, and when the stone-cutters are once taught to cut a stone no further difficulty is encountered." Truesdell noted that arches of this type "are quite common in England and Scotland, but very few have ever been built in this country."⁴²

Compared to St. Paul and Minneapolis, the City of Duluth came relatively late to masonry-arch bridge construction. In 1895, the city engineer recommended stone-arch spans as suitable replacements for the town's numerous wooden bridges.⁴³ Apparently, this recommendation was not adopted until about 1915, when the city constructed four brick arches (88156, 88548, 91143, and 93402) with stone abutments and spandrel walls across Chester Creek and Tischers Creek. Because of their relatively small openings (10 to 16 feet in span), elongated barrels (50 to 230 feet in length), and heavy overburden (15 to 30 feet in depth), these structures perhaps should be considered sewer tunnels rather than highway bridges.

Park Bridges

Minnesota has four masonry-arch structures that fall into the park-bridge genre (see Table 3). To a certain extent, this group overlaps the city-bridge category, since most park bridges were funded and built by municipalities. The distinguishing characteristic is that park bridges were designed to be ornamental landscape features as much as load-bearing structures. As the noted bridge engineer Henry G. Tyrral observed in 1901, "In the matter of ornamental park-bridges the engineer has opportunity to display more or less artistic taste, and create not only useful works, but architectural ornaments as well."⁴⁴

Park planners have long appreciated the versatility of masonry-arch design, which draws equally on traditions of rustic simplicity and Neoclassical elegance. The genre received a particular boost during the 1930s, when New Deal programs encouraged roadside beautification projects and labor-intensive construction techniques.⁴⁵ This era witnessed the construction of the state's most notable, ornamental, masonry arch — the Split Rock Creek Bridge in Pipestone County (5744), completed by the WPA in 1938 as part of the general development of Split Rock Creek State Park. Forming a clear span of 50 feet, the bridge's masonry offers a superb example of meticulously cut and laid random-ashlar pink quartzite, a beautiful but obdurate building stone for which the area is widely known.⁴⁶

Table 3
Minnesota Masonry-Arch Park Bridges on Public Highways
 (N =4)

MNDOT No.	Locale	Date	Material	Arches	Span*	Rise*	Lngh*	Width*
L5852	St. Paul	1894	B,A-S,L	1	18	6	36	33**
L6007	Duluth	C. 1919	R-Ga	1	30	10.5	37	29
L8476	Duluth	1934	R-Ga , C	1	15	5	22	29
5744	Pipestone County	1938	A-Q	1	50	12	68	28

* Dimensions in feet

** Closed to vehicular traffic

- A = Ashlar
- B = Brick
- C = Concrete-Arch Addition
- Ga = Gabbro
- L=Limestone
- Q=Quartzite
- R=Rubble
- S=Sandstone

Notes

1. David Plowden, Bridges: The Spans of North America (New York: Viking Press, 1974), pp. 9, 32. This introductory section on the historiography of masonry-arch bridges is adapted from the author's essay "Stone Arch Bridges" in Jeffrey A. Hess and Robert M. Frame III, An Historical Survey of Wisconsin Stone-Arch and Concrete-Arch Bridges, Part 1, (Madison: Wisconsin Department of Transportation, 1986), pp. 13-14.
2. Plowden, p. 31.
3. Elizabeth B. Mock, The Architecture of Bridges (New York: The Museum of Modern Art, 1949), p. 7. For similar sentiments, see David P. Billington, The Tower and the Bridge (Princeton: Princeton University Press, 1985), p. 15.
4. Carl W. Condit, American Building (Chicago and London: University of Chicago Press, 1982), p. 75.
5. Historic Highway Bridges in Pennsylvania (Pennsylvania Historical and Museum Commission and Pennsylvania Department of Transportation, 1986), pp. 7, 27.
6. Hess and Frame, Historical Survey of Wisconsin Stone-Arch and Concrete-Arch Bridges, pp. 14-15.
7. Hess and Frame, p. 102.
8. Arthur J. Larsen, The Development of the Minnesota Road System (St. Paul: Minnesota Historical Society, 1966), pp. 287-329.
9. Larsen, pp. 266-286.
10. Proceedings of the Houston County Board of Commissioners, November 21, 1900, unpublished, Houston County Courthouse.
11. Proceedings of the Supervisors of Carimona Township, Fillmore County, March 8, 1882, unpublished, Carimona Town Hall. Research was also conducted in the records of Chester Township (formerly Bear Valley Township) in Chester Town Hall, Wabasha County. Township officials were unable to locate pre-1920 records for Black Hammer Township in Houston County. Chester, Carimona, and Black Hammer townships have, respectively, six, five, and two masonry-arch bridges.
12. A total of 56 bridges were included in the field survey sample of this study (see Section G of this report). Eleven, however, were not considered masonry-arch highway bridges for the following reasons: one is a reinforced-concrete arch with stone facing (5368, Mower County); two are railroad bridges (L8564, Brown County; L1394, Winona County); four are corrugated-metal (i.e., "Multi Plate") arches with stone facing (L4796, 88883, Fillmore County; L2080, Lincoln County; 94069, Renville County); five are either completely buried below grade or so extensively altered by concrete additions that no masonry arch *is* visible (4128, 92815, Blue Earth County; 88547, 92277AB; St. Louis County; 2000, Washington County).

