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A SURVEY AND PHOTOGRAPHIC INVENTORY OF CONCRETE AND MASONRY ARCH BRIDGES IN VIRGINIA

by

Paula A. C. Spero
Research Engineer

(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

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PREFACE

In 1974 the Research Council initiated a statewide survey of metal truss bridges to identify any with historic significance. This pioneering effort was financed with state research funds, as it was intended to aid the Virginia Department of Highways and Transportation in meeting its obligations mandated by various requirements of the environmental review process. Reports on the surveys of the Department's eight construction districts have been published.

As the work in Virginia proceeded, interest in the historic significance of bridges developed nationwide and warranted funding of the research under Highway Planning and Research funds administered by the Federal Highway Administration. A working plan for the development of criteria for the preservation or adaptive use of bridges was approved, and this work included surveys of metal truss bridges in the Lynchburg and Bristol districts and a statewide survey of concrete and masonry bridges.

An interim report entitled "Criteria For Preservation and Adaptive Use of Historic Highway Structures -- A Trial Rating System for Truss Bridges" was issued in January 1978.

This present report presents the results of the statewide survey of concrete and masonry bridges in Virginia completed by the author in 1981. The issuance of this report has been delayed because of the resignation of the author.

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The survey and photographic inventory of Virginia's arch bridges completes the bridge portion of the Research Council's investigation of the history and development of road and bridge building technology in Virginia. The purpose of the photographic inventory has been to record the remaining pre-1932 metal truss, stone, and concrete bridges in Virginia, with an attempt to relate them to broad developments in bridge design and technology in the nineteenth and early twentieth centuries.

From the information assembled in the survey, guidelines have been established for evaluating the historical and technological significance of the extant metal truss, stone, and concrete arch bridges in Virginia. These guidelines will be used for the development and implementation of a conservation plan for those structures found to have historic significance. It is hoped that in this way the state will satisfy both the engineering demands for safety and the aesthetic need to preserve engineering heritage.

Virginia's bridge surveys have focused on bridges built prior to 1932 primarily because of the way responsibility for bridge building developed in Virginia. Until 1932, each county was responsible for the construction and maintenance of its road system. Although the formulation of some recommended standards and specifications in bridge construction came with the establishment of the Virginia State Highway Commission in 1906, the counties remained generally autonomous in their decision making. The regional diversity in bridge types created by this system has been recorded in the surveys. In 1932, when the Virginia Department of Highways was created, both the primary and secondary road systems came under its direction and the tendency to statewide standardization began.

CLASSIFICATION OF ARCH BRIDGES

The portion of the bridge study represented by this report examined the oldest remaining bridge type in Virginia, the arch. There are numerous methods of classifying arch bridges. First, by their behavior

under load they are distinguished from modern types which appear to be arches but, indeed, are curved beams. The arch, when loaded, develops lateral thrust, i.e., a pushing out at the supports, and is supported by piers or abutments which are capable of sustaining lateral thrusts.

By construction materials, arches can be classified as timber, brick and stone masonry, cast iron, wrought iron, steel, plain concrete, and reinforced concrete types.

With respect to the method by which the dead load of the structure is carried, arches can be classified as --

1. filled spandrel arches,

2. closed spandrel arches,

3. open spandrel arches, and

4. through arches.

The filled spandrel arch consists of a barrel arch which carries filling material and terminates in closed longitudinal walls that act as retaining walls for the fill. Both closed and open spandrel arch types carry the roadway loads to the arch ribs and contain no fill. The former type carry the deck loads by spandrel walls resting on the arch ribs, while the latter type carry the roadway loads to the arch ribs by spandrel columns. Through arches consist of ribs which extend above the roadway and carry the deck loads by vertical hangers.

Arch bridges can also be classified by the curve of the arch. There are semicircular arches, segmental arches, multicentered arches, parabolic arches, elliptical arches, and other curves. Where the arches spring from a horizontal plane, no matter what the curve, the type is termed full-centered.

Finally, with reference to the method of stress distribution in the arch rings, arches can be classified as fixed or hingeless, single-hinged, two-hinged, or three-hinged.

The method of classification chosen for categorizing the inventoried Virginia arch bridges is by materials and dead load. There are two broad categories for materials: stone and brick masonry and concrete. The concrete arches are classified as filled spandrel, closed spandrel, open spandrel, and through arch.

The numerical breakdown of types in Virginia, both stone and concrete, seems to correspond with the general historical building trends in the United States.

EVOLUTION OR ARCH BRIDGES IN THE UNITED STATES

Early stone masonry structures of any sort seem to be poorly represented in America. Technological historian Carl Condit says:

> Arch bridges of stone were extremely rare in the colonies, and reliable records are nonexistent. There is scarcely any evidence for the construction of stone bridges in the seventeenth century, and there is little to suggest the exact form of those built in the eighteenth. (1)

There are only scant representatives for this era. Documentation for larger structures validates the idea that "there was a steady progress in the art during the late colonial period.... Construction in stone masonry continued to flourish in the first half of the nineteenth century, but thereafter its role was progressively superseded by iron and concrete."(1)

Most early stone bridges appear to be constructed of rubble masonry. Condit cites the 1829 Baltimore and Ohio Railroad's Carrollton Viaduct in Baltimore as the first stone bridge in the United States of highly dressed stone and uniform mortar joints. This was followed by the 1835 Thomas Viaduct in Relay, Maryland.(1) These are both large-scale, well-engineered structures of high quality which are singled out as early, exceptional examples. Most stone bridges built after 1900 are probably stone-faced concrete or steel,(1) although railroad companies continued to use solid masonry types beyond that date.

J. A. L. Waddell validates Condit's conclusion by this comment in his 1917 Bridge Engineering: "Stone arch bridges have played a very small part in bridge evolution in America."(2) He added, "but stone and brick were for many years the principal materials for substructure,"(2) which also concurs with the results of the Research Council's survey of metal truss and arch bridges. Although there were relatively very few masonry arch bridges, many masonry piers and abutments remain throughout the state.

The transition in bridge-building materials from wood to iron, alone and in composite use, to steel has been discussed in reports on metal truss bridges in this series.(3) The development of concrete as a primary construction material in the United States was roughly simultaneous with that of steel. By 1900 zealous proponents of both materials were developing patents and selling their bridge types throughout the states. Concrete became the predominant form for highway bridges and short railroad spans early in the twentieth century, but the competition between it and steel is a tradition which continues today.

In 1899 an article in an engineering technical journal by Edwin Thacher, who had iron as well as concrete bridge patents, typified the pro-concrete sentiment. He said of concrete-steel bridges:

> ...they are more beautiful and graceful in design, architectural ornamentaion can be applied as sparingly or as lavishly as desired; they have vastly greater durability, and generally greater ultimate economy; they are comparatively free from vibration and noise; they are proof against tornadoes, high water or fire; the cost of maintenance is confined to the pavements, and is no greater than for any other part of the street; home labor is employed in building it, and the greater part of the money that it costs is left among the people who pay for it, and its cost as a rule does not much, if any, exceed that of a steel bridge carrying a pavement.(4)

Concrete also lent itself to a structurally preferable arch shape, which allowed for much longer spans than masonry arches. Arch bridges of stone construction were generally of the semicircular or full-centered variety. Stone bridges of low rise-span ratio were extremely rare, but concrete arches were often formed as shallow arches.

Bridge construction in concrete appeared first with plain concrete structures -- e.g., the 1871 Prospect Park Bridge in Brooklyn, New York -- but quickly progressed to the composite use of concrete and steel. The addition of iron reinforcement to masonry structures had been used in isolated cases for centuries, as the nature of masonry as a compressive material was appreciated by ancient engineers. The interaction of the two materials remained to be studied by late nineteenth or early twentieth century engineers. The incipient theoretical understanding of metal reinforcement embedded in the new plastic masonry -- concrete -- seems to have been realized simultaneously in Europe and the United States. However, French and German engineers first applied the principles of steel reinforcement for tensile stresses in concrete arches in the 1880s. A serious obstacle to the use of concrete arches was the unknown character of their behavior under live loads. From 1890-95 the Austrian Society of Engineers and Architects conducted extensive experiments on full-size concrete arches and the results were published in engineering journals throughout Europe and America. Thus, the use of reinforced concrete escalated.

The first reinforced concrete arch in the United States was designed by Ernest L. Ransome and built in 1889 in Golden Gate Park, San Francisco. It was scored and roughened to imitate stone but was reinforced with rods or bars, probably of the twisted type patented by Ransome in 1884. Bar reinforcement became the predominant type in the early twentieth century, and is the type of reinforcement encountered today. However, Austrian engineer Joseph Melan's 1894 American patent for arched I-beam reinforcement introduced that type into the United

States, and it was the predominant type to the end of the century. Melan's design was modified and patented by Austrian engineer Fritz von Emperger, a member of the Austrian Society of Engineers and Architects.(4) Emperger built numerous beam-reinforced arch bridges throughout the states,(1) beginning in 1897.

Waddell concurred with this chronology in his 1917 Bridge Engineering:

> The first application of reinforced concrete to bridge construction was in the early nineties. Within the next few years a large number of such structures were built, largely of the Melan arch type, von Emperger and Thacher being pioneers in this work.(2)

It was soon realized that the amount of steel used in these beam-reinforced arches was a highly inefficient use of materials. The steel reinforcement was necessary in areas of tensile stresses and bar reinforcement was understood to be adequate as it could be bent and placed in regions of high tensile stresses. Numerous variations in shapes, deformations, and bending schemes were developed and patented. The list of these patents is at least as long as that of the truss patents described in the relevant previous reports.

Not only did the concrete arch reinforcement follow a progression of shapes and types, but the arch form itself changed with the decades. By the end of the nineteenth century there was a well-established form of concrete culvert,(1) shaped as the traditional masonry barrel.

The division of the barrel into ribs is not generally mentioned in historical texts until the first decade of the twentieth century. However, this development is documented by Condit to 1898 and attributed to Pennsylvania Public Roads Department Engineer F. W. Patterson for his small-span, two-ribbed highway bridges in Alleghany County, Pennsylvania.(1) Patterson used the predominant curved I-beam reinforcement of the time. As early as 1896, a patent by Edwin Thacher used the elements of an open spandrel arch in a bridge design which carried the deck loads to the arch rib by vertical posts. By 1905, the construction of arch bridges in separate ribs was established, in 1906 the Philadelphia Walnut Lane open spandrel arch was built, and in 1911 Tyrell recommended open spandrels with projecting sidewalks in preference to solid spandrel filled arches.(5) A 1928 text on concrete design suggested open spandrel arches where the ratio of rise to span was large, and the spans were greater than 100 ft. (30.5 m.).(6)

Despite the early, apparently isolated, development in Pennsylvania, concrete arch bridge construction in America was conservative up to the first decade of the twentieth century. The material itself

was not trusted and often was acceptable aesthetically only when treated to imitate stone or even covered with a stone veneer. Concerning concrete-steel bridge construction, the previously cited well-known nineteenth century bridge engineer, Edwin Thacher, wrote in 1899:

> Public confidence in concrete, and concrete-steel construction, is gaining rapidly in this country, and in Europe, where there is plenty of precedent, and where the people have been more thoroughly educated up to it, there has been no lack of confidence in it for some years. These engineers, who have used it the most, and investigated it most thoroughly, are its greatest admirers. We hear nothing now from intelligent men about mud bridges....(4)

Engineering seems to be a historically conservative profession, and the widespread use of this new material, concrete, underwent an evolution typical of the introduction of the other major building materials. Even Thacher's wholehearted acceptance of the material focused on the form and not the potential structural advantages, as he stressed its advantages did not lie in the direction of diminished sections. Both the early structural and aesthetic treatments of concrete were governed by the forms of stone masonry bridges. Concrete arch bridges whose appearance was deemed important had voussoirs of molded concrete blocks and bush-hammered or otherwise rusticated exposed surfaces.(5)

Thacher's claims may have been somewhat premature, but certainly by 1910 the general American mistrust of the material was gone. Massive designs were giving way to flatter, multicentered arches with narrow ribs. The solid ribs then lightened into pierced walls. These open spandrel arches were tied to the bridge deck by progressively thinner spandrel posts and supported by less massive piers.

At the same time, another form of reinforced arch rib developed in the United States as a through arch. The two arch ribs of this type rise from piers and carry the deck on vertical members suspended from their crowns. They are sometimes referred to as "Rainbow Arches," sometimes as "Marsh Arches," after a German born engineer named Marsh, of Marsh Engineering Company of Des Moines, Iowa. Marsh patented his through arch and built it between 1912 and 1930.(7) The through arch, with its ribs extending above the roadway, can take two forms. The arched ribs can be rigidly fixed at the piers or abutments, or each arch rib may be connected with a tie and rest on the supports. The latter, a bow-string form, was used when conditions were not favorable for the arch thrust to be absorbed by the supports. The tie resisted all the thrust and looked much like the bottom chord of a truss.

Concrete, although scientifically understood in some degree of sophistication in the 1890s, began to be used generally in a more structurally efficient manner in the United States after the first decade of the twentieth century. In 1903-04 the American Society of Civil Engineers formed its Joint Committee on Concrete and Reinforced Concrete in an attempt to standardize concrete design. In 1909, they published their first report. The American Concrete Institute (ACI) was working to formulate standards at about the same time. In 1916, the Committee on Reinforced Concrete Highway Bridges and Culverts issued its report, which was adopted by the ACI. Highway bridges were classified by them and appropriate loads for design were recommended. According to bridge engineer-historian Tyrell, between 1894 and 1904 about 100 concrete bridges had been built in the United States in spans up to 125 ft. (38.1 m.), and in 1917 Waddell claimed that "for city bridges of short span its use is becoming almost universal," with other wide applications noted.

American engineers, however, never used the concrete arch as imaginatively or daringly as their European counterparts. In fact, massive, overdesigned barrels and arch ribs continued to be built into the 1930s, as they were frequently considered more attractive by some designers.

This background discourse has shown that the arch form, in general, went through a progressive evolution from the solid, earth-filled masonry barrel to the lighter, separate arch ribs which carry the bridge deck by posts, girders, and slabs. The concrete and stone masonry arch bridges surveyed throughout Virginia illustrate this general evolution and represent a variety of types.

ARCH BRIDGES IN VIRGINIA

The most remarkable arch bridge in Virginia is the Natural Bridge, a 90 ft. (27.4 m.) long rock arch carved by Cedar Creek aeons ago. It has probably carried traffic of some sort for centuries. At present, two-laned Rte. 11 spans the river and gorge on Natural Bridge, which is listed as structure number 8,443, in the computer printout of all Virginia bridges in the Virginia Department of Highways and Transportation inventory. To the author's knowledge, it is the only natural bridge in the United States that carries vehicular traffic on a U. S. numbered route.

The form of Virginia's arch bridges ranges from this noteworthy natural phenomenon to various stone and concrete arches and one brick arch. There are only 30 remaining stone masonry bridges on Virginia's state routes. These include highway bridges and railroad underpasses, as do the concrete bridges surveyed in this study. The concrete arch bridges represent the predominant historical types and total 136 in number.

Masonry Arches

Very few stone masonry bridges remain in Virginia. Included in the Research Council's survey were 30 stone bridges built prior to 1932. These are either presently in use as highway bridges or they were previously used and then abandoned by modern upgrading of the old roads on which they stood.

Virginia's existing stone bridges appear to date to the nineteenth century, with the exception, of course, of the Natural Bridge. An examination of 28 of the remaining 30 stone bridges shows that they can be broadly divided into two reliably identified types:

1) Stream crossings of rubble masonry, generally built in the early nineteenth century by Virginia turnpike companies, and

2) railroad underpasses of dressed masonry, generally built in the late nineteenth century by Virginia railroads.

Turnpike Bridges

There are 12 stone bridges which appear to be early nineteenth century turnpike bridges. The most noteworthy representatives are found in the Culpeper Construction District on the Ashby's Gap Turnpike and the Snicker's Gap Turnpike. A preliminary study and report on the Ashby's Gap Turnpike by Shaver and Newlon documented 14 stone bridges on the original turnpike road.(8,9) Four of these stone bridges are extant.

The Ashby's Gap Turnpike was created by an act of the General Assembly of Virginia on January 30, 1810. The present Rte. 50, west of Aldie, approximately follows the Ashby's Gap Turnpike, which was established to provide a good road from the Little River Turnpike road through Ashby's Gap to the Shenandoah River. The bridges on the Ashby's Gap Turnpike were in service prior to 1824, when they were described in

a report to the Virginia Board of Public Works, cited in Newlon's report:

> At little river is a stone bridge built at the joint expense of the Company and the Littleriver Company -- at Cromwile run there is a stone bridge of some size -- at Rocky branch a large Stone Bridge, at Goose Creek a very large stone bridge of four arches which with the paving and improving of three fourths of a mile of road adjacent to it, cost nearly $17,000 -- At Plum run is a Stone bridge of some size and there are many other Stone Bridges over smaller streams on the route....(10)

From the 1844 annual report of the Board of Public Works, it is certain that there were at least 14 bridges on the Ashby's Gap Turnpike:

> Our road is in travelling order. We have repaired nine stone bridges, and there are five more that want dressing up next summer....(11)

Three extant Ashby's Gap Turnpike bridges are illustrated in Figures 1-3. Figure 1, a two-span arch, with a slight camelback profile, is still in use as a vehicular bridge. It is located in a historic district at Aldie. Figure 2 shows the four-span Goose Creek bridge, no longer in service but maintained by private organizations. Figure 3 illustrates a heavily buttressed, single-span-arch which is now adjacent to Rte. 50. It is partially covered by fill.

These bridges, though of a grander scale than most turnpike bridges surveyed in Virginia, are typical of the general building style. All turnpike bridges in this study were constructed of rubble, laid at random, with voussoirs of roughly cut and roughly finished stone.

The Ashby's Gap and Snicker's Gap Turnpike bridges are distinguished by their conical piers and buttresses. Figure 4 shows the Snicker's Gap Turnpike bridge, probably built under contract to the same mason responsible for the Ashby's Gap bridges. The Snicker's Gap Turnpike was chartered by an act of the General Assembly on January 29, 1810. The Snicker's Gap Turnpike Company described the route of their completed road in a report to the Board of Public Works in 1830:

> Commences at or near the termination of the Little River Turnpike road, about thirty-four miles from Alexandria, and passes (nearly in a north-western direction) through Snicker's Gap to Snicker's ferry, in a direction for Winchester, Cumberland, and the western states; and is intended to form a link of the great national road at or near Cumberland.(12)

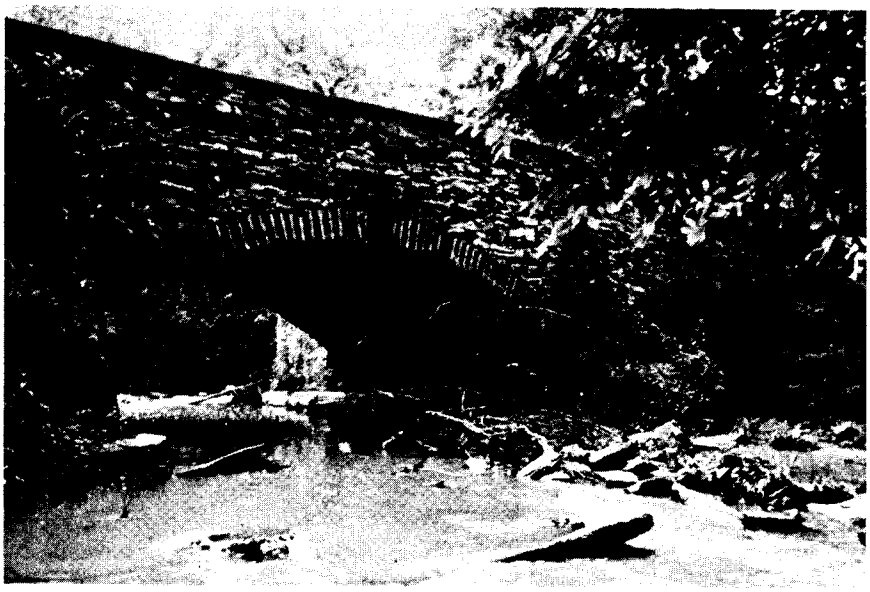


Figure 1. Two-span masonry arch bridge in Aldie crossed the Little River on the nineteenth century Ashby's Gap Turnpike. This Loudoun County bridge is still in service and is located within the Aldie Historic District.

Figure 2. Four-span masonry arch bridge carried the Ashby's Gap Turnpike over Goose Creek. Also located in Loudoun County, this bridge is listed on the National Register of Historic Places. It is no longer in service for vehicular traffic.

Figure 3. Single-span arch bridge on the Ashby's Gap Turnpike is now partially covered by fill on present Virginia Rte. 50.

Figure 4. Two-span stone arch bridge on the nineteenth century Snicker's Gap Turnpike corresponds to the construction types in Figures 2 and 3, and could have been built by the same mason.

This route is further clarified by their description of tollgate locations:

> ...One tollgate at Aldie, the place of intersection with the Ashby's Gap Turnpike road... another tollgate at Mountville, the lower end of the second section; and another tollgate on the Blue Ridge, about three miles from the termination of our road, at the Shenandoah river.(12)

This description corresponds to the present Rte. 734, which passes through Mountville and Snicker's Gap, and intersects the Ashby's Gap Turnpike on a modern upgrading about one-half mile (0.8 km.) west of Aldie. Originally, the intersection of the two turnpikes was in Aldie.

The report describes 3 large stone culverts and 2 major bridges, 1 at Goose Creek and 1 at Beaverdam. The bridge at Goose Creek was "a handsome and substantial wooden bridge in one span of one hundred feet, forming one entire arch at its framing, and resting on stone abutments at each side of the stream. The bridge is weather-boarded with plank, and covered with cypress shingles." It cost $2,800 and was built by Lewis Wermwag (sic).(12) At Beaverdam there was "a handsome and substantial stone arch," built at a cost of $3,500 by Ariel Glasscock.(12)

The bridge at Goose Creek no longer exists. The existing bridge across Beaverdam Creek is 124 ft. (37.8 m.) long and built in the style of the Ashby's Gap bridges. One inconsistency exists in that the Turnpike Company directors describe the Beaverdam bridge as having three arches of nearly 30 ft. (9.1 m.) each, and this bridge consists of two arches of that approximate size. The author is satisfied to call this bridge a Snicker's Gap Turnpike bridge despite this apparent descriptive inconsistency; the bridge could finally have been built of two arches without the directors having noted the change.

Two small-span masonry arch bridges located in the Culpeper District are illustrated in Figures 5 and 6. They appear to be turnpike bridges, or "large stone culverts." The one in Figure 5 is possibly on the north Loudoun Turnpike and that in Figure 6 could be located on a leg off the Manassas Gap Turnpike or the Middleburg-Plains Station Turnpike.

A larger, two-span stone masonry arch carried the Warrenton Turnpike across Bull Run. It was originally built in 1824, destroyed during the Civil War, and rebuilt in 1884. It is now maintained in Bull Run Park as a pedestrian bridge and stands within a stone's throw of present Rte. 29. Also in the Culpeper District is a small, brick-lined arch on the Georgetown Pike, dated 1893 by its builder, "J. S.," both carved on the keystone.

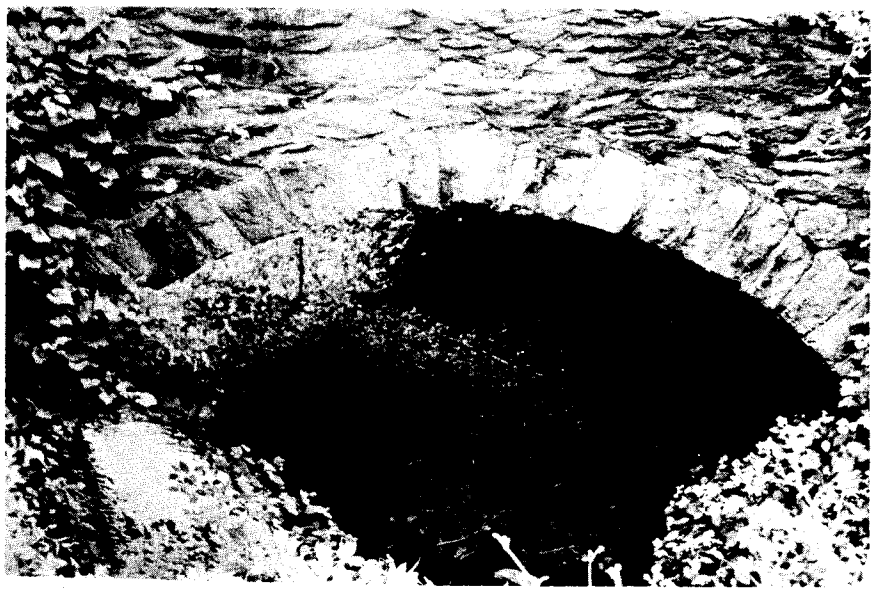


Figure 5. Single-span stone masonry arch bridge located in Loudoun County.

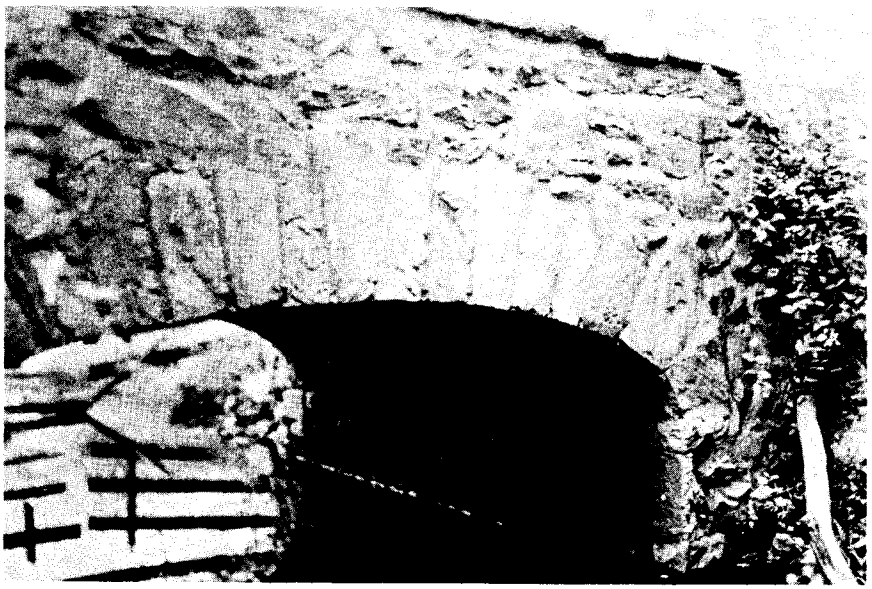


Figure 6. Single-span stone masonry bridge, also located in Loudoun County, is similar to that in Figure 5. These may be small-span nineteenth century turnpike bridges, termed "large stone culverts" in the Public Works records.

To the west, in the Staunton District, are 2 small-span masonry arches like those of Figures 5 and 6. They may be bridges which carried the Huntersville-Warm Springs Turnpike, or they may date to a later period.

Located in the Richmond District, south of Richmond, is the Falling Creek bridge illustrated in Figure 7. This two-span stone masonry arch carried the Manchester and Petersburg Turnpike over Falling Creek. Although the Manchester and Petersburg Turnpike Company was initiated in 1815, construction was delayed and this bridge was not completed until 1823.(13) It was considered by the turnpike directors to be "in this part of the world a structure of some elegance."(13) Today, the abandoned Falling Creek bridge provides a wayside for travellers on U. S. Rte. 1.

Research on a local level may provide more insight into these turnpike bridges and possibly others which were abandoned and were located in remote areas, away from present primary or secondary routes and not within the scope of this survey.

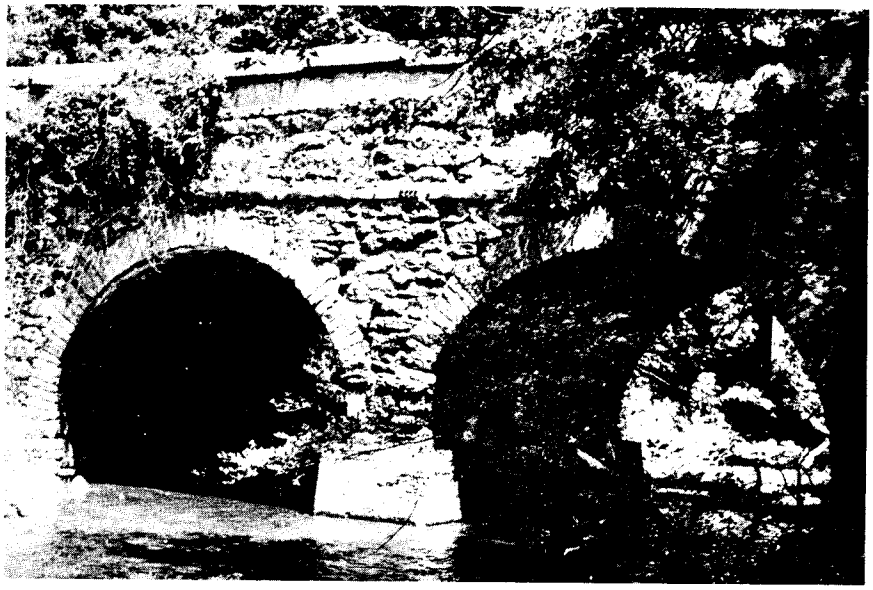


Figure 7. The Falling Creek bridge, located south of Richmond on the Manchester and Petersburg Turnpike, was constructed in 1823. It was abandoned when U. S. Rte. 1 was upgraded, and serves today as a wayside for travellers on Rte. 1.

Railroad Bridges

There are 16 masonry railroad arch bridges which carry highway traffic over or under railroad lines and which were built prior to 1932. Many, if not all, of these are owned by the railroad but they have been included because of their direct association with roadways. In contrast with the earlier turnpike bridges, the high quality of construction in the railroad bridges strikes one immediately. They are constructed of dressed masonry with uniform joints and articulated springings.

Fifteen of these railroad arch bridges were built of stone and 1 was built of brick. They were built by various railroads; 10 are now owned by the N & W Railway; 4 were built by the C &O Railway; and 1 was owned by the W & OD Railroad. The brick arch overpass spans the abandoned Lorton & Occoquan Railroad.

The history of the N & W Railway is the history of a series of predecessor companies. In a comprehensive study of the N & W Railway, Joseph T. Lambie traced N & W roots back to an 1837 9-mile (14.4 km.) long railroad in tidewater Virginia.(14) As the railroad industry developed, rapid growth and construction occurred. Three main roots are distinguished in the evolution of the N & W Railway: the Southside Railroad Company (from Petersburg to Lynchburg, 1854), the Virginia and Tennessee Railroad (from Lynchburg to the Tennessee border, 1852-1856), and the Norfolk and Petersburg Railroad (from Norfolk to Petersburg, 1858).(14) In 1870, these three were merged into the Atlantic, Mississippi and Ohio Railroad, which floundered, went into receivership in 1876, and was bought and reorganized into the Norfolk and Western Railroad Company in 1881.(14)

In addition to its main branches, the N & W acquired and built other branches. Those on which Virginia survey bridges exist are the former Shenandoah Valley Railroad Company, the New River Division, the Clinch Valley Extension, and the former Southside Railroad Company.(15) Figure 8 is a map of the N & W Railway lines in 1893.

There are 2 stone N & W underpasses in the Staunton Construction District and 1 in the Salem Construction District. These are located on a route which traverses north-south from Hagerstown, Md. to Roanoke. This line began as the Shenandoah Valley Railroad Company, which was chartered in 1867.(14) In 1870, it was organized and construction was begun, with Chief Engineer Herman Haupt (General Theory of Bridge Construction, 1851), but by 1873 all construction of the railroad was stopped by that year's panic and depression. In 1878, construction was resumed and by 1881 the line was built to Basic City (Waynesboro).(14) Figure 9 shows an underpass constructed on this portion of the line. From the above account, construction of this arch was between 1870 and 1881. By 1882, the line was complete to its juncture with the N & W at Roanoke;(14) thus, the arches illustrated in Figures 10 and 11 were probably constructed in 1882. From 1882 to 1890, various financial arrangements existed between the Shenandoah Valley Railroad and the N & W, but in 1890 the N & W purchased the Shenandoah Valley Railroad.

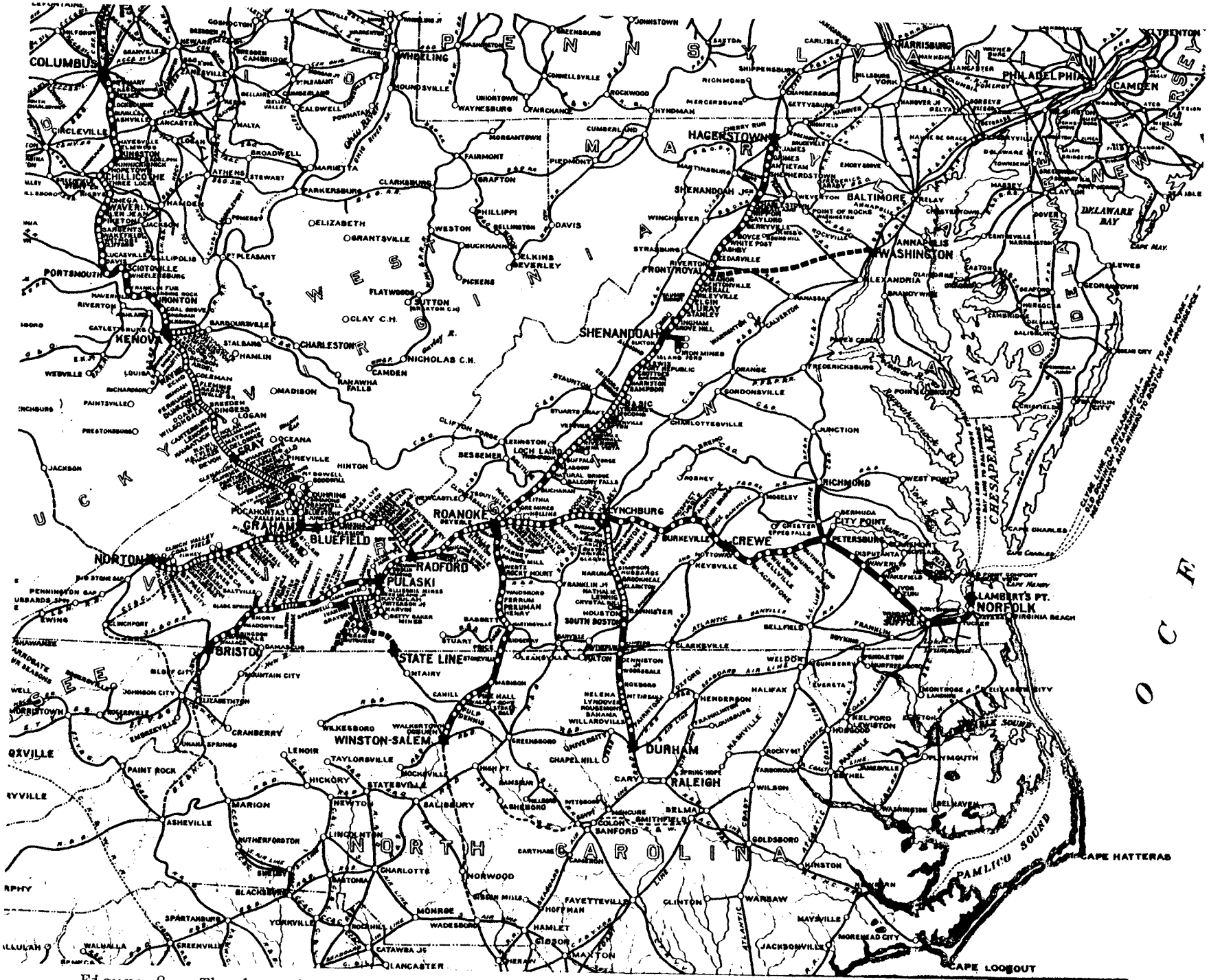


Figure 8. The branches of the Norfolk and Western Railway were illustrated in the Railroad Company's thirteenth annual report for 1893.

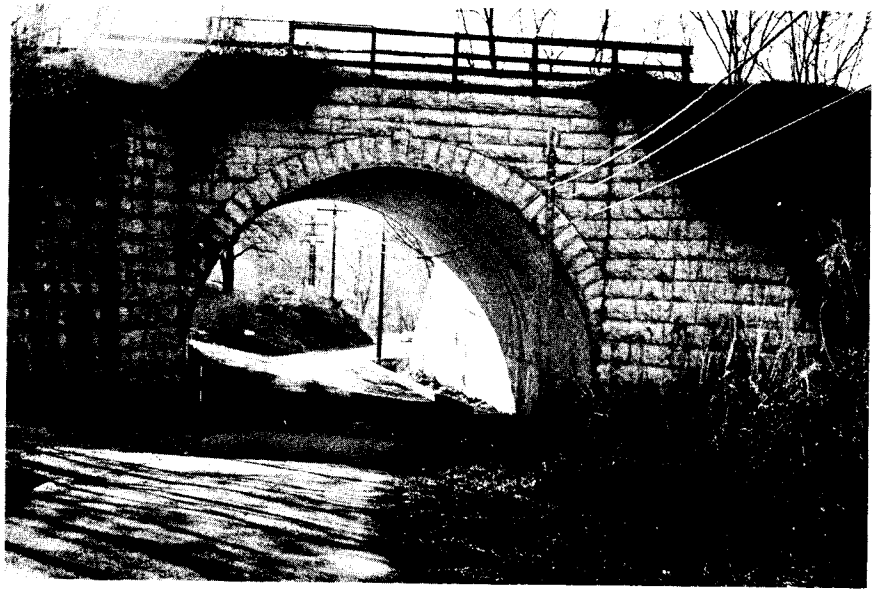


Figure 9. The stone arch railroad underpass was constructed in Page County by the Shenandoah Valley Railroad Company between 1870 and 1881. The Shenandoah Valley Railroad was purchased by the N & W Railroad Company in 1890.

Figure 10. Like the underpass in Figure 9, this stone arch was constructed by the Shenandoah Railroad Company.

Figure 11. The panic of 1873 halted construction of the Shenandoah Valley Railroad Company until 1878. This stone underpass at Buchanan was built between 1881 and 1882, during the company's second phase of construction.

On the southern end of the N & W line, the push west to the Pocahontas coal fields began in 1881. The coal found in these fields ranks at the top for efficiency in heating among U. S. coal samples. Construction was begun on the New River Division in August 1881 and the line was completed from Radford to Pocahontas in March 1883.(14) It was extended to the Ohio River between 1890 and 1893.(14)

The arch at Belspring, Pulaski County, Bristol Construction District, was built on the New River Division, probably during 1881-82, as its location is near the beginning of this line.

After construction of the New River Division, the N & W built two more branches, the Clinch River Extension and the Cripple Creek Extension. The Clinch River Extension diverged off the New River Division at Graham Station (near Bluefield) and followed the Clinch River Valley. Construction began in 1887; the line was open to Honaker at the end of 1889; and by June 1891 it was completed to its juncture with the Louisville and Nashville Railroad at Norton.(14)

The most remarkable grouping of N & W railroad underpasses was surveyed at Honaker, on the Clinch River Extension, in Russell County, Bristol Construction District. This group is illustrated in Figures 12-14. These underpasses are heavily structured but finely built. They are in remarkably good condition and are completely unmodified. These structures are built of rock-face stones in courses ranging from 15 to 24 in. (38.6 to 60.9 cm.) and with brick linings. Mason's marks were observed on all the underpasses. Stream diversion troughs run through 2 of the underpasses.

There are 2 arches which appear to be on a portion of the N & W line which was originally the Virginia and Tennessee Railroad. Lambie cites the construction of this line as 1852 to 1856;(14) thus, it was completed when the N & W acquired it. One of these arches, however, is dated 1896, and the other 1901. Figure 15 illustrates a Roman arch underpass in Smyth County. The keystone is carved with its date, 1896. It is probable that this bridge, at its major span crossing the Holston River, already existed in some form and that the 1896 arch was a modification to the original bridge. The masonry courses of arch, wing wall, and buttress appear to be inconsistent, and could indicate "accretionary growth" in this structure. Figure 16 shows an underpass, concrete on one side, with 1901 carved in the keystone on the masonry side. The concreted side was added when the line was widened.

The arch shown in Figure 17 illustrates a different type of construction. Its pristine condition and isolated location ranks it with the Honaker bridges, but it appears to be of a different era. Its location in Campbell County places it on that part of the N & W line that was originally the Southside Railroad. Its construction could, therefore, date to 1854. The style of construction, which is somewhat more primitive than that of the other railroad bridges surveyed, seems to confirm this. Inspection of Figure 17 shows an arch with smooth looking voussoirs, surfaces rough-point finished, and springings articulated by rock-faced stones with small chiseled margins. However, the remainder of the underpass, including the spandrel walls, is built completely of coursed rubble masonry.

This Lynchburg District bridge can be contrasted to Figure 18, which is representative of the 3 stone railroad underpasses in Staunton. The C & O Railroad built its line through this region in the mid-nineteenth century. Their date of construction is uncertain but it is pre-1881, when the Shenandoah Valley line was completed to Waynesboro, where it intersected the C & O Railroad. One of these bridges is illustrated in Figure 18. The masonry work is smooth finished with uniform joints throughout. The fourth C & O stone underpass is in Alleghany County and is of typical underpass construction -- i.e., it has smooth and rock-face finishing -- and it has been modified with concrete on one approach.