13. Hess and Frame, p. 35.
14. Hess and Frame, pp. 46-47. A student of eighteenth-century, English, country, stone-arch bridges notes the same kind of construction technique: "The arches were almost invariably built of local shistose stone . . . with very irregular edges and surfaces. The most regular of these stones were chosen to make the faces of the arch on the elevations and others, often thinner, were used to make up the rest of the arch. For some, and possible a majority, of the arches, it is likely that the arch stones were first placed on the centring standing on their ends, with little or no mortar Mortar was then poured or packed into the irregular voids between the stones"; Ted Ruddock, Arch Bridges and Their Builders, 1735-1835 (Cambridge, England: Cambridge University Press, 1979), p. 22.
15. George A. Thiel and Carl E. Dutton, The Architectural, Structural and Monumental Stones of Minnesota (Minneapolis: University of Minnesota Press, Minnesota Geological Survey Bulletin 25, 1935), pp. 134-135, 151-153.
16. Hans Nelson Brue, "The Development of Highway Bridges in Wisconsin," unpublished civil engineering thesis, University of Wisconsin, 1916, p. 6; these bridges are no longer extant; see Hess and Frame, p. 21.
17. Clayton B. Fraser, "Historic American Engineering Record Lower Plymouth Rock Bridge," HAER No. 1A-18, unpublished, 1986, pp. 5-9, HABS/HAER Division, National Park Service. It is not known whether these Winneshiek County stone arches survive.
18. Apart from date stones found on four bridges (L3040, Scott County; L90990, Meeker County; L1408, L1409, Winona County), MNDOT files are almost the sole source of construction dates for the state's country, masonry-arch bridges. Unfortunately, these records rarely provide substantiating evidence. In the case of two Houston County bridges, we have identified construction dates from county board proceedings, as shown in parentheses: L3972 (1909), L4013 (1915). MNDOT dates for these structures are, respectively, 1900 and 1903. Although the sample is too small to provide a meaningful basis for evaluation, the discrepancies do raise questions about the accuracy of MNDOT records. We have, therefore, preceded all MNDOT construction dates with a cautionary "C.," unless there is corroborating information.
19. Hess and Frame, pp. 91-96.
20. Larsen, pp. 360-371.
21. Omar H. Case, "County Bridges and Their Construction," Proceedings of the Minnesota Surveyors' and Engineers' Society at Its Premier Annual Convention...1896" (n. pub., n.d.), pp. 73-74. Born in Pittsfield, Massachusetts in 1842, Case attended "the public and high schools of his native town, and after finishing a two-year course in surveying and engineering," he settled in Chatfield, Minnesota where he embarked on "a general surveying and engineering business." During the 1880s, he was "in the employ of several railways, principally the Northern Pacific, as resident engineer"; see "Biographical Sketch, Omar H. Case, C.E.," Proceedings of the Minnesota Surveyors' and Engineers'

Society at Its Fourth, Fifth and Sixth Annual Conventions (n. pub., n.d.), pp. 61-62. In this same volume of the Proceedings, Case placed an advertisement offering his services for preparing "Plans and Specifications for Steel Highway Bridges, Stone Arch Bridges, Sewers, and General Engineering."

Apparently, Good-Roads advocates in others parts of southeastern Minnesota also were aware of the virtues of stone-arch bridges. In 1903, the Good Roads Association of Houston County urged the County Board of Commissioners to discourage the construction of wood bridges by making bridge appropriations only to "those towns that shall erect and maintain bridges therein of iron or steel with stone piers and abutments, or stone arch bridges"; see "Proceedings of the Houston County Board of Commissioners," July 13, 1903, unpublished, Houston County Courthouse.

22. "[July 10, 1899,] Appropriated to the Town of Holt [for] Stone Arch Bridge \$35"; "[July 8, 1901] Township of Preston \$100 to be used for a stone arched bridge"; "[July 14, 1902] \$50 Preston, to assist in the construction of a stone arch bridge"; "Proceedings of the Fillmore County Board of Commissioners," unpublished, Fillmore County Courthouse. None of these bridges survives.
23. Author's interview with James Pickett, Fountain Township Clerk, February 8, 1988.
24. "Proceedings of Annual Town Meeting of Carimona Township," March 12, 1901, in an unpublished volume containing the proceedings of Town Meetings and Township Board of Supervisors Meetings, 1899-1904, in Carimona Town Hall. The same volume records that on August 28, 1901, the town board contracted with E. Kallbaugh to build the first "stone culvert or bridge in Section 9 for \$60." This structure is no longer extant.
25. Robert M. Frame III, "Historic Bridge Project, A Report," unpublished, 1985, pp. 21-22, in State Historic Preservation Office, Minnesota Historical Society.
26. Hess and Frame, pp. 100-101.
27. State Highway Commission of Minnesota, Rules and Regulations of the State Highway Commission of Minnesota, 1907 (n. pub., Bulletin No. 2, 1907), n.p. Technically, the agency's engineers defined "all openings under 50 square feet of cross section, or 10 foot span as culverts"; see Report of the State Highway Commission of Minnesota for 1912-1913 (n. pub., n.d.), p. 9. In general usage, however, the terms "culvert" and "bridge" were often applied indiscriminately to small-span structures. MNDOT still observes the 10-foot limit and now is quite precise in applying it.
28. Second Annual Report of the State Highway Commission of Minnesota, December 31, 1908 (Minneapolis: Pedersen Linotyping Co. Print, n.d.), pp. 10, 17, 32, 52, 53; Report of the State Highway Commission of Minnesota for 1909 and 1910 (n. pub., n.d.), p. 21.
29. Entry for Bridge #400, Bridge Log, Minnesota State Highway Commission Papers, Minnesota Historical Society. See also entry for Bridge 241, Rice County, July 15, 1911: "[Field engineer] C. A. Reed in office and requested permission to change one end of culvert to rock construction as rock is on ground. Permission given."