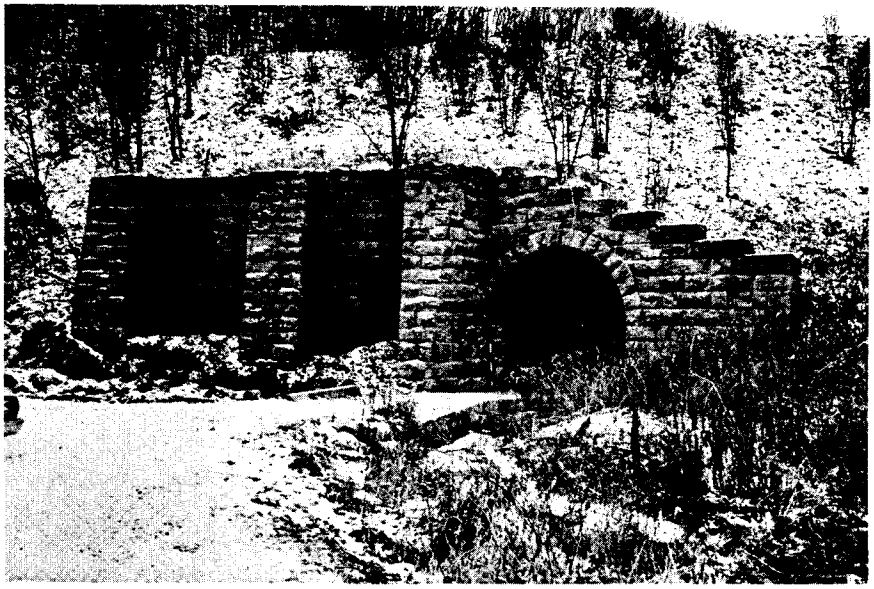


Figure 12. This asymetrical, massively buttressed railroad underpass was built at Honaker by the N & W Railroad between 1887 and 1889 on its Clinch River Extension, which tapped rich coal fields.

Figure 13. Also built at Honaker for the N & W's Clinch River line, this stone arch underpass exhibits mason's marks and is of typical late nineteenth century masonry construction.

Figure 14. Like those in Figures 12 and 13, this somewhat smaller arch forms a part of the remarkable railroad underpass grouping at Honaker.

Figure 15. This Roman arch was constructed in 1896 in Smyth County. The arch acts as an underpass for this bridge which carries the N & W Railroad across the Holston River.

Figure 16. The keystone carving of 1901 on this N & W Railroad underpass dates this arch to an era of very late solid masonry construction.

Figure 17. This large circular stone arch, located in Campbell County, was probably built by the Southside Railroad, later part of the N & W system.

Figure 18. The C & O Railroad built several stone arch underpasses in the Staunton Construction District. This bridge is located in the city of Staunton.

Probably constructed between 1858 and 1866, but attributed by the Culpeper Construction District to 1892, is the Loudoun County stone bridge over the abandoned Washington and Old Dominion Railroad Company. This was a local railroad that changed hands frequently from 1847 to its abandonment. This arch is a roughly constructed underpass of large coursed stone.

Some of the railroad underpasses surveyed originally were constructed of stone and were modified at the widening or raising of the railroad line. This type sometimes appears to be a masonry arch from one approach and a concrete arch from the other. Figure 19, an underpass on Rte. 649 in Giles County, is located on the New River Division line and was probably constructed in 1882. It shows the original stone masonry, lined with concrete, while Figure 20 shows the other side, completely encased in concrete.

Figure 19. This stone underpass was built by the N & W Railroad in Giles County. It was later widened and modified with concrete. Note the concrete lining inside the barrel.

Figure 20. The stone arch in Figure 19 is completely encased in concrete on its opposite approach. It appears to be a concrete structure from this side.

These modified stone bridges sometimes appear to be concrete arches from both approaches, but closer examination within the barrel reveals a small stone barrel in the core of the structure. Figure 21 shows this type of modified stone arch, located in Montgomery County (Salem Construction District), on the N & W branch from Radford to Christiansburg, which is shown on the 1893 N & W map. This same type of concrete modification sometimes leaves wing walls exposed.

Thirdly, these modified stone underpasses can be completely encased in concrete, undetected by nondestructive means.

The only brick arch surveyed in the state is located in Fairfax County and carries Rte. 611 over an abandoned railroad line, a short spur off the Richmond, Fredericksburg, & Petersburg (R F & P) Railroad, called the Lorton & Occoquan (L & O) Railroad. The date of its construction is unknown.

The only stone masonry arch bridge surveyed in Virginia which exists in a category apart from turnpike bridges and railroad bridges is illustrated in Figure 22. Located in Nelson County, Lynchburg Construction District, this two-span arch bridge now carries Rte. 606 over Owens Creek. Originally it carried the James River and Kanawha Canal over the creek, so it was probably constructed between 1830 and 1840. The view illustrated in Figure 22 shows the aqueduct unmodified. On the other side it has been widened significantly with concrete barrel arches to accommodate the C & O Railroad. This modification makes it unrecognizable from the James River side.

Additional information and photographs for some of these stone masonry arch bridges can be found in Tables 1-8 shown following the discussion of concrete arch bridges and on the survey information sheets in Appendix A.

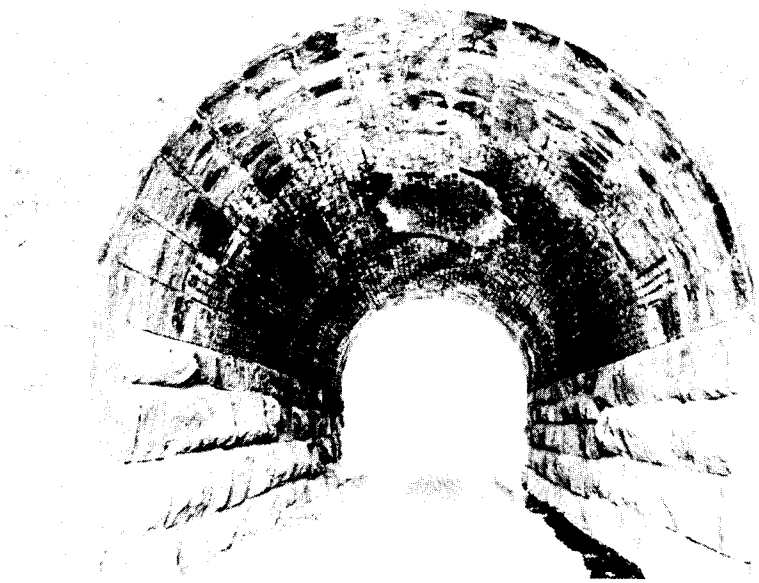


Figure 21. The original stone masonry arch portion of this N & W Railroad underpass in Montgomery County is visible between two concrete barrels which were added later to widen the bridge.

Figure 22. This two-span stone masonry bridge originally carried the James River and Kanawha Canal over Owens Creek. It is located in Nelson County and now carries Rte. 606 over the creek.

Concrete Arch Bridges in Virginia

The majority of the arch bridges surveyed in Virginia were of concrete construction. Out of a total of 166 arch bridges, 136 were concrete. These bridges have been categorized, as noted in the introduction and shown in Tables 1-8, as

1. filled spandrel arches,
2. closed spandrel arches,
3. open spandrel arches, and
4. through arches.

Seventy-four percent of the concrete arches are filled spandrel arches (101/136); 8% are closed spandrel arches (11/136), 16% are open spandrel arches (22/136); and 1+ % are through arches (2/136). The dated filled spandrel arches were built from 1904 to 1931, the earlier ones until 1911, being railroad underpasses. Of the other dated arches, the closed spandrel arches were built from 1926 to 1930, the open spandrel arches from 1913 to 1930, and the through arches in 1926 and 1927.

Tables 1B-8B categorize the arch bridges by builders. Most of the bridges are undocumented with respect to builder. Thirty-two bridges credit Daniel B. Luten on their bridge plates or plans, 30 as Luten Bridge Company, 1 as designer for Atlantic Bridge Company of Greensboro, North Carolina, and 1 as designer for the Concrete Steel Bridge Company of Clarkville, West Virginia. Two bridges were built by Roehl & Steel of Knoxville, Tennessee; 2 by Churchill Co.; 1 by W. W. Boxley & Co.; and 1 by Bates and Rogers Construction Co. The long-span 1911-13 Mayo Bridge in Richmond was designed by the Concrete Steel Engineering Company of New York and built by I. J. Smith of Richmond. Ten bridges are credited to the Virginia State Highway Commission.

Thus, most of the arch bridges are undocumented with respect to designer or builder. The most prolific documented designer is Daniel B. Luten, designer of hundreds of such bridges throughout the east and midwest and holder of more than thirty patents.

Luten was an 1894 civil engineering graduate of the University of Michigan. Upon graduation he was retained at Michigan as an instructor and assistant to Professor Charles E. Greene, whose arch analyses were noted in A.S.C.E. transactions.(16) From 1895 to 1900, Luten was instructor of civil engineering at Purdue University and in 1900 he resigned to design bridges.(17) One year later he was designing and patenting his designs.

In 1899, Luten applied for a patent for an arch bridge of concrete, stone, brick, iron, or steel in which ties were placed below the water, from abutment to abutment to resist the arch thrust, and it was granted on May 15, 1900. His ties "which may be made of any material - as wood, iron, or steel - but in this case are shown as being made of wood or timber, as this is the best material now known to me for the purpose, it being practically everlasting when used under water."(18) This concept developed into his patent for a tied concrete arch in which steel tie rods were embedded in a concrete pavement across the streambed. A 1906 text on reinforced concrete by Albert Buel described Luten's steel-tied, paved arch bridge.(19)

Luten's 1907 patent #852,970 shows a barrel arch with recessed panel parapet walls and a similar "flat arch or girder" type design with the same parapet detail. A similar patent of 1907 lightened the bridge dead load with open spandrels but maintained a barrel arch.

In 1907, Luten patented another arch type which reinforced the arch barrel transversely as well as longitudinally. In effect, this design was a stiffened spandrel which allowed for thinner arch sections. Included in this patent were several variations, one of which made parapet walls act with the superstructure to carry the loads. In patent #853,203, this variation was described as follows:

> A concrete bridge having a roadway bordered by a concrete wall, a longitudinal reinforcing member embedded in the walls, and transverse reinforcing members embedded in the wall and extending into the bridge under the roadway.(20)

Other Luten patents included numerous arch variations, among them a hinged arch and viaducts; systems of reinforcement; ingenious centering forms and methods; methods of bridge construction; and reinforced concrete beams.

Daniel Luten was also an enthusiastic salesman of his bridge designs, using professional presentations to speak for their advantages. In the American Concrete Institute Proceedings of 1912, he praised concrete arches:

> Concrete as a structural material is full of surprising possibilities and one of these is that the most beautiful and appropriate applications of concrete to bridges, that is in the arch form, is also the most satisfactory from almost every engineering standpoint.

His company catalogs list the advantages of concrete bridges emphatically, and echo Edwin Thacher's previously listed advantages.

Luten's first bridge company was the National Bridge Company, formed in 1902. A 1914 Luten publication stated that until 1905 The National Bridge Company did the contracting and constructing of its bridges, but after that it was involved only in engineering design and supervision. In 1907, a company catalog advertised a variety of earth filled arches reinforced with steel rods. It claimed the company had designed more than 700 bridges of this type. An interesting arch type included in this 1907 catalog was the "arch-girder" bridge, described as a flat arched floor supported on five girders.

Ten years later, in 1917, a publication called "Reinforced Concrete Bridges" by Daniel B. Luten, designing and consulting engineer, illustrated a broader range of arch types, although still based on the same theme as his earlier designs. In this catalog, bridge illustrations ranged from long-span, high-level open spandrel bridges to small highway bridges. Luten contrasted a "Highway Bridge of Plain Design" with a "Park Bridge of Attractive Design" in the same publication. Both had the same arch form. The parapet wall of the highway bridge was a solid recessed panel and that of the park bridge a balustrade type.

Tyrell, as well, was conscious of appropriate bridge types in his 1911 publication. Among the types he listed were Roman arches, rustic arches, and ornamental bridges. In the same book, Tyrell noted Luten as a "designer and builder of many fine concrete bridges throughout America."(5)

Although 32 bridges are documented by bridge plates to Luten, many more can be attributed to him stylistically, particularly those located near documented Luten arches.

Most of the Luten bridges in this survey were of the filled spandrel variety illustrated in Figure 23 and like Luten patent #852,970 in detail. In the southwestern counties, this type was sometimes built with concrete post and rails rather than solid parapet walls.

Figure 24 shows a Luten arch which is well-documented and in remarkable condition. This falls into Luten's "park bridge" category, with its balustrade railings and decorative, fluted concrete columns at each end. These columns were originally light posts. The decorative concrete is attributed to "PETTYJOHN ART CONCRETE" of Terre Haute, Indiana, by a bridge plate. Structurally, this bridge is a four-ribbed arch of closed spandrel type, and it was constructed in 1929.

Figure 25 illustrates one of two long-span Luten arch bridges in Danville, Virginia. The main spans of both bridges are open spandrel arches, while some of the approach spans are filled spandrel arches. Both bridges are capped with balustrade type railings. Luten acted as designing engineer for both of these bridges, one built by the Atlantic Bridge Company and the other by the Concrete Bridge Company. They were built in 1926 and 1927.

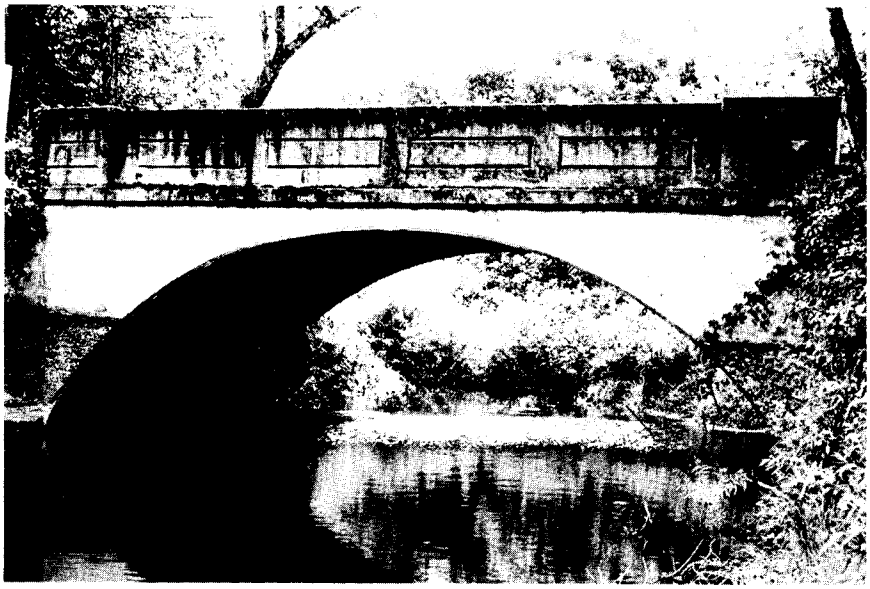


Figure 23. Typical single-span Luten barrel arch highway bridge. This type, patented by Daniel B. Luten, was built throughout Virginia.

Figure 24. The single-span barrel arch with decorative elements added constitutes Luten's "park bridge." This Luten bridge is located in Bland, Virginia.

Figure 25. A long-span, open spandrel arch bridge designed by Daniel B. Luten for Danville, Virginia, in 1927. Luten designed arch bridges of filled, closed, and open spandrel types.

The other design company for which references were found is the Concrete Steel Engineering Company of New York. Tyrell cited this company as designer of three long-span bridges in Dayton, Ohio, between 1902 and 1906. They were designed using the Melan system of reinforcing; William Menser (sic) was the engineer.(5) In an article for The Cornell Civil Engineer, William Mueser of the Concrete Steel Engineering Company in New York traced the development of reinforced concrete bridge construction, and stated that he had been a young engineer in von Emperger's office.(21)

In the 1920 Handbook of Building Construction, George A. Hool noted that the Concrete Steel Engineering Company of New York furnished "Diamond Bar" steel reinforcement in standard sizes from 1/4 in. to 1¼ in. (0.60 cm. to 3.2 cm).(22) It was this firm which designed the multi-span, filled spandrel arch bridge known as Richmond's Mayo Bridge. This bridge crosses the James River and was built from 1911 to 1913.

Another long-span, relatively early, city bridge is the old Rte. 29 bridge in Lynchburg, Virginia, illustrated in Figure 26. Designated as Williams Viaduct locally, it was begun in 1916 and completed in 1918. It was built by the N & W, C & O, and Southern railroad companies. This early use of open spandrel arches in Virginia, combined with the "T" design of this bridge, makes it unique in Virginia. This bridge intersects another at 90°, and both bridges are built as one "T" shaped unit. This bridge includes five main spans of heavy two-ribbed construction, a four-ribbed open spandrel arch, and concrete beams and slabs.

The earliest city bridge in Virginia is in Bedford, Salem Construction District. This large railroad overpass was built in 1907 to carry the main street over the N & W railroad. It is illustrated in Figure 27, which shows it to be a concrete bridge articulated to look like stone.

A small, double arch railroad underpass located in Stafford County, Fredericksburg Construction District, was the earliest concrete arch surveyed in Virginia. Its date of construction, 1904, is formed in the concrete. Figure 28 illustrates this Stafford County concrete arch.

The other concrete bridges noted in this portion of the text have been isolated because of the regional peculiarities of their design.

Two through trusses, like the Rainbow Arches described previously in the historical development, were built in the Richmond Construction District. These bridges were of the bowstring variety and were designed by the Virginia State Highway Commission for U. S. Rte. 1 highway traffic. They were built in 1926 and 1927. Figure 29 is an elevation view of the Nottoway River bowstring through arch. Note the lateral bracing from arch crown to arch crown. Sometimes this structural member was necessary to sustain wind loads and to prevent lateral instability of the bridge.

In contrast to these bowstring arches are three heavily designed monumental city bridges built in the city of Roanoke, Salem Construction District, between 1926 and 1928. They are massive arches, detailed with heavy towers and applied ornamentation. One of these bridges, the Memorial Avenue Bridge, is illustrated in Figure 30.

Several railroad underpasses in Montgomery County, Salem Construction District, were built in "horseshoe" arch forms, as illustrated by the underpass in Figure 31. This shape was not seen elsewhere in the state. It is not without precedent, however, as a discussion on railroad arch and box culverts in a 1903 A.S.C.E. Transactions paper cites a preference for arches with battered 1/2 in. to 1 ft. (0.6 cm to 30.0 cm) barrel walls. In Virginia, its occurrence is isolated in Montgomery County.

Figure 26. This open spandrel arch bridge was built in Lynchburg between 1916 and 1918. It carries Rte. 29 across the James River.

Figure 27. Concrete arch bridge built in Bedford in 1907. The surface was treated to roughly imitate stone.

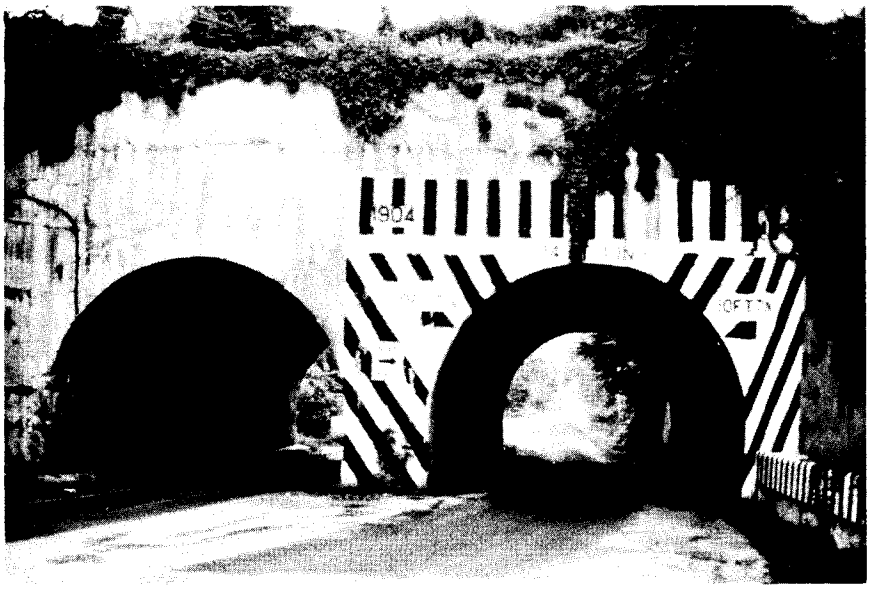


Figure 28. The earliest surveyed concrete arch bridge was this double arch underpass, built in 1904 in Stafford County.