30. Although the state's highway law was frequently amended, the commission's basic responsibilities remained essentially the same; see Chapter 33, General Laws of 1911; Chapter 235, Session Laws of 1913, as Amended by 1915 Session; Chapters 52, 75, 119, and 259, Session Laws of 1917.
31. Report of the State Highway Commission of Minnesota for 1914 (n. pub., 1915), p. 222.
32. "Proceedings of Houston County Board of Commissioners," January 6, 1915, unpublished, Houston County Courthouse. In his annual report for 1915, Rasmussen noted that he enjoyed cordial relations with county officials: "The county board . . . favor[s] state supervision and the engineer has been asked to give his advice on all road questions that have come before the Board and to make such changes as are necessary. . . ."; Rasmussen, "Houston County," Report of the State Highway Commission, 1914, p. 98. In June 1915, the county board appointed Rasmussen to serve as its own salaried "County Road and Bridge Engineer." His appointment was renewed the next year; see "Proceedings," June 22, 1915; March 29, 1916.
33. Hess and Frame, p. 75.
34. Annual Report of the City Engineer of the City of Minneapolis (Minneapolis: Reywood Manufacturing Co., 1908), pp. 77-78.
35. Minneapolis Tribune, September 24, 1871.
36. "Annual Report of City Engineer," Proceedings of the City of Minneapolis from April 9 1878 to April 8, 1879 (no pub, 1879), p. 101. Originally 40 feet wide, the bridge consisted of a central 60-foot span flanked by paired spans of 57 feet and 54 feet. The structure was widened by steel-beam-on-steel-bracket additions in 1895; see "Widening a Stone-Arch Bridge," Engineering Record, 32 (November 23, 1895), 454. It was demolished about 1970.
37. Minneapolis Tribune, August 22, 1886.
38. Annual Report of the Board of Public Works of the City of St. Paul for the Year 1885 (St. Paul: D. Ramaley and Son, Globe Job Office, 1886), Table N; Annual Report of the City Engineer of the City of St. Paul for the Year Ending December 31, 1901 (St. Paul: Pioneer Press Company, 1902), Table 34. The city also built a masonry-arch bridge in Como Park in 1894; this structure is discussed under the category of "Park Bridges."
39. "The Colorado Street (St. Paul) Skew Arch Bridge," Engineering and Building Record, 20 (November 23, 1889), 365-366; Annual Report of the City Engineer of the City of Saint Paul, 1888 (St. Paul: Globe Job Office, D. Ramaley & Son, Printers, 1889), p. 34.
40. The construction of the East Seventh Street Bridge is discussed in W. A. Truesdell, "The Seventh Street Improvement Arches," Association of Engineering Societies Journal, 5 (July 1886), 317-324; "The Arches of the Seventh Street Improvement, St. Paul, Minn.," Engineering News and American Contract Journal, 14 (October 17, 1885), 245. For biographical information on Truesdell, see his obituary in Association of Engineering Societies Journal, (1909), 369-371.

41. The standard railroad stone-arch design is discussed in Hess and Frame, p. 22. Both railroad bridges in the field survey sample conform to this basic plan (L8564, Brown County; L1394, Winona County).
42. Truesdell, "The Seventh Street Improvement Arches," 318.
43. Eighth Annual Report of the Board of Public Works, City of Duluth, 1893 (Duluth: J. J. Le Tourneau and Company, 1895), pp. 25-26.
44. Henry G. Tyrrell, "American Park Bridges," American Architect (March 1901), 100-101.
45. Biennial Report of the Commissioner of Highways of Minnesota for 1935-1936 (Minneapolis: Syndicate Printing Co., 1937), pp. 28-31; Harold E. Olson, "Roadside Development Along the Trunk Highways of Minnesota," Minnesota Highways, 23 (April 1938), 10-11; Works Progress Administration of Minnesota, WPA Accomplishments; Minnesota 1935-1939 (St. Paul: Works Progress Administration, 1939), n.p., see section on "Physical Accomplishments."
46. A History of Pipestone County (Pipestone: Pipestone County Historical Society, 1984), n.p., see section on "Split Rock Creek State Park."

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