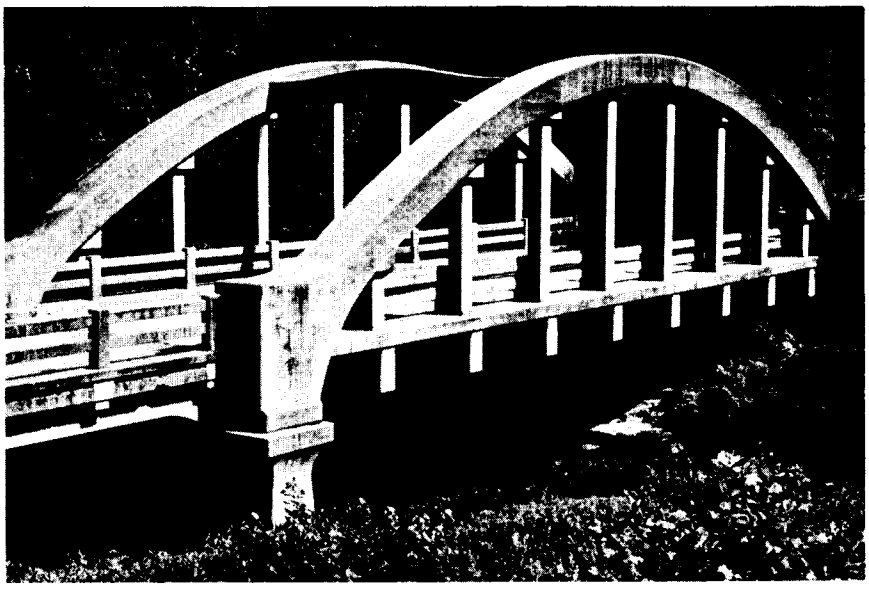


Figure 29. This concrete bowstring arch was built by the Virginia Department of Highways in 1926.

Figure 30. The Memorial Avenue Bridge in Roanoke was built in 1926. This ornamented, monumental metropolitan highway bridge is constructed with three heavy arch ribs.

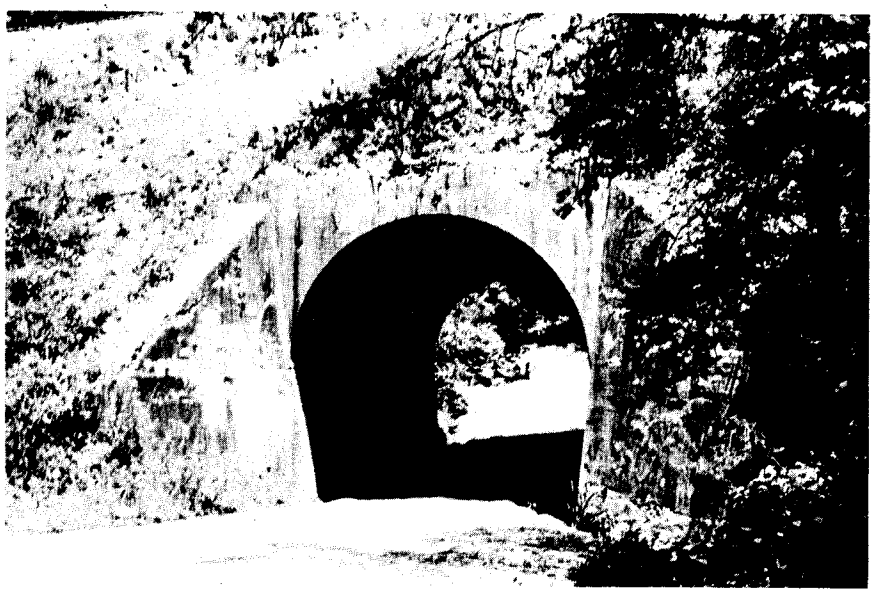


Figure 31. Concrete arch underpass, constructed in Montgomery County, illustrates the regional diversity found in Virginia arch types. This "horseshoe arch" was built only in Montgomery County.

Figure 32 shows a multi-span, low arch bridge typical of Shenandoah County design and encountered elsewhere only in 2 bridges in Montgomery County.

The bridges shown in Figure 33 are stone-faced concrete arches built on two approach roads to a private home in Halifax County. The bridges were probably built before the 1928-30 date of construction for the corresponding stone house. They are particularly significant when viewed in the context of the estate. There is another stone-faced arch, of yet another style, and a solid masonry double box culvert opposite the 2 bridges illustrated. The structural unity created by these bridges and the house and its setting is striking. Although the bridges are of recent construction and anachronistic structurally, they are unique and noteworthy.

These examples illustrate the regional diversity in bridge types seen throughout Virginia's bridge survey and attributed to the relative autonomy of county road supervisors in the early years of highway bridge construction. The need for consistent bridge standards, however, was addressed early by the Virginia State Highway Commission. The third annual report of the State Highway Commission, for the year ending September 30, 1909, stated:

> After a careful study of the needs and desiring that bridges should be designed and erected according to some specifications which could be used and lived up to as standard by the State and county, this department, last July, issued "General Specifications for Steel Highway Bridges".

Copies of these were sent to all county clerks for use in their bridge work. To make the process less confusing, the report stated that standard plans for steel bridges were being prepared according to the specifications.

Also in preparation were standard plans for reinforced concrete bridges. The 1909 annual report further states a Highway Commission preference for reinforced concrete design:

> Whenever practicable reinforced concrete spans have been used. This type of construction requires no maintenance, and its strength increases instead of diminishing with age. Spans from five to fifty feet in length have been designed and constructed.

Of the bridges surveyed, only 10 were credited by their bridge plates to Virginia State Highway Commission design. The majority of the concrete arch bridges surveyed were designed and built by unidentified companies.

Additional information and photographs of concrete arch bridges in Virginia can be found in the survey information sheets in Appendix A.

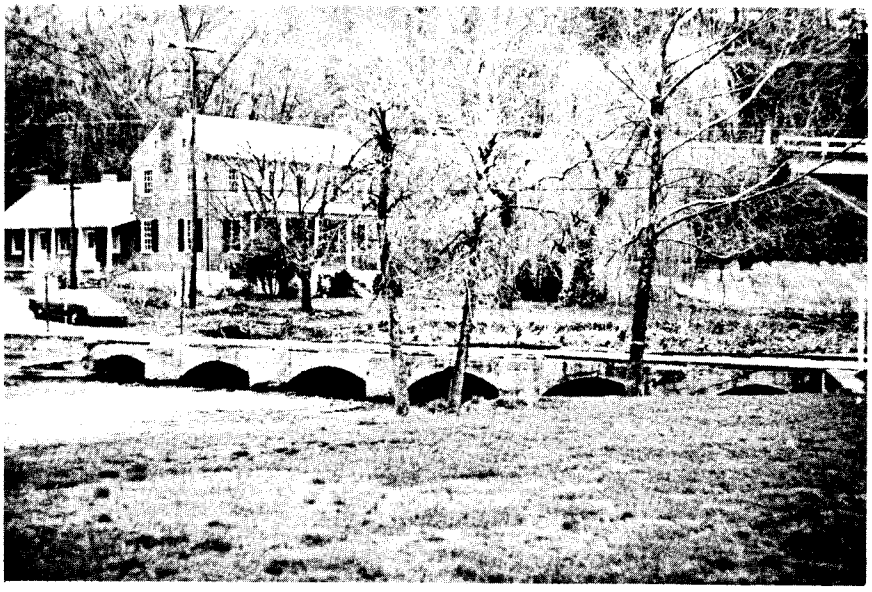


Figure 32. Regional diversity also is illustrated by a series of low multiple arches built in Shenandoah County.

Figure 33. Unusual stone-faced concrete arch bridge built in Halifax County.

Table 1. Arch Bridges and Bridge Companies in Virginia: Bristol Construction District

BRIDGE TYPE / COUNTY	BRICK or STONE MASONRY	CONCRETE: FILLED SPANDREL ARCH	CONCRETE: CLOSED SPANDREL ARCH	CONCRETE: OPEN SPANDREL ARCH	OTHER	TOTAL
Bland			1-1929, 42'			1
Buchanan						0
Dickenson						0
Grayson		1-ND, 24'				1
Lee						0
Russell	1-ND, 16' RR U 1-ND, 20' RR U 1-ND, 30' RR U	1-ND, RR U (2 spans at 26')				4
Scott		1-1907, 14', RR U	1-1928 (2 spans at 75') 1-ND (2 spans at 75')	1-1922, 120' 1-1922, 152'		5
Smyth	1-1896, 14' RR U	1-ND (2 spans at 67')	1-1928, 57' 1-ND, 44'			4
Tazewell		*1-1890-1919, 2 spans 1-1923 (2 spans at 49') 1-1923 (3 spans at 38') 1-1924 (3 spans at 38') 1-ND, 53'		1-ND, 113'		6
Washington	1-1901, 21'	2-1927, 10' 1-ND, 20' 1-1927, 13' 1-ND, 12' 1-ND, 17'				7
Wise		1-1907, 16' RR U 2-ND, 37' 2-ND (2 spans at 28')		1-1926, 73' 1-1926, 96' 1-1926, 132' 1-1925, 105'		9
Wythe			1-1928 (2 spans at 58') 1-1930, 45'			2
TOTAL	5	20	7	7	0	39

* Older masonry structure visible within this structure.

ND- no date

BRIDGE TYPE / BRIDGE COMPANY	BRICK or STONE MASONRY	CONCRETE: FILLED SPANDREL ARCH	CONCRETE: CLOSED SPANDREL ARCH	CONCRETE: OPEN SPANDREL ARCH	ND- no date: OTHER	TOTAL
Atlantic Bridge Co. Greensboro, N. C.						0
Bates & Rogers Construction Co.						0
W. W. Boxley & Co.						0
Churchill Co.						0
Concrete Steel Bridge Co. Clarksville, W. Va.						0
Concrete Steel Engineering Co. New York, New York						0
Luten Bridge Co. York, Pa. Knoxville, Tenn. Clarksburg, W. Va.		Tazewell Co: 3-1923 1-1924 Washington Co: 3-1927	Bland Co: 1-1929, 4 ribs Scott Co: 1-1928, 2 ribs Smyth Co: 1-1928, 2 ribs Wythe Co: 1-1928, 3 ribs 1-1930, 2 ribs	Wise Co: 1-1926, 2 ribs 2-1926, 3 ribs		14
Roehl & Steel Knoxville, Tenn.				Scott Co: 2-1922, 2 ribs		2
Virginia State Highway Commission Richmond, Va.				Wise Co: 1-1929, 2 ribs		1
Unknown	5	14	2	1		22
TOTAL	5	20	7	7	0	39

Table 2. Arch Bridges and Bridge Companies in Virginia: Salem Construction District

BRIDGE TYPE / COUNTY	BRICK or STONE MASONRY	CONCRETE: FILLED SPANDREL ARCH	CONCRETE: CLOSED SPANDREL ARCH	CONCRETE: OPEN SPANDREL ARCH	OTHER (ND- no date)	TOTAL
Bedford		1-1906, RR U, 23' *1-1906, RR U, 30' 1-1907, RR O, 60'				3
Botetourt	1-ND, RR U, 20'					1
Carroll						0
Craig						0
Franklin		1-ND, 96'		1-1928, 104'		2
Floyd						0
Giles		* 1-1919, RR U, 18' 1-1928, RR U, 22' 1-ND, 26' 1-ND, 27' 1-ND, 40'				5
Henry						0
Montgomery		1-1906, RR U, 16' 1-ND (3 spans at 7') 1-1913, RR U, 16' *1-1916, RR U, 11' 1-ND, RR U, 2 spans (ab'd) 1-ND, RR U, 15' 1-ND (3 spans at 10')				7
Patrick						0
Pulaski	1-1900, RR U, 20'		1-1927, 40' 1-1929, 60'	1-1927, 100' 1-1930 (2 spans at 60')		5
Roanoke		1-1928 (3 spans at 125')		1-1926, 5 spans at 177' 1-1930, 5 spans at 128'		3
TOTAL	2	17	2	5	0	26

* Older masonry structure visible within this structure.

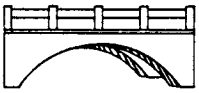
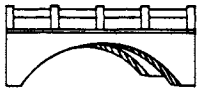
BRIDGE TYPE / BRIDGE COMPANY	BRICK or STONE MASONRY	CONCRETE: FILLED SPANDREL ARCH	CONCRETE: CLOSED SPANDREL ARCH	CONCRETE: OPEN SPANDREL ARCH	OTHER (ND- no date)	TOTAL
						
lantic Bridge Co.						0
ates & Rogers Construction Co.		Montgomery Co: 1-1906, RR U				1
. W. Boxley & Co.				Roanoke: 1-1926, 3 ribs		1
. C. Churchill Co., Inc.		Roanoke: 1-1928		Roanoke: 1-1930, 2 ribs		2
ncrete Steel Bridge Co.						0
oncrete Steel Engineering Co. ew York, New York						0
uten Bridge Co. ork, Pa./Knoxville, Tenn. larksville, W. Va./Knoxville, Tenn.			Pulaski Co: 1-1927, 2 ribs 1-1929, 2 ribs	Pulaski Co: 1-1927, 2 ribs 1-1930, 2 ribs		4
oehl & Steel						0
rginia State Highway Commission				Franklin Co: 1-1928, 2 ribs		1
nknown	2	15	0	0	0	17
TOTAL	2	17	2	5	0	26

Table 3. Arch Bridges and Bridge Companies in Virginia: Lynchburg Construction District

BRIDGE TYPE / COUNTY	BRICK or STONE MASONRY 	CONCRETE: FILLED SPANDREL ARCH 	CONCRETE: CLOSED SPANDREL ARCH 	CONCRETE: OPEN SPANDREL ARCH 	OTHER	TOTAL
Amherst		2-ND, 22'				2
Appomattox						0
Buckingham		1-1931, 20'				1
Campbell	1-ND, RR U, 30'	1-ND, 15' 2-ND, RR U, 16' 1-ND, 28'		1-1928, 77' 1-1928, 85' 1-1928, 95'		8
Charlotte						0
Cumberland		1-ND, 8'				1
Halifax		1-ND, 12' (stone faced) 1-ND, 20' (stone faced) 1-ND, 22' (stone faced)				3
Nelson	1-ND, 2 spans at 20'					1
Pittsylvania		1-ND, RR U, 16'				1
Prince Edward						0
Lynchburg (City)		1-1906, RR U, 20'		1-1916 (7 spans >100')		2
Danville (City)				1-1927 (10 spans > 100') 1-1928 (7 spans > 100')		2
TOTAL	2	13	0	6	0	21

ND- no date

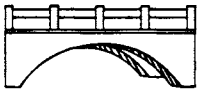
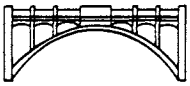
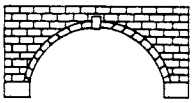
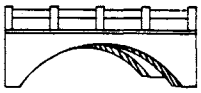
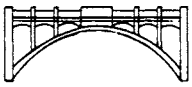
BRIDGE TYPE / BRIDGE COMPANY	BRICK or STONE MASONRY	CONCRETE				TOTAL
		FILLED SPANDREL ARCH	CLOSED SPANDREL ARCH	OPEN SPANDREL ARCH	OTHER (ND- no date)	
						
Atlantic Bridge Co.				Danville: 1-1928 (D. B. Luten, Designer), 2 ribs		1
Bates & Rogers Construction Co.						0
W. W. Boxley & Co.						0
Churchill Co.						0
Concrete Steel Bridge Co. Clarksville, W. Va.				Danville: 1-1927 (D. B. Luten, Designer), 2 ribs		1
Concrete Steel Engineering Co. New York, New York						0
Luten Bridge Co. York, Pa. Knoxville, Tenn.				Campbell Co: 2-1928, 2 ribs		2
Roehl & Steel						0
Virginia State Highway Commission		Buckingham Co: 1-1931				1
Unknown	2	12	0	2	0	16
TOTAL	2	13	0	6	0	21

Table 4. Arch Bridges and Bridge Companies in Virginia: Richmond Construction District

BRIDGE TYPE / COUNTY	BRICK or STONE MASONRY 	CONCRETE: FILLED SPANDREL ARCH 	CONCRETE: CLOSED SPANDREL ARCH 	CONCRETE: OPEN SPANDREL ARCH 	ND- no date: OTHER	TOTAL
Amelia						0
Brunswick		1-1922, 33' 1-1923, 32' 1-ND, 29'		1-ND, 62'		4
Charles City						0
Chesterfield	1-1825, 2 spans =134' (ab'd)	1-ND, 23'				2
Dinwiddie					1-1926, 90' 1-1927, 95'	2
Goochland						0
Hanover		1-1925, 3 spans at 95'				1
Henrico		1-1911, 18 spans = 1375' 1-ND, 20'				2
Lunenburg						0
Mecklenburg						0
New Kent						0
Nottoway						0
Powhatan						0
Prince George						0
TOTAL	1	7	0	1	2	11

* Old masonry structure visible within this structure.

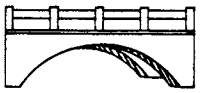
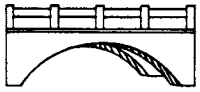
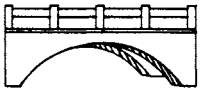
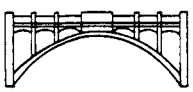
BRIDGE TYPE / BRIDGE COMPANY	BRICK or STONE MASONRY 	CONCRETE				TOTAL
		FILLED SPANDREL ARCH 	CLOSED SPANDREL ARCH 	OPEN SPANDREL ARCH 	OTHER (ND- no date)	
Atlantic Bridge Co.						0
Bates & Rogers Construction Co.						0
W. W. Boxley & Co.						0
Churchill Co.						0
Concrete Steel Bridge Co.						0
Concrete Steel Engineering Co. New York, New York		Nearing Co: 1-1911-1913				1
Luten Bridge Co. Knoxville, Tennessee		Brunswick Co: 1-1922 " 1-1923 " 1-ND				3
Roebl & Sons						0
Virginia State Highway Commission					Dinwiddie 1-1926 " 1-1927	2
Unknown	1	3	0	1	0	5
TOTAL	1	7	0	1	2	11

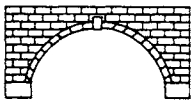
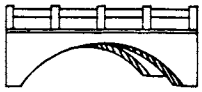
Table 5. Arch Bridges and Bridge Companies in Virginia: Suffolk Construction District

BRIDGE TYPE / COUNTY	BRICK or STONE MASONRY	CONCRETE			ND- no date	TOTAL
		FILLED SPANDREL ARCH 	CLOSED SPANDREL ARCH 	OPEN SPANDREL ARCH 	OTHER	
Accomack						0
Chesapeake						0
Greensville						0
Isle of Wight						0
James City		1-ND, RR U, 16'				1
Newport News						0
Northampton						0
Portsmouth						0
Southampton						0
Suffolk						0
Surry						0
Sussex						0
Virginia Beach						0
York						
TOTAL	0	1	0	0	0	1

BRIDGE TYPE / BRIDGE COMPANY	BRICK or STONE MASONRY 	CONCRETE			ND- no date	TOTAL
		FILLED SPANDREL ARCH 	CLOSED SPANDREL ARCH 	OPEN SPANDREL ARCH 	OTHER	
Atlantic Bridge Co.						
Bates & Rogers Construction Co.						0
W.W. Boxley & Co.						0
Churchill Co.						0
Concrete Steel Bridge Co.						0
Concrete Steel Engineering Co. New York, New York						0
Luten Bridge Co.						0
Roehl & Steel						0
Virginia State Highway Commission						0
Unknown		1				1
TOTAL	0	1	0		0	1

1852

Table 6. Arch Bridges and Bridge Companies in Virginia: Fredericksburg Construction District

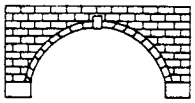
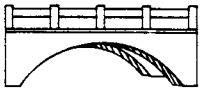
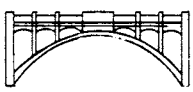
BRIDGE TYPE / COUNTY	BRICK or STONE MASONRY 	CONCRETE: FILLED SPANDREL ARCH 	CONCRETE: CLOSED SPANDREL ARCH 	CONCRETE: OPEN SPANDREL ARCH 	ND- no date: OTHER	TOTAL
Caroline						0
Essex						0
Gloucester						0
King George						0
King & Queen						0
King William						0
Lancaster						0
Mathews						0
Middlesex						0
Northumberland						0
Richmond						0
Spotsylvania						0
Stafford		1-1904, RR U, 2 spans at 11' 1-ND, 2 spans at 23'				2
Westmoreland						0
TOTAL	0	2	0	0	0	2

1933

BRIDGE TYPE / BRIDGE COMPANY	BRICK or STONE MASONRY	CONCRETE: FILLED SPANDREL ARCH	CONCRETE: CLOSED SPANDREL ARCH	CONCRETE: OPEN SPANDREL ARCH	ND- no date: OTHER	TOTAL
Atlantic Bridge Co.						
Bates & Rogers Construction Co.						0
W. W. Boxley & Co.						0
Churchill Co.						0
Concrete Steel Bridge Co.						0
Concrete Steel Engineering Co. New York, New York						0
Luten Bridge Co.						0
Roehl & Steel						0
Virginia State Highway Commission						0
Unknown		2				2
TOTAL	0	2	0	0	0	2

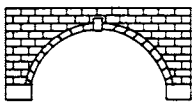
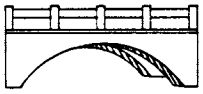
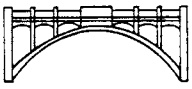
1854

Table 7. Arch Bridges and Bridge Companies in Virginia: Culpeper Construction District

BRIDGE TYPE / COUNTY	BRICK or STONE MASONRY 	CONCRETE: FILLED SPANDREL ARCH 	CONCRETE: CLOSED SPANDREL ARCH 	CONCRETE: OPEN SPANDREL ARCH 	ND- no date: OTHER	TOTAL
Albemarle						0
Culpeper						0
Fairfax	1-1893, 8' 1-ND, RR U, 23' (brick) 1-1824/1884 (ab'd)	1-ND, RR U, 12'	1-ND, (5 spans at 20' & 13')			5
Fauquier	1-ND, 18'	1-1919 (2 spans at 30') 1-ND, 23'				3
Fluvanna			1-1926, 19'			1
Greene						0
Loudon	1-ND, 18' 1-ND, 26' 1-ND, (2 spans at 30') 1-ND, (2 spans at 62') 1-ND, (4 spans = 272'), (ab'd) 1-ND,	1-1915, 48' 1-1916, 32' (ab'd) 1-1916, 43' 1-1921, 38' 1-ND, 13' 1-ND, 29' 1-ND, 32' (ab'd) 3-ND, 49' 1-ND, 51' 1-ND, 53' 2-ND (ab'd)				20
Louisa						0
Madison						0
Orange		1-ND, RR U (2 spans at 30')				1
Prince William						0
Rappahannock						0
TOTAL	10	18	2	0	0	30

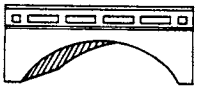
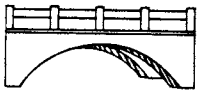
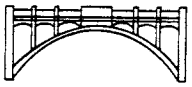
*Older masonry structure visible within this structure.

1955

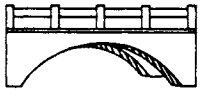
BRIDGE TYPE / BRIDGE COMPANY	BRICK or STONE MASONRY 	CONCRETE: FILLED SPANDREL ARCH 	CONCRETE: CLOSED SPANDREL ARCH 	CONCRETE: OPEN SPANDREL ARCH 	ND- no date: OTHER	TOTAL
Atlantic Bridge Co.						0
Bates & Rogers Construction Co.						0
W.W. Boxley & Co.						0
Churchill Co.						0
Concrete Steel Bridge Co.						0
Concrete Steel Engineering Co. New York, New York						0
Luten Bridge Co. York, Pa.		Fauquier Co: 2-1919 Loudon Co: 1-1915 2-1916 1-1921				6
Roehl & Steel						0
Virginia State Highway Commission						0
Unknown	10	12	2	0	0	24
TOTAL	10	18	2	0	0	30

1856

Table 8. Arch Bridges and Bridge Companies in Virginia: Staunton Construction District

BRIDGE TYPE / COUNTY	BRICK or STONE MASONRY	CONCRETE				TOTAL
		FILLED SPANDREL ARCH	CLOSED SPANDREL ARCH	OPEN SPANDREL ARCH	OTHER	
					ND- no date	
Alleghany	* 1-ND, RR U, 19'	1-1928, RR U, 25' 1-ND, 45' 1-ND, 12' 2-ND, 11'		1-1925, 4 spans at 65' 1-1929, 3 spans at 130'		3
Augusta	1-ND, RR U, 3 spans at 13' 1-ND, RRU, 3 spans at 13' 1-ND, RR U, 41' 1-1874, ab'd			1-1926, 103'		5
Bath	1-ND, 27' 1-ND, 29'	1-1927, 84'				3
Clark						0
Frederick		1-1917, 2 spans at 83' 1-1929, 28'				2
Highland						0
Page	1-ND, RR U, 35'					1
Rockbridge	1-ND, RR U, 22' 1-ND, 90' (Natural Bridge)	1-ND, 6' 1-ND, 18' 1-ND, 8' 1-ND, 19' 1-ND, 9' 1-ND, 21' 1-ND, 13'				9
Rockingham		1-ND, 8' 1-ND, 11' 1-ND, 12'				3
Shenandoah		1-1921, 4 spans at 22' 1-ND, 5 spans at 20' 3-ND, 6 spans at 16'				5
Warren						0
TOTAL	10	23	0	3	0	36

* Older masonry structure visible within this structure.

BRIDGE TYPE / BRIDGE COMPANY	BRICK or STONE MASONRY 	CONCRETE: FILLED SPANDREL ARCH 	CONCRETE: CLOSED SPANDREL ARCH 	CONCRETE: OPEN SPANDREL ARCH 	ND- no date: OTHER	TOTAL
Atlantic Bridge Co.						0
Bates & Rogers Construction Co.						0
W. W. Boxley & Co.						0
Churchill Co.						0
Concrete Steel Bridge Co.						0
Concrete Steel Engineering Co. New York, New York						0
Lutan Bridge Co.		Frederick Co: 1-1929				1
Roehl & Steel						0
Virginia State Highway Commission		Bath Co: 1-1927 Frederick Co: 1-1917		Alleghany Co: 1-1925, 2 ribs " 1-1929, 2 ribs Augusta Co: 1-1926, 2 ribs		5
Unknown	10	20	0	0	0	30
TOTAL	10	23	0	3	0	38

1858

CRITERIA

The diversity of types encountered in the survey of masonry and concrete arches conducted as the final stage of the Virginia inventory requires a modification of the numerical rating system developed previously to evaluate the metal truss bridges and shown in Appendix B. The arch bridges would not be so easily divided into the more rigidly defined metal truss categories, and thus it is difficult to apply those criteria on a broader basis.

A trial numerical rating system which combines aspects of Virginia's prior system (23) with one developed by Kemp in West Virginia (24) is shown in Table 9.

The factors comprising the criteria for historic significance of Virginia's masonry and concrete arch bridges parallel and appear to be compatible with the criteria developed for its metal trusses. Differences derive from conditions such as the fact that stone and concrete bridges have not been moved as was sometimes the case with metal trusses while site integrity is thus common to all arch bridges setting may have been significantly compromised. The significance of age for concrete bridges derives from the development of the technology (reinforcing systems etc.) whereas that for stone, an ancient technology, derives from the periods of Virginia's transportation history (turnpike era, railroad era, etc.). In the case of metal trusses, technological developments were reflected in designs that were massed-produced and marketed on a national scale. These differences have been considered in all three of the areas; i.e., documentation, technological significance, and environmental and historical factors.

The factors considered and the weight given to each are shown in Table 9. The rationale for the factors and relative weighting is then described.

The maximum number of points that can be given is 35, as compared with 27 for metal trusses. Application of the criteria to the stone and concrete bridges was accomplished by a panel of seven people. A discussion of the results follows the explanation of the criteria.

Table 9

Factors Comprising the Criteria for Historic Significance of Virginia's Masonry and Concrete Arch Bridges

Factor	Points Assigned Maximum: 8
A. Documentation	
1. Designer/builder*	
a. Unknown	0
b. Known, technological contribution undetermined	1
c. Known, prolific builder	2
d. Known, unusual designer	3
2. Date**	
a. Post-1932	0
b. Obsolescent phase for technology, but pre-1932	1
c. Mature flourishing phase	2
d. Early flourishing phase	3
e. Pioneering phase	4
f. Unique example of very early date	5

Suggested for Stone	Suggested for Reinforced Concrete
a. Post 1932	a. Post 1932
b. 1885-1932	b. Varies**
c. 1835-1885	c. 1915-1930
d. 1800-1835	d. 1900-1915
e. Pre-1800	e. 1895-1900
f. Pre-1700	f. 1889-1895

* When designer is ascribed by stylistic attributes, one-half value is assigned.

** When date is estimated, one-half value is assigned.

1860

Table 9 (continued)

B. Technological Significance	Maximum:	18
1. Technology		
a. Unique or significant structural features including patented technology		3
b. Materials and craftsmanship		3
c. Integrity of structure		3
d. Individual span lengths		2
e. Number of spans		2
f. Noteworthy architectural or engineering details		1
g. Special considerations		1
2. Configuration/Type		
a. Unique/unusual in its time		3
b. Rare survivor though of standard design		1
c. Typical example of its time and a common survivor		0
C. Environmental and Historical Factors	Maximum:	9
1. Aesthetics		3
2. History		3
3. *Integrity of setting		3

Documentation

The important elements for documentation are the designer or builder and the age of the bridge.

Designer or Builder

Concrete and masonry bridges were built by prolific bridge building companies, just as metal truss bridges were, and concrete bridge companies patented their technological innovations as prolifically as the metal truss bridge companies did. Unlike metal truss bridge

construction, however, individual masonry and concrete arch bridge design was often attributable to an individual designer or builder. The individual could be a master mason or a consulting engineer whose acknowledgement ranged from initials carved in a keystone to a bridge nameplate. The category "designer/builder" includes bridge companies but allows for individual designers.

Designers or builders, either individuals or companies, are characterized at three levels of significance. The maximum number of points are ascribed to the category of "known, recognized designer," which is used for companies or individuals with a major influence in the development of arch bridge design. Among these would be Latrobe for masonry bridges and Ransome, von Emperger, or the Concrete Steel Engineering Company for concrete bridges.

The second category is "known, prolific builder."

Most of the masonry arches were built by known companies; e.g., the N & W Railroad, the C & O Railroad, or the Ashby's Gap Turnpike Company. The historical background for Virginia railroads and turnpikes was given previously in the text of this report. Bridges which were known to be built by these companies were given 2 points for known, prolific builder.

For concrete bridges, the designation "known, prolific builder" is used to describe the Luten Bridge Company, the Concrete Steel Bridge Company, and the Virginia State Highway Commission.

Twenty-four percent (32/136) of the concrete arch bridges are documented Luten Bridge Company bridges. Many more were attributed to this company stylistically. Daniel B. Luten patented many arch bridge and reinforcement schemes, and his company built hundreds of concrete bridges in the East and Midwest.

The Concrete Steel Bridge Company was organized in Clarksburg, West Virginia, in 1914 by Frank D. McEnter and P. M. Harrison. They built many reinforced concrete structures in the East until 1931. The Main Street Bridge in Danville was built by the Concrete Steel Bridge Company, with Daniel B. Luten.

The Virginia State Highway Commission was established in 1907 and began standardizing bridge design on a small scale. Of the bridges surveyed, only 10 were documented by their bridge plates to be of Virginia State Highway Commission design.

The third category is "known, contribution undetermined." This category gives latitude for future research, which may result in a bridge changing its point value by 1 or 2 points higher when more is learned about designers/builders.

-1862

The majority of the concrete arch bridges surveyed were designed and built by unidentified companies. Where the builder is unknown, no points are given.

Where the designer/builder can be attributed by location, style, or design, the points assigned are one-half the documented point value.

Age

The general categories developed by Kemp, as shown in Table 9, give a framework for the development of specific dates.

> Stone masonry is an ancient technology and can be more readily categorized into periods of historical significance than can concrete. Since concrete bridges depend upon the development of technology it is especially important to apply dating criteria with respect to each type of bridge, i.e., plain vs. reinforced concrete, closed vs. open spandrel arch, application of patented systems, etc.

For each material there are six categories; points are given for increasing age in five periods.

For stone: pre-1700 - 5; pre-1800 - 4; 1800-1835 - 3; 1835-1885 - 2; 1885-1932 - 1.

These categories generally reflect the development of transportation systems as follows:

- Pre-1700-masonry bridges rare in the United States,
- Pre-1800-masonry bridges were scarce in the United States,
- 1800-1835-masonry bridges were built by turnpike companies or very early railroads,
- 1835-1885-masonry bridges were built prolifically by railroads and sparsely by turnpike/highway builders, and
- 1885-1932-masonry bridges were built still by railroad companies and some highway builders but the use of stone became anachronistic during this period

For reinforced concrete: 1889-1893 - 5; 1895-1900 - 4; 1900-1915 - 3; 1915-1930 - 2; no specific time can be assigned to the 1 point category for reinforced concrete, in general. This category, "obsolescent phase for technology but pre-1932," is appropriate for only the concrete designs evolved in the late nineteenth and early twentieth century, i.e., solid, filled barrel arches. It is inappropriate to apply "obsolescent" to the general category of reinforced concrete, as technological innovations continue to date.

The categories for reinforced concrete reflect the development of transportation systems with technologically significant dates incorporated:

- o 1889-1895: Early development of reinforced concrete bridge design; concrete bridge built in 1889 by E. L. Ransome.
- o 1895-1900: Era of experimentation in reinforced concrete bridge design.
- o 1900-1915: Era of increasing confidence in reinforced concrete as a building material, and prolific patent development.
- o 1915-1930: Era of rapid growth of transportation needs and confident, established procedures for reinforced concrete arch bridge design. (Still an era of experimentation in reinforced concrete design and application.)

The concrete categories, particularly, are intended to be used solely as a general framework, and should be applied by persons with familiarity with historical concrete bridges. (The existing data on plain concrete [i.e., non-reinforced concrete] allow for the development of only a very general historical dating system: any pre-1890 plain concrete bridge should rate 5 points, those built between 1890-1910 should rate 3 points, and any plain concrete bridge built after 1910 should rate 1 point.)

The points are awarded when the date can be definitely established from date plates, plans, newspaper articles, railroad reports, or public records. Where such information is not available, the age can sometimes be estimated. When the date is estimated, one-half the point value is given.

Technological Significance

The second broad category evaluates the elements of the bridge's structure and construction. In all cases the bridge is awarded points if it possesses the characteristic under consideration. No fractional points are given.

Unique or Significant Structural Features, Including Patented Technology

Unlike the case of metal truss bridges the significant technological elements of concrete or masonry bridge structures may not be apparent by visual inspection. Without documentation, it is generally not possible to ascribe unique structural features or patented technology to these bridges without destructive testing.

Concrete arch bridge documentation consisted of bridge plates, company catalogs, and plans. Additional sources might be contemporary engineering periodicals.

Features which scored points were Luten patents, Concrete Steel Engineering Company patents, and an innovative design solution.

No masonry arch bridges in Virginia were known to have significant structural features or patented technology. In fact, this category would exclude all but rare masonry arch bridges. Thus, the maximum number of points possible for masonry arches is 3 points less than the maximum possible for concrete arches.

Materials and Craftsmanship

Points are given if the structure was constructed of high quality materials (no deterioration apparent) and high quality craftsmanship.

Integrity of Structure

Points are given if the bridge structure has not been modified. Modifications are usually evident during field inspection.

Individual Span Lengths

Points are given for masonry spans in excess of 30 ft. (9m). For concrete arches built until 1915, points are given for spans in excess of 50 ft.(15m). For concrete arches built after 1915 but prior to 1932 points are given for spans in excess of 125 ft.(38m).

Number of Spans

Points are given for bridges with multiple arches for all bridges built prior to 1915. For bridges with more than two arch spans built after 1915 points are awarded.

Noteworthy Architectural or Engineering Details

Points are given for ornamental details or interesting technological applications.

Special Considerations

This category is for features which are not indicative of advanced or special applications of technology, but reflect special design features. It includes local design idiosyncrasies, types peculiar to a particular region, construction with a nineteenth century appearance built in the twentieth century, use of unusual materials, or unique items such as George Washington's initials carved in the Natural Bridge.

Configuration/Type

The arch bridge was characterized as (1) unique/unusual in its time, (2) a rare survivor though of standard design, or (3) typical example of its time and a common survivor. This classification follows the one

used in the field survey inventory sheets. It is a characterization which is relative to Virginia's surviving arch bridges.

Environmental and Historical Features

Environmental factors are evaluated in three areas: aesthetics, history, and integrity of setting. Points are awarded if the bridge possesses the characteristic under consideration. No fractional points are awarded. While environmental factors are more subjective than those in the preceding categories, experience in applying these criteria to metal trusses and to the arch bridges included in this report showed that there was broad consensus on when the points should or should not be awarded.

Aesthetics

The bridge is an integral part of its setting and removal of the bridge would be detrimental to the setting.

History

Bridges are awarded points if there is documented historical significance associated with them; the category is broad and subject to available research.

A bridge may be a part of an important historically documented transportation network; e.g. a railroad or turnpike company. It may be located at a significant crossing and be part of a series of bridges built at that site.

A bridge may be associated with significant industrial or residential development, or it may be associated with individuals or events of local or statewide significance.

Integrity of Setting

Unlike metal truss bridges, arch bridges of monolithic construction require destruction for removal. Since relocation is not a feasible alternative, the bridge's setting is important.

This setting has integrity if changes have not occurred which detract from the bridge's historical setting. The setting should convey a sense of what it was like in its historic period.

-1986

APPLICATION OF THE RATING SYSTEM

The criteria were applied to each of the 166 arch bridges included in the survey. Of these, 30 were masonry and 136 concrete. The bridges were evaluated by a seven-member panel consisting of the author, three persons from the Research Council with experience in historical issues, representatives from the Environmental Quality and Bridge Divisions of the Virginia Department of Highways and Transportation, and a representative of the Virginia Historic Landmarks Commission. This panel reached a consensus on the points to be awarded to each of the bridges. The results of the consensus are given in Table C-1 for masonry bridges and in Table C-2 for concrete bridges. Within the tables the bridges are grouped by construction district, county, and route number.

The maximum score possible for concrete bridges would be 35, while the corresponding maximum for masonry structures would be 32 since the attribute "unique or significant structural features including patented technology", worth 3 points, would not be applicable.

Modified masonry arches, like those illustrated in Figure 21, were evaluated as masonry structures which lacked integrity of structure.

Application of the criteria by the panel resulted in ratings ranging from zero to 31 for the concrete arches and from 9 to 29 for the masonry arches. Establishing a numerical value as a standard by which potential historic significance would be judged is to some degree arbitrary but the value should be such as to ensure proper consideration of clearly significant structures, to obviate the expenditure of effort on structures that are clearly not significant, and to identify those in the "grey area" that would warrant further study on a case-by-case basis. Based upon discussions during the application of the criteria to the arch bridges, Virginia's experience with the criteria developed for its metal trusses, and refinements and procedures developed by several other states, it would appear that the ranges shown in Table 10 should be established.

Table 10

Suggested Ranges to Use When Considering Potential Historic Significance of Arch Bridges in Virginia

Significance Levels	Masonry Arches			Concrete Arches		
	Range	No.	Percent	Range	No.	Percent
High	>22	11	37	>24	9	7
Case-by-Case Study	15-21	17	57	17-23	33	24
Low	<15	2	6	<17	94	69

There were 11 masonry bridges which rated 22 or more points. These were the Natural Bridge (Rockbridge County, on cover), the Aldie Bridge (Loudoun County, Figure 1), the Falling Creek Bridge (Chesterfield County, Figure 7), the Goose Creek Bridge (Loudoun County, Figure 2), the Snicker's Gap Turnpike Bridge (Loudoun County, Figure 4), the two Staunton C & O RR bridges (Augusta County, Figure 18 and Appendix Sheet A-41), the Honaker N & W RR underpasses (Russell County, Figures 12 and 13), the Southside RR underpass (Campbell County, Figure 17), and the Shenandoah Valley RR underpass at Buchanan (Botetourt County, Figure 11).

The Aldie Bridge is located in a National Register Historic District and the Goose Creek Bridge is listed on the National Register of Historic Places.

There were 9 concrete arches which rated 24 points or higher. They were the Richmond Mayo Bridge (Appendix Sheet A-65), the old Rte. 29 Lynchburg bridge (Figure 26), the Luten bridges in Appalachia (Wise County, Appendix sheets A-17 and A-19), the Bedford city bridge (Bedford County, Figure 28), the Luten bridge in Bland (Bland County, Figure 24), the Roanoke Memorial Ave. Bridge (Figure 27) and Rte. 116 (Appendix Sheet A-41) bridges, and the Worsham Street Bridge in Danville (Figure 25).

The Bedford bridge is located in a National Register Historic District.

There are 17 masonry arches that rated between 15 and 21 points and 33 concrete arches that rated between 17 and 23 points. When these

bridges are evaluated on a case-by-case basis, their point value may increase since research undertaken for the evaluation may produce information concerning designers, patents, local history, etc., not discovered during the inventory.

Of the 166 arches included in the inventory, 96 would fall in the not significant category.

SUMMARY AND CONCLUSIONS

As stated in the introductory remarks to this report, the survey and photographic inventory of Virginia's bridges has been completed with the issuance of this report.

The arch bridges surveyed in Virginia fell into three broad categories:

1. stone turnpike bridges,
2. stone railroad bridges, and
3. concrete highway bridges.

The arch bridge types surveyed in Virginia reflected the general historical building trends in the United States. However, with respect to nationwide significance, there seem to be no remarkably early or otherwise noteworthy examples of construction types in Virginia. On a state and local level, Natural Bridge, the James River and Kanawha canal bridge, the turnpike and railroad bridges, and the concrete arches noted in the text were all representative of important aspects in the development of Virginia's transportation network.

The diversity of types encountered in this final stage of the Virginia inventory required a modification of the numerical rating system used to evaluate the metal truss bridges. The arch bridges would not be so easily divided into the more rigidly defined metal truss categories previously developed, and thus it would be difficult to apply those criteria on this broader basis.

A numerical rating system which combines aspects of Virginia's prior system (23) with one developed by Kemp in West Virginia (24) was developed and applied.

This resulted in suggesting that three levels be considered in evaluating potential historic significance of Virginia's arch bridges. Eleven (37%) of the masonry and 9 (7%) of the concrete arches were classified in the most significant category, and 2 (6%) of the masonry and 94 (69%) of the concrete arches in the lowest category. The remaining 17 (57%) masonry and 33 (24%) concrete arches were identified for further evaluation on a case-by-case basis.

Of course, the aim of such a system is the development of criteria for determining the relative significance of historic bridges. Those bridges isolated as eligible for listing on the National Register of Historic Places should be given due consideration in the long-range highway planning process through the development of a conservation plan, which is beyond the scope of this project.

It would be important to note in the development of a statewide conservation plan for historic bridges that those structures which fall outside the eligibility range can provide invaluable information to the engineering community. The evaluation of bridge-building technology for monolithic structures is largely guesswork unless plans exist. Unlike the readily identified structural systems of iron and steel bridges, masonry bridges do not readily reveal their structural identity or means of construction. In demolishing masonry and concrete bridges, load tests could be conducted on specific bridges, core samples could be evaluated, and reinforcement systems could be identified. If such exhaustive testing appeared unnecessary, recovery of sample reinforcement would be an easy matter, and a systematic understanding of reinforcement systems used in Virginia could be compiled with minimal effort. Photogrammetrc techniques, such as described in another Council report,(25) could aid in such recovery and should be part of the conservation plan.

In this way, those resources which are lost in the necessary upgrading of bridges and highways could provide knowledge necessary for stabilizing, rehabilitating, and maintaining those bridges deemed appropriate for preservation. The results of historic bridge inventories thereby serve multiple purposes as a compilation of historical data, a highway department planning tool, and an engineering design reference.

1971

ACKNOWLEDGEMENTS

The author expresses gratitude to the many Virginia Highway and Transportation Research Council employees who have eased this long-distance project, particularly to Nathaniel Mason Pawlett for his insight on Virginia railroads and his coordination of work on the project during my absences. The author expresses gratitude to Howard H. Newlon, Jr. for his continued guidance over the course of the Virginia historic bridge project, and to Ed Deasy and Jerry Garrison for enduring one last onslaught of bridge photographs.

1972

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-1974

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1975

APPENDIX A

SURVEY INFORMATION AND LOCATION OF CONCRETE AND MASONRY ARCH BRIDGES IN VIRGINIA

Appendix A consists of eight Virginia district maps and isolated survey sheets which represent types of arch bridges located in each district. The information is presented in a district-by-district arrangement, based upon Department of Highways and Transportation district numbering. The order is as follows: 1. Bristol District, 2. Salem District, 3. Lynchburg District, 4. Richmond District, 5. Suffolk District, 6. Fredericksburg District, 7. Culpeper District, 8. Staunton District.

Each district map locates the arch bridges in the district and identifies them by the following categories: Stone or brick arches, concrete filled spandrel arches, concrete ribbed closed spandrel arches, concrete ribbed open spandrel arches, and other. (See legend on the district maps.)

The survey sheets which follow each district map are arranged in alphabetical order by county, and within each county by route number. The photographs which illustrate the arch bridges on the survey sheets are located in the Arch Survey files. Each photograph is one of a number listed on the front of each survey sheet.

1976

BRISTOL DISTRICT

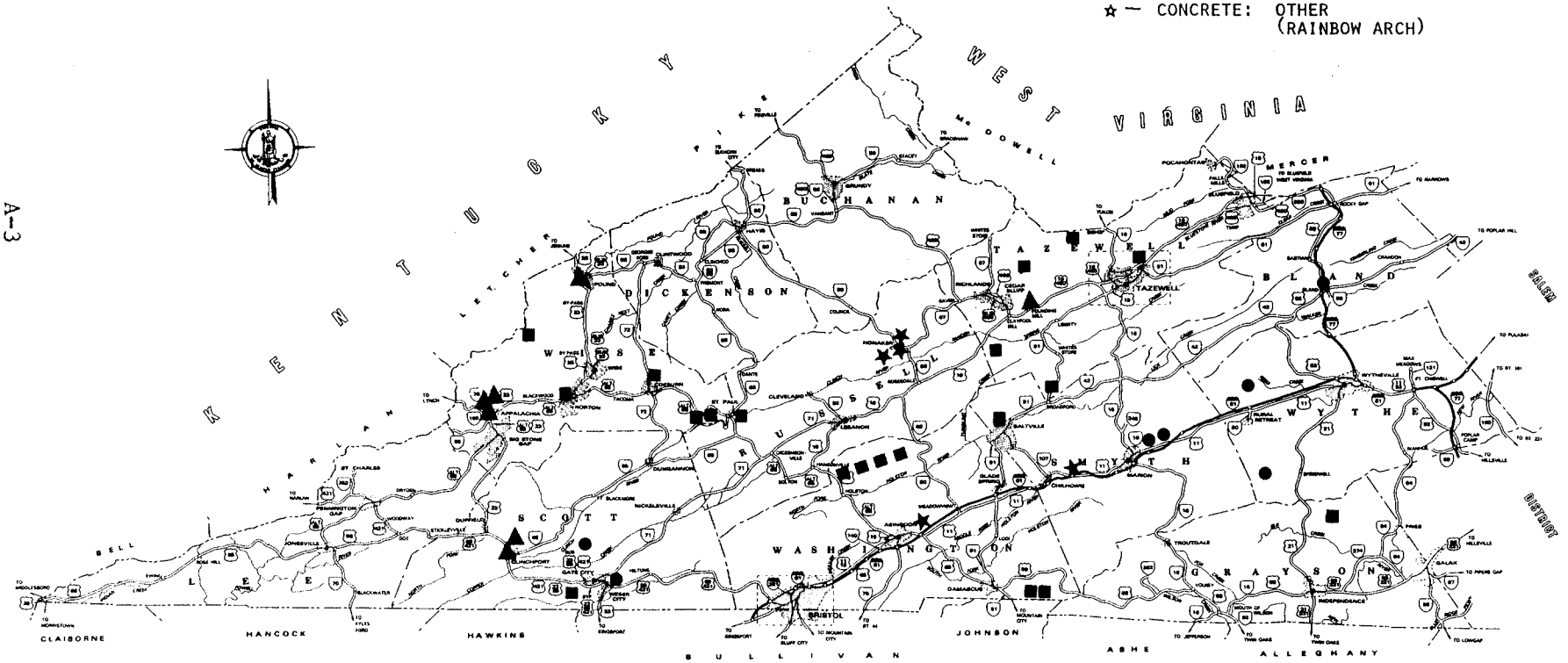
★ — STONE OR BRICK ARCH

■ — CONCRETE: FILLED SPANDREL ARCH (SOLID BARREL)

● — CONCRETE: CLOSED SPANDREL ARCH (RIBBED)

▲ — CONCRETE: OPEN SPANDREL ARCH (RIBBED)

☆ — CONCRETE: OTHER (RAINBOW ARCH)



1978

R-383

Photo Numbers: -1979

A11:25-32

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Bristol ; No. 1 .
County: Bland ; No. 10 .
City/Town: Bland .
Street/Road: Route 98 .
River/Stream/Railroad (crossing): Crab Orchard Creek .
UTM/KGS Coordinates: _____ .

Historical Information

Formal designation: _____ .
Local designation: _____ .
Designer: Luten Bridge Company .
Builder: York, Pennsylvania; Knoxville, Tennessee .
Date: 1929 ; basis for: bridge plate .
Original owner: _____ ; use: vehicular .
Present owner: VDH & T ; use: vehicular .

Historical or Technological Significance

____ Unique/Unusual in its time: _____

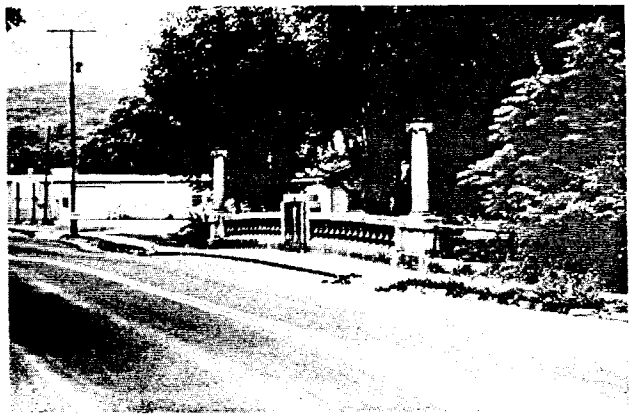
X Rare survivor though of standard design: Best Luten bridge surveyed in Virginia; 2 lane, 4 ribbed Luten seamental arch with decoratve parapet wall and posts

____ Typical example of its time and a common survivor: _____

X Other Remarks/Explanation: Decorative concrete column light posts on each end made by: Pettu John
Art Concrete bridge plate
Terre Havte
Indiana
This bridge, typical of Luten's "park" bridges, is in remarkably good condition.

Nature/Degree of any destructive threats: _____

Reference materials and contamporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: July 1981 .
Affiliation: V. H. & T. R. C. .

Design Information

Compass orientation of axis: _____.

No. of spans: 1 ; length overall: 43'.
Span types:
(1) arch ; length: 43'.
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 2 ; Roadway width: 30'-9".

Architectural or decorative features:

-Balustrade of urn-shaped post as parapet wall

-Fluted columns with decorative capitals at ends of bridge

Structural Information

Substructure:
Material: _____.
Foundations: _____.
Piers: _____.
Abutments: Concrete.
Wings: Concrete.
Seats: _____.

Superstructure:
Material: Stone _____ Concrete X

Configuration:
A. Arch X Barrel _____ Ribs (no.) 4 ; Spandrel: Open _____ Solid X
Circular _____ Segmental X Other _____ ; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

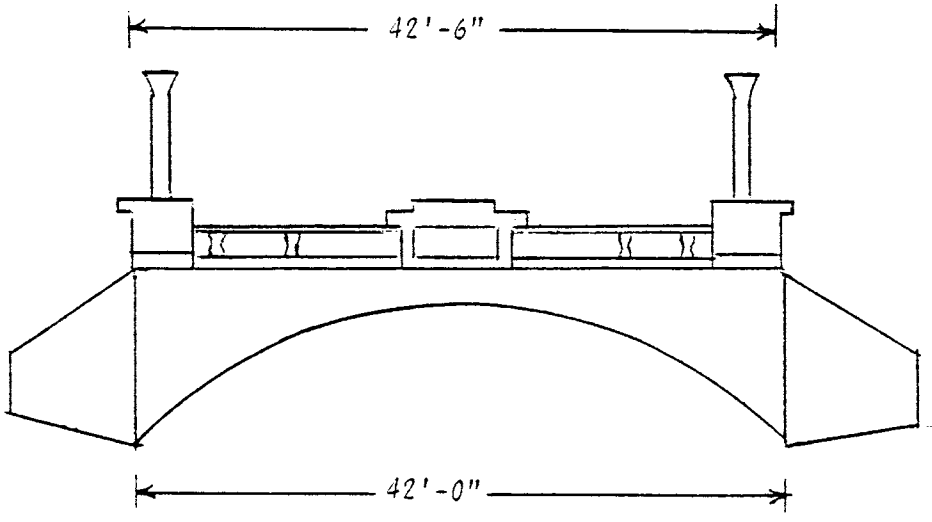
D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

Parapets: Decorative, typical fluted posts on parapet wall. Clasical type posts at ends of bridge which were light posts.

Sketch

Side Elevation



Section A-A

R-383

A-7

Photo Numbers: 1231

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

A10:32

Geographic Information

State: Virginia
Va. Dept. of Highways District: Bristol ; No. 1 .
County: Russell ; No. 83 .
City/Town: Honaker .
Street/Road: Route 646 .
River/Stream/Railroad (crossing): N&W RR .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: .
Builder: .
Date: 1887-1889 ; basis for: N & W Annual Report .
Original owner: N & W RR ; use: Vehicular .
Present owner: ; use: Vehicular .

Historical or Technological Significance

x Unique/Unusual in its time: Ashlar masonry circular barrel carrying road and stream. From spring point up, arch is brick lined. .

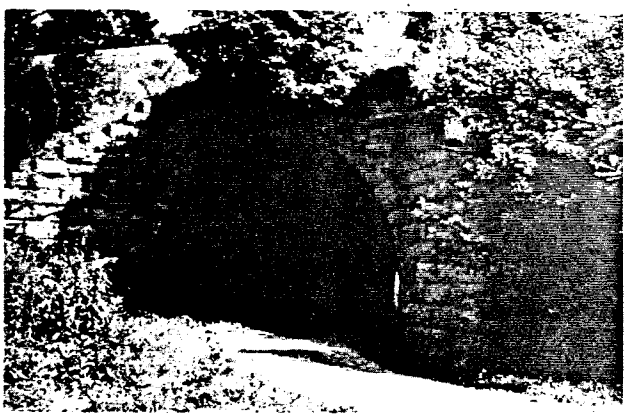
___ Rare survivor though of standard design: Voussoir and coping stones are distinguished from others. .

___ Typical example of its time and a common survivor: .

x Other Remarks/Explanation: Three N & W underpasses, all built at the same time, Route 637, 646, 647. The two others no longer carry traffic on local roads.

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: July 1981 .
Affiliation: V.H. & T.R.C. .

-1932

Design Information

Compass orientation of axis: _____. Architectural or decorative features:

No. of spans: 1 ; length overall: _____.
Span types:
(1) Arch ; length: 30' .
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 1 ; Roadway width: 11'-1"

Structural Information

Substructure:
Material: _____. Abutments: _____.
Foundations: _____. Wings: Masonry .
Piers: _____. Seats: _____.

Superstructure:
Material: Stone X Concrete _____

Configuration:
A. Arch X Barrel X Ribs(no.) ; Spandrel: Open _____ Solid X
Circular X Segmental _____ Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

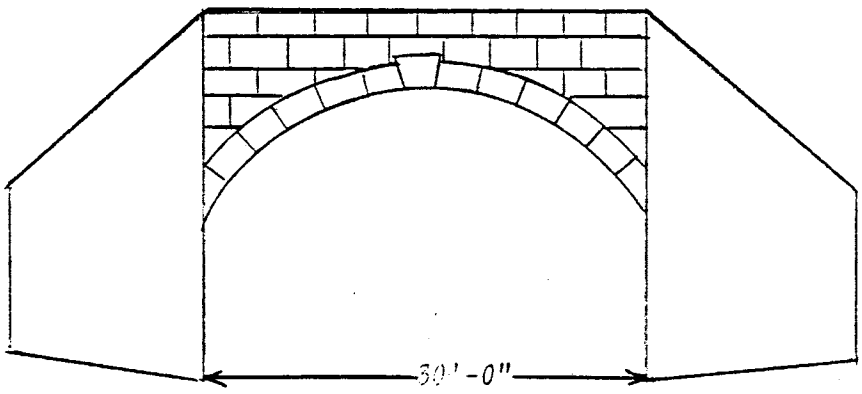
Parapets: _____

Sketch

Side Elevation

Section A-A

Barrel is 56'-0" long



R-383

Photo Numbers: 1983

A8:24-27

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Bristol ; No. 1 .
County: Scott ; No. 84 .
City/Town: .
Street/Road: Route 650 .
River/Stream/Railroad (crossing): Stock Creek .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: Roehl and Steel, Knoxville, Tennessee .
Builder: .
Date: 1922 ; basis for: Bridge plate .
Original owner: ; use: Vehicular .
Present owner: V.D. H & T. ; use: Vehicular .

Historical or Technological Significance

___ Unique/Unusual in its time: .

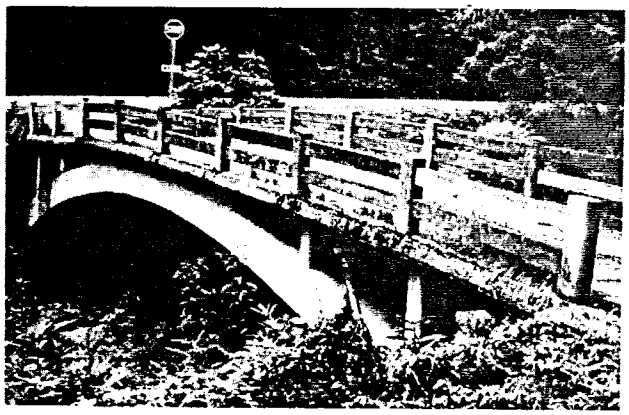
___ Rare survivor though of standard design: .

X Typical example of its time and a common survivor: 2 ribbed open spandrel segmental arch .

X Other Remarks/Explanation: The roadway arches slightly with the arch and guard rail/parapet wall follows arch, much shallower than structure's arch.

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: July 29, 1981 .
Affiliation: V.H. & T. R. C. .

A-10 1984

Design Information

Compass orientation of axis: _____. Architectural or decorative features:

No. of spans: 1 ; length overall: _____.
Span types:
(1) Arch ; length: 120' .
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 1 ; Roadway width: 11'-1".

Structural Information

Substructure:
Material: _____. Abutments: Concrete .
Foundations: _____. Wings: _____.
Piers: _____. Seats: _____.

Superstructure:
Material: Stone _____ Concrete X

Configuration:
A. Arch X Barrel _____ Ribs(no.) 2 ; Spandrel: Open X Solid _____
Circular _____ Segmental X Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

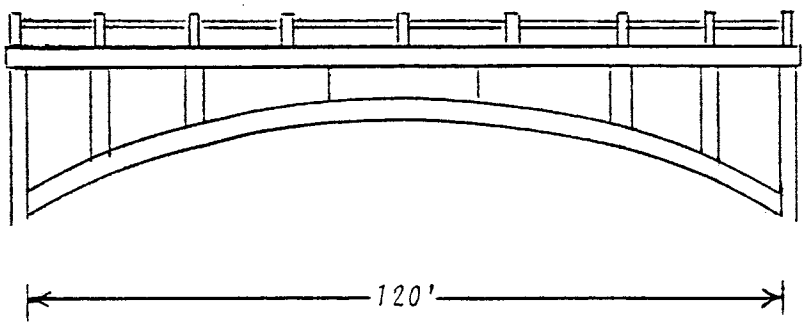
D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

Parapets: _____

Sketch

Side Elevation Section A-A



A-11

R-383

Photo Numbers: 1035

A10:17-20

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Bristol ; No. 1 .
County: Smyth ; No. 86 .
City/Town: Saltville .
Street/Road: Route 634, Allison Gap Road .
River/Stream/Railroad (crossing): N.F. Holston R .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: .
Builder: .
Date: ; basis for: .
Original owner: ; use: Vehicular .
Present owner: V.D.H. & T. ; use: Vehicular .

Historical or Technological Significance

___ Unique/Unusual in its time: .

___ Rare survivor though of standard design: .

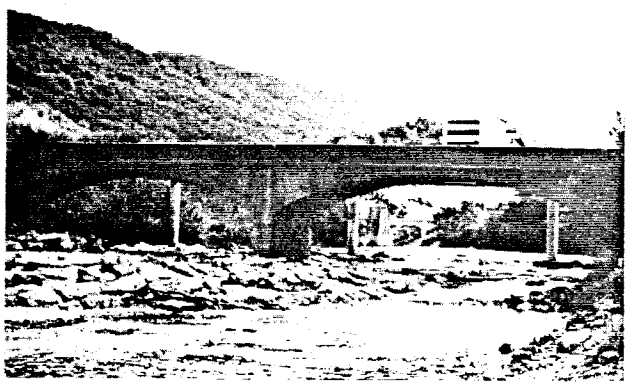
X Typical example of its time and a common survivor: 2 span segmental arch barrel highway bridge .

X Other Remarks/Explanation: Concrete on arch, pier, parapet walls is severely deteriorated, particularly on up-stream side.

Nature/Degree of any destructive threats: .

Reference materials and contamporary photos/illustrations with their respective locations:

Recorder: P. A. C. Spero .
Date: July 1981 .
Affiliation: V.H. & T.R.C. .



-1936

Design Information

Compass orientation of axis: _____. Architectural or decorative features:

No. of spans: 2 ; length overall: 133'-3"
Span types:
(1) Arch ; length: 67'.
(2) Arch ; length: 67'.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 1 ; Roadway width: 17'-8"

Structural Information

Substructure:
Material: _____. Abutments: Concrete.
Foundations: _____. Wings: _____.
Piers: _____. Seats: _____.

Superstructure:
Material: Stone_____ Concrete X

Configuration:
A. Arch X Barrel X Ribs(no.)_____; Spandrel: Open_____ Solid X
Circular_____ Segmental X Other_____; Fixed_____ Hinged_____
Infilling: Earth_____ Ballast_____ None_____

B. Slab_____ C. Rigid Frame_____

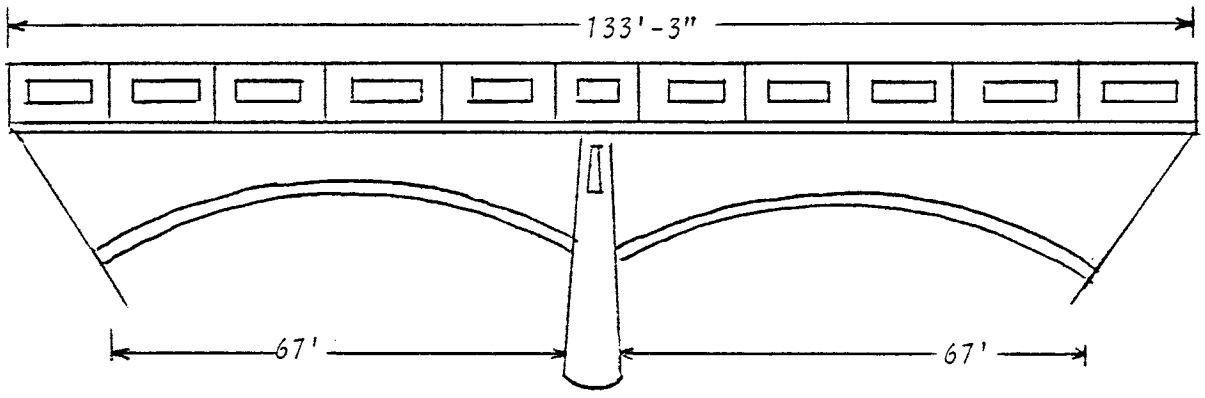
D. Beam_____ Type_____ Size_____ No./Spacing_____
Floorbeam_____ Type_____ Size_____ No./Spacing_____

Reinforcing System: _____

Parapets: Solid concrete with formed line articulation

Sketch

Side Elevation



Section A-A

R-383

A-13

Photo Numbers: -1937

A10:11-16

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Bristol ; No. 1 .
County: Smyth ; No. 86 .
City/Town: .
Street/Road: Route 645 .
River/Stream/Railroad (crossing): N & W RR .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: .
Builder: .
Date: 1896 ; basis for: Keystone carving .
Original owner: N & W RR ; use: Vehicular .
Present owner: ; use: Vehicular .

Historical or Technological Significance

__X__ Unique/Unusual in its time: Ashlar masonry high circular barrel arch underpass.

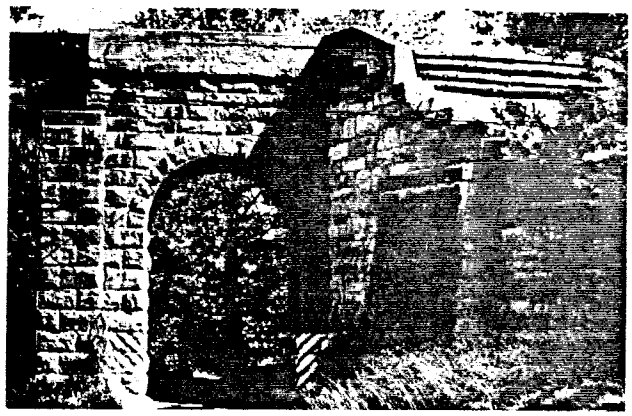
_____ Rare survivor though of standard design: .

_____ Typical example of its time and a common survivor: .

__X__ Other Remarks/Explanation:
-Wing walls heavily buttressed with masonry buttress, projecting from plane of wing wall.
-Seat on s/w end of arch for plate girder which spans river.
-No symmetry, i.e., there is no arch on other bank of river.
-Deteriorated concrete capping on arch and girder seat, added later.

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: July 1981 .
Affiliation: V.H. & T. R. C. .

-1038

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: _____; length overall: _____.

Span types:

(1) *Arch* ; length: *14'-0"* .
(2) _____; length: _____.
(3) _____; length: _____.
(4) _____; length: _____.
(5) _____; length: _____.
(6) _____; length: _____.

No. of lanes: *1* ; Roadway width: *10'-0"*

Structural Information

Substructure:

Material: _____.
Foundations: _____.
Piers: _____.

Abutments: *Masonry* .
Wings: *Masonry* .
Seats: _____.

Superstructure:

Material: Stone *X* Concrete _____

Configuration:

A. Arch *X* Barrel *X* Ribs(no.) _____; Spandrel: Open _____ Solid *X*
Circular *X* Segmental _____ Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

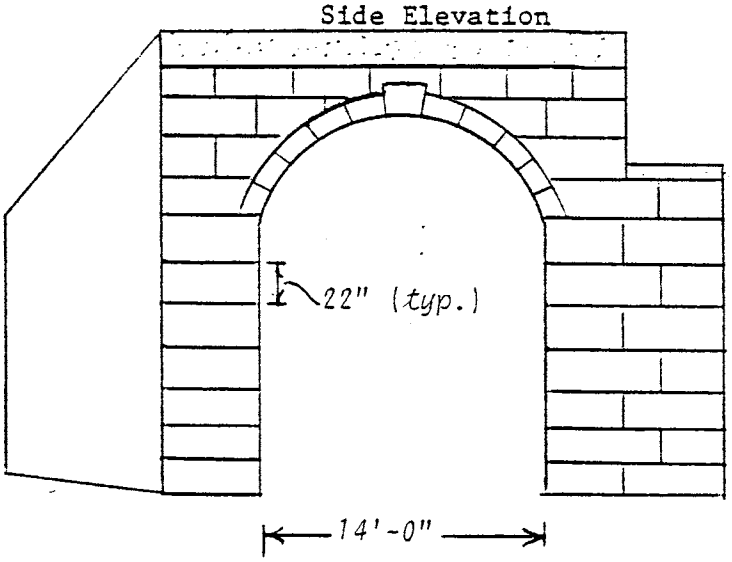
D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

Parapets: _____

Sketch

Side Elevation



Section A-A

-Arch barrell is 13'-1" long
-Courses are 22"

R-383

Photo Numbers. 1029

A9:30-33

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Bristol ; No. 1
County: Washington ; No. 95
City/Town:
Street/Road: Route 612
River/Stream/Railroad (crossing): Stream
UTM/KGS Coordinates:

Historical Information

Formal designation:
Local designation:
Designer:
Builder:
Date: ; basis for:
Original owner: ; use: Vehicular
Present owner: V.D.H & T. ; use: Vehicular

Historical or Technological Significance

X Unique/Unusual in its time: Huge, boulder sized cut stone bridge/culvert with single huge lintel as roadbed.

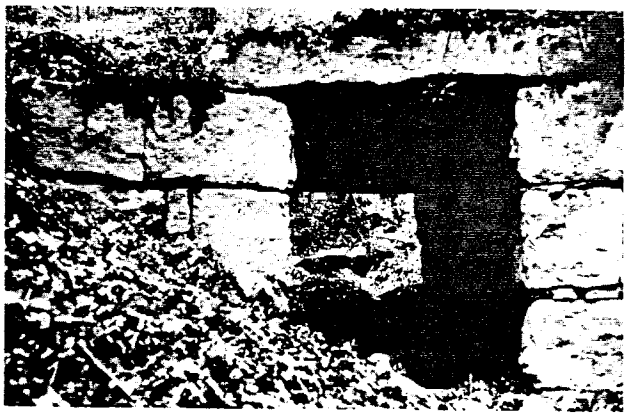
___ Rare survivor though of standard design:

___ Typical example of its time and a common survivor:

X Other Remarks/Explanation: This is not an arch, but is an atypical structure. Road is carried on lintels, which are approximately 8' long, across this stream.

Nature/Degree of any destructive threats:

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero
Date: July 1981
Affiliation: V.H. & T. R. C.

A- 16 -1900

Design Information

Compass orientation of axis: _____. Architectural or decorative features:

No. of spans: 1 ; length overall: _____.
Span types:
(1) Beam ; length: 7'-6" .
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 1 ; Roadway width: 18'-0"

Structural Information

Substructure:
Material: _____. Abutments: _____.
Foundations: _____. Wings: Masonry .
Piers: _____. Seats: _____.

Superstructure:
Material: Stone X Concrete _____ Huge masonry

Configuration:
A. Arch _____ Barrel _____ Ribs (no.) _____ ; Spandrel: Open _____ Solid _____
Circular _____ Segmental _____ Other _____ ; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

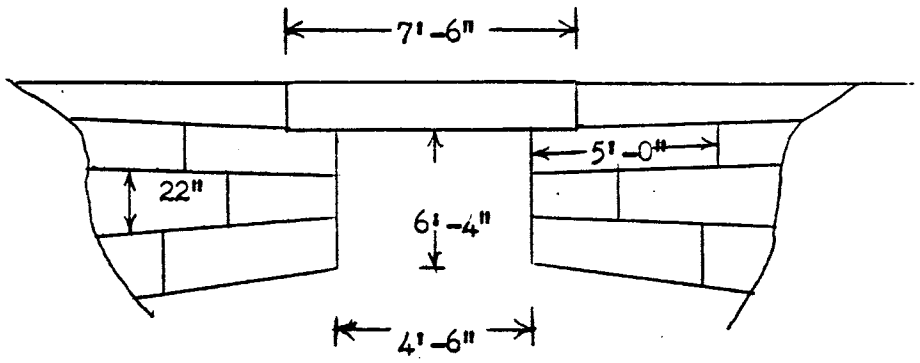
Parapets: _____

Sketch

Side Elevation

Section A-A

goes thru 21'-4"



R-383

Photo Numbers: 1321

8:8 - 8:19

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Bristol ; No. 1 .
County: Wise ; No. 97 .
City/Town: Appalachia .
Street/Road: 23 .
River/Stream/Railroad (crossing): Callahan Creek .
~~UTM/KGS Coordinates:~~ .

Historical Information

Formal designation: .
Local designation: Main Street Bridge .
Designer: Daniel B. Luten .
Builder: .
Date: 1926 ; basis for: Plans .
Original owner: ; use: Vehicular .
Present owner: VDH&T ; use: Vehicular .

Historical or Technological Significance

__X__ Unique/Unusual in its time: Single span 3 ribbed segmental arch with open spandrels .

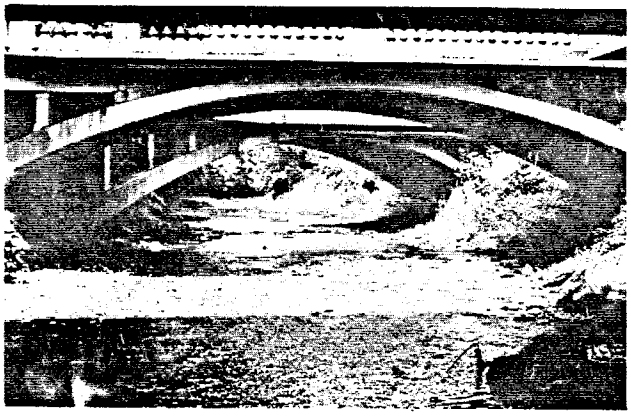
_____ Rare survivor though of standard design: .

_____ Typical example of its time and a common survivor: .

__X__ Other Remarks/Explanation: This bridge and Route 1308 Appalachia Bridge are a pair, same design, at the intersection, a "Y" intersection, of Routes 23 and 1308. Bridge on 1321 in Appalachia designed with these; plans for all three bridges in a set.
-Inner parapet wall remodeled, with modern guardrail .

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: July 1981 .
Affiliation: VH&TRC .

·1[illegible]2

Design Information

Compass orientation of axis: _____.

No. of spans: 1 ; length overall: _____.
Span types:
(1) Arch ; length: 96' .
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 2 ; Roadway width: _____.

Architectural or decorative features:

Decorative posts on north side of bridge

Structural Information

Substructure:
Material: _____. Abutments: Concrete .
Foundations: _____. Wings: Concrete .
Piers: _____. Seats: _____.

Superstructure:
Material: Stone _____ Concrete X

Configuration:
A. Arch X Barrel _____ Ribs(no.) 3 ; Spandrel: Open X Solid _____
Circular _____ Segmental X Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

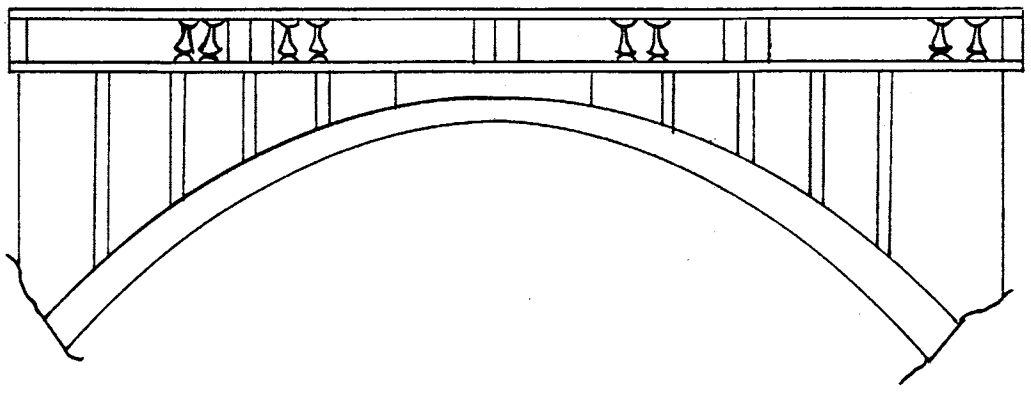
D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

Parapets: _____

Sketch

Side Elevation Section A-A



96'

A-19 1[illegible]3

R-383

Photo Numbers:

8:8 - 8:19

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: *Bristol*; No. *1*.
County: *Wise*; No. *97*.
City/Town: *Appalachia*.
Street/Road: *1308*.
River/Stream/Railroad (crossing): *Callahan Creek*.
~~UTM/KGS Coordinates:~~ .

Historical Information

Formal designation: .
Local designation: *Depot Street Bridge*.
Designer: *Daniel B. Luten*.
Builder: .
Date: *1926*; basis for: *Plans*.
Original owner: ; use: *Vehicular*.
Present owner: *VDH&T*; use: *Vehicular*.

Historical or Technological Significance

X Unique/Unusual in its time: *3 ribbed open spandrel segmental arch - usually 2 ribs on this design*.

____ Rare survivor though of standard design: .

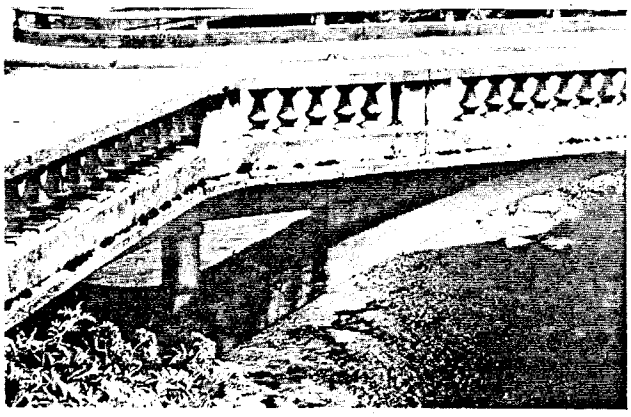
____ Typical example of its time and a common survivor: .

X Other Remarks/Explanation: *Approach roadway is on a skew and supporting beam, which rests on small post, is angled away from bridge.*
-This bridge and the Route 23 bridge form an intersecting pair of bridges which separate Route 23 and Route 1308

-Inner parapet wall remodeled, modern guardrail

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: *P. A. C. Spero*.
Date: *July 1981*.
Affiliation: *VH&TRC*.

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

Decorative parapet wall

No. of spans: *1* ; length overall: _____.
Span types:
(1) *Arch* ; length: *76'* .
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: *2* ; Roadway width: *23'-1"*

Structural Information

Substructure:
Material: _____.
Foundations: _____.
Piers: _____.
Abutments: *Concrete* .
Wings: *Concrete* .
Seats: _____.

Superstructure:
Material: Stone _____ Concrete *X*

Configuration:
A. Arch *X* Barrel _____ Ribs(no.) *3* ; Spandrel: Open *X* Solid _____
Circular _____ Segmental *X* Other _____ ; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

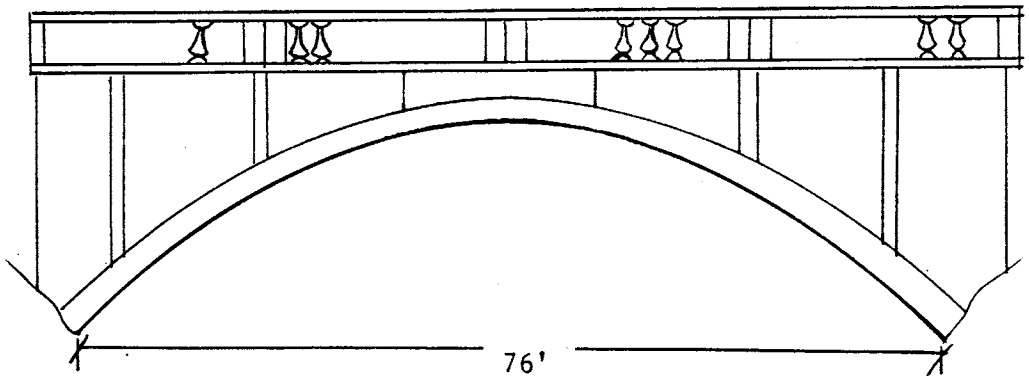
Reinforcing System: _____

Parapets: _____

Sketch

Side Elevation

Section A-A



R-383

A-21

Photo Numbers: 1[illegible]5

A12:2-4

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Bristol ; No. 1 .
County: Wythe ; No. 98 .
City/Town: .
Street/Road: Route 671 .
River/Stream/Railroad (crossing): Cripple Creek .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: Designed and built by: .
Designer: Luten Bridge Company .
Builder: Knoxville, Tennessee - Clarksburg, West Virginia .
Date: 1930 ; basis for: Bridge plate .
Original owner: Speedwell District ; use: Vehicular .
Present owner: V.D.H. & T ; use: Vehicular .

Historical or Technological Significance

_____ Unique/Unusual in its time: .

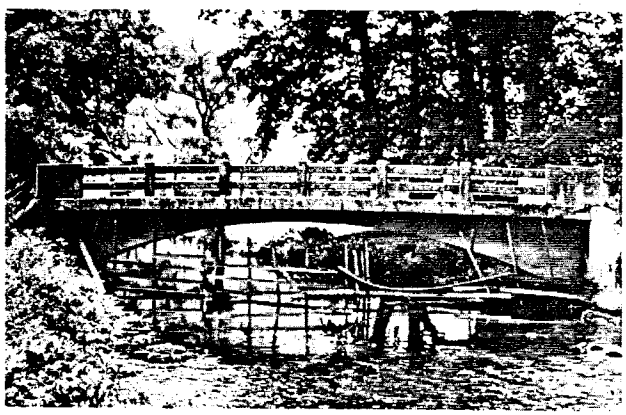
_____ Rare survivor though of standard design: .

X Typical example of its time and a common survivor: Closed spandrel single span, segmental 2 ribbed arch; typical simple Luten bridge .

_____ Other Remarks/Explanation: .

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: July 1981 .
Affiliation: V.H. & T.R.C. .

A-22

1936

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 1 ; length overall: 47'-1"

Span types:

(1) Arch ; length: 45' .
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 1 ; Roadway width: 12'-3".

Structural Information

Substructure:

Material: _____.
Foundations: _____.
Piers: _____.

Abutments: Concrete .
Wings: Concrete .
Seats: _____.

Superstructure:

Material: Stone _____ Concrete X

Configuration:

A. Arch X Barrel _____ Ribs (no.) 2 ; Spandrel: Open _____ Solid X
Circular _____ Segmental X Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

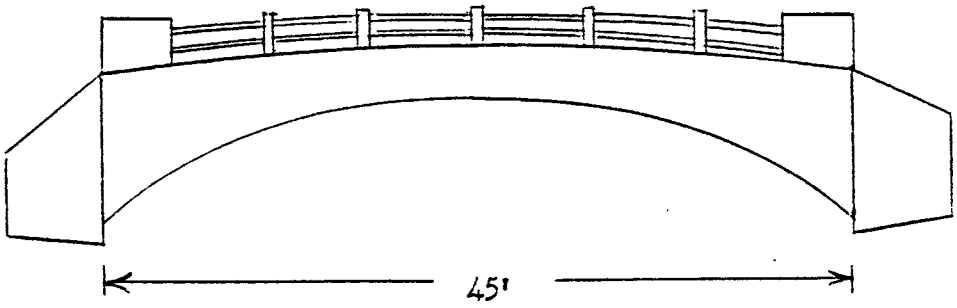
Reinforcing System: _____

Parapets: Concrete post and rail

Sketch

Side Elevation

Section A-A



R-383

A-23

Photo Numbers: 1927

A11:33-36

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Bristol ; No. 1 .
County: Wythe ; No. 98 .
City/Town: .
Street/Road: Route 680 .
River/Stream/Railroad (crossing): Reed Creek .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: Luten Bridge Company, York, Pennsylvania; Knoxville Tennessee .
Builder: .
Date: 1928 ; basis for: Bridge plate .
Original owner: ; use: Vehicular .
Present owner: V.D.H. & T. ; use: Vehicular .

Historical or Technological Significance

_____ Unique/Unusual in its time: .

_____ Rare survivor though of standard design: .

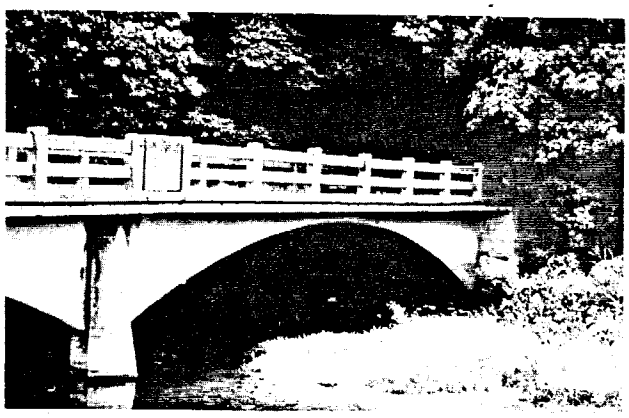
X Typical example of its time and a common survivor: 2 span segmental arch 2 ribs.

_____ Other Remarks/Explanation: .

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:

Recorder: P. A. C. Spero .
Date: July 1981 .
Affiliation: N.H. & T. R. C. .



-1?28

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 2 ; length overall: _____.

Span types:

(1) Arch ; length: 58' .
(2) Arch ; length: 58' .
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 1 ; Roadway width: _____.

Structural Information

Substructure:

Material: _____.
Foundations: _____.
Piers: _____.

Abutments: Concrete .
Wings: Concrete .
Seats: _____.

Superstructure:

Material: Stone _____ Concrete X

Configuration:

A. Arch X Barrel _____ Ribs(no.) 2 ; Spandrel: Open _____ Solid X
Circular _____ Segmental X Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

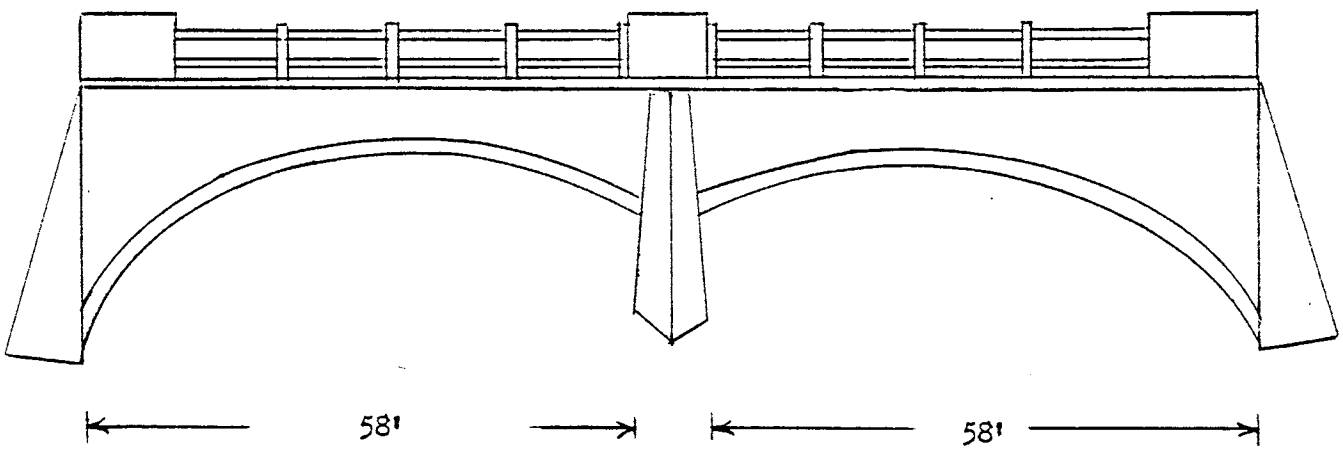
Reinforcing System: _____

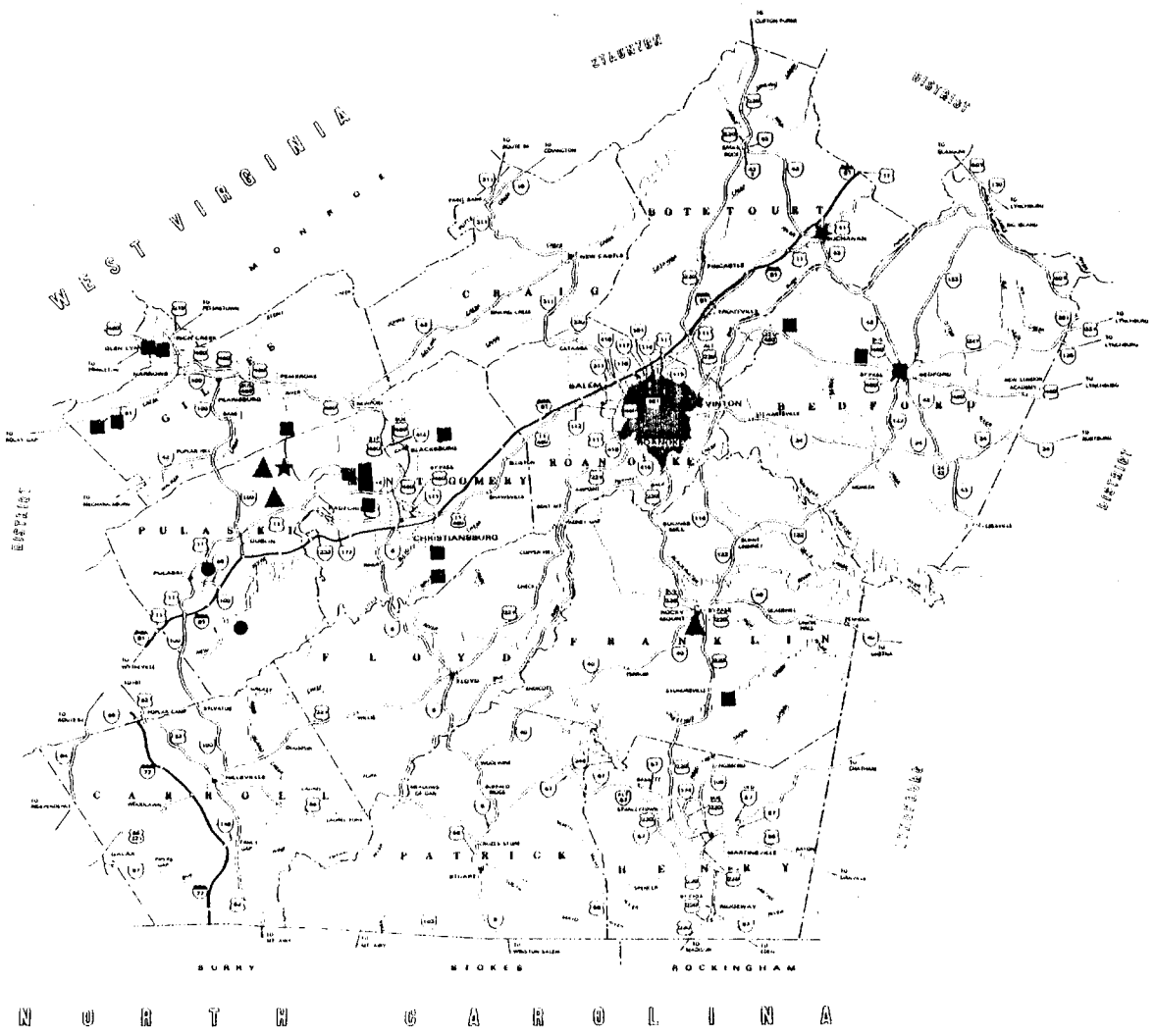
Parapets: Concrete post and rail

Sketch

Side Elevation

Section A-A





SALEM DISTRICT

★ — STONE OR BRICK ARCH

■ — CONCRETE: FILLED SPANDREL ARCH (SOLID BARREL)

● — CONCRETE: CLOSED SPANDREL ARCH (RIBBED)

▲ — CONCRETE: OPEN SPANDREL ARCH (RIBBED)

☆ — CONCRETE: OTHER (RAINBOW ARCH)

1930

R-283

A-27

Photo Numbers: 1021

A15:1-6

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Salem ; No. 2.
County: Bedford ; No. 9.
City/Town: Bedford.
Street/Road: Route 43 and 122 and 221 (N. Bridge Street).
River/Stream/Railroad (crossing): N & W RR.
UTM/KGS Coordinates: _____.

Historical Information

Formal designation: _____.
Local designation: _____.
Designer: _____.
Builder: _____.
Date: 1907 ; basis for: VDH & T records.
Original owner: _____; use: _____.
Present owner: _____; use: Vehicular.

Historical or Technological Significance

_____ Unique/Unusual in its time: _____.

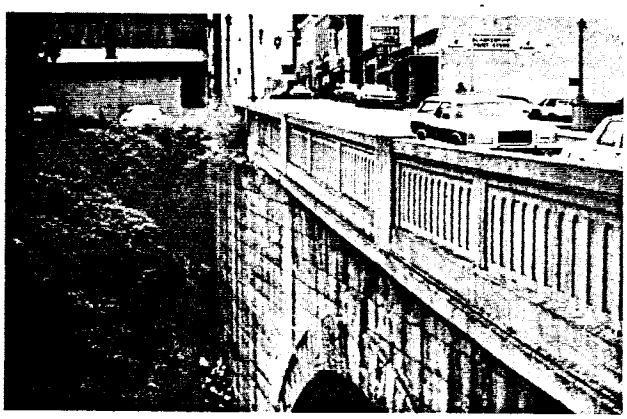
X Rare survivor though of standard design: Earliest large-scale concrete bridge. Single span circular barrel.

_____ Typical example of its time and a common survivor: _____.

X Other Remarks/Explanation: Concrete is formed with high articulation: voussoirs and large keystone and masonry courses.
-Parapets formed to look like post and rails.
-Road and barrel intersect each other, i.e., road crosses on barrel at an angle.

Nature/Degree of any destructive threats: _____.

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero.
Date: July 1981.
Affiliation: V.H. & T.R.C.

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 1 ; length overall: _____.

Span types:

(1) 1 ; length: _____.
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 2 ; Roadway width: _____.

Structural Information

Substructure:

Material: _____.
Foundations: _____.
Piers: _____.

Abutments: Concrete.
Wings: _____.
Seats: _____.

Superstructure:

Material: Stone _____ Concrete X

Configuration:

A. Arch _____ Barrel X Ribs (no.) _____; Spandrel: Open _____ Solid X
Circular X Segmental _____ Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

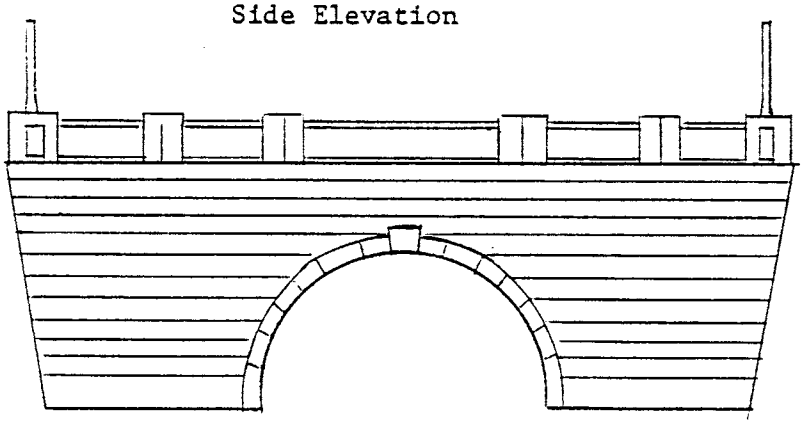
D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

Parapets: Solid concrete, articulated; formed to look like posts and rails, simple lightposts at ends.

Sketch

Side Elevation



Section A-A

B-383

Photo Numbers: 1[illegible]3

A14:32-36

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Salem ; No. 2 .
County: Bedford ; No. 9 .
City/Town: _____ .
Street/Road: Route 680 .
River/Stream/Railroad (crossing): N & W RR .
UTM/KGS Coordinates: _____ .

Historical Information

Formal designation: _____ .
Local designation: _____ .
Designer: _____ .
Builder: _____ .
Date: 1906 ; basis for: Formed in concrete .
Original owner: _____ ; use: _____ .
Present owner: _____ ; use: _____ .

Historical or Technological Significance

_____ Unique/Unusual in its time: _____ .

X Rare survivor though of standard design: Early circular barrel railroad underpass, high and wide clearance.

_____ Typical example of its time and a common survivor: _____ .

X Other Remarks/Explanation: Old stone masonry wing walls and retaining wall remain in front of structure on south side.

Nature/Degree of any destructive threats: _____ .

Reference materials and contemporary photos/illustrations with their respective locations:

Recorder: P. A. C. Spero .
Date: August 1981 .
Affiliation: V.H & T.R.C. .

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 1 ; length overall: _____.

Span types:

(1) Arch ; length: 30' .
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 1 ; Roadway width: _____.

Structural Information

Substructure:

Material: _____.
Foundations: _____.
Piers: _____.

Abutments: Concrete .
Wings: Concrete and stone on south .
[illegible]: Concrete only on north side .

Superstructure:

Material: Stone _____ Concrete X

Configuration:

A. Arch _____ Barrel X Ribs(no.) _____; Spandrel: Open _____ Solid X
Circular X Segmental _____ Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

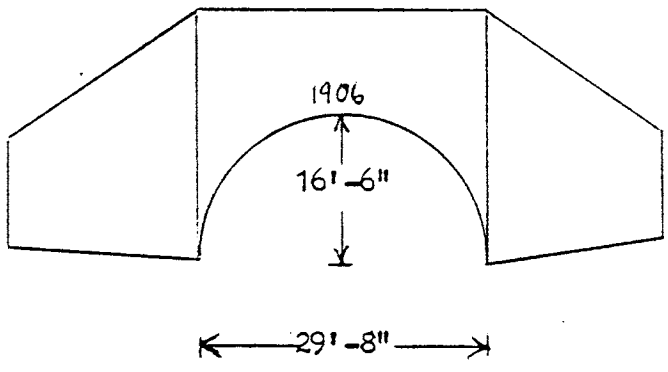
Reinforcing System: _____

Parapets: _____

Sketch

Side Elevation

Section A-A



R-383

A-31

Photo Numbers: 10

A13:29-32

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Salem ; No. 2 .
County: Botetourt ; No. 11 .
City/Town: Buchanan .
Street/Road: Route 1308 .
River/Stream/Railroad (crossing): N & W RR .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: .
Builder: .
Date: c. 1870-1881 ; basis for: N & W RR history .
Original owner: N & W RR ; use: Vehicular .
Present owner: ; use: Vehicular .

Historical or Technological Significance

____ Unique/Unusual in its time: .

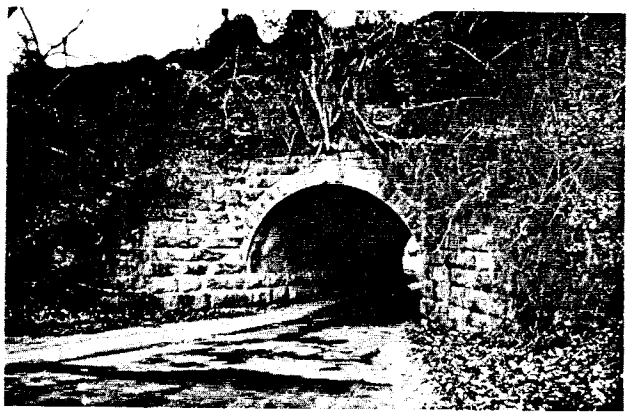
__X__ Rare survivor though of standard design: Stone masonry railroad underpass.

____ Typical example of its time and a common survivor: .

__X__ Other Remarks/Explanation: Voussoirs and cap stones are differentiated from rest of structure

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: August 1981 .
Affiliation: V.H.& T.R.C. .

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 1 ; length overall: _____.

Span types:

(1) Arch ; length: 20' .
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 1 ; Roadway width: _____.

Structural Information

Substructure:

Material: _____.
Foundations: _____.
Piers: _____.

Abutments: Stone .
Wings: Stone .
Seats: _____.

Superstructure:

Material: Stone X Concrete _____

Configuration:

A. Arch _____ Barrel X Ribs(no.) _____; Spandrel: Open _____ Solid X
Circular X Segmental _____ Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

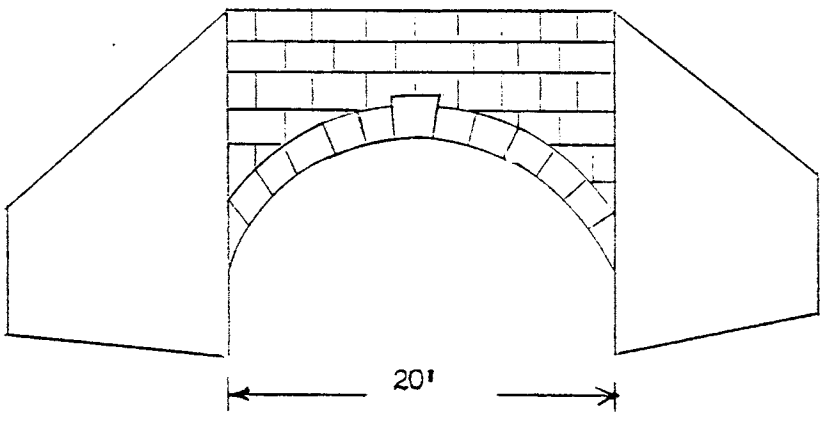
D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

Parapets: _____

Sketch

Side Elevation



Section A-A

Barrel is 80' long

R-383

A-33

1907

Photo Numbers:

A13:24-27

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Salem ; No. 2 .
County: Franklin ; No. 33 .
City/Town: Rocky Mount .
Street/Road: Route 220 .
River/Stream/Railroad (crossing): Pigg River .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: Peter Sanders Memorial Bridge .
Designer: .
Builder: .
Date: 1928 ; basis for: Date plate .
Original owner: Virginia State Highway Comm. ; use: Vehicular .
Present owner: V.D.H. & T. ; use: Vehicular .

Historical or Technological Significance

_____ Unique/Unusual in its time: .

_____ Rare survivor though of standard design: .

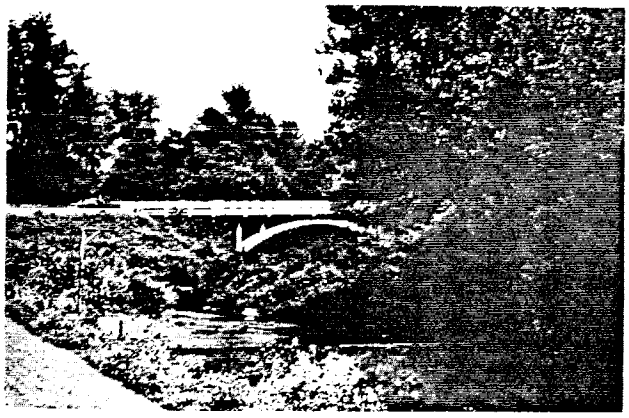
__X__ Typical example of its time and a common survivor: 2 ribbed open spandiel arch.

_____ Other Remarks/Explanation: .

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:

Recorder: P. A. C. Spero .
Date: August 1981 .
Affiliation: V.H. & T.R.C. .



-1[illegible]8

Design Information

Compass orientation of axis: _____. Architectural or decorative features:

No. of spans: 3 ; length overall: _____.
Span types:
(1) Concrete beam ; length: 34' .
(2) Concrete arch ; length: 106' .
(3) Concrete beam ; length: 34' .
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 2 ; Roadway width: _____.

Structural Information

Substructure:
Material: _____. Abutments: Concrete .
Foundations: _____. Wings: Concrete .
Piers: _____. Seats: _____.

Superstructure:
Material: Stone _____ Concrete X

Configuration:
A. Arch X Barrel _____ Ribs(no.) 2 ; Spandrel: Open X Solid _____
Circular _____ Segmental X Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

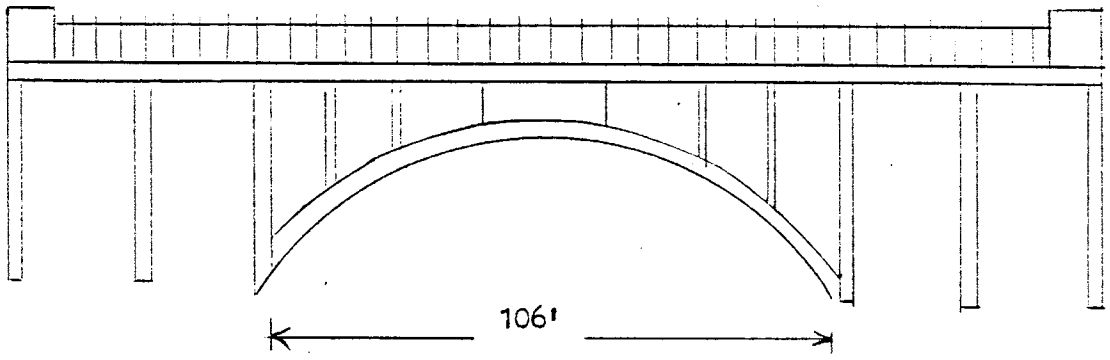
D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

Parapets: Concrete post and rail

Sketch

Side Elevation Section A-A



R-383

A-35

Photo Numbers: 1[illegible]9

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

A13:18-20

Geographic Information

State: Virginia
Va. Dept. of Highways District: Salem ; No. 2.
County: Montgomery ; No. 60.
City/Town: .
Street/Road: Route 723.
River/Stream/Railroad (crossing): N & W RR.
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: .
Builder: Bates and Rogers Construction Company.
Date: 1906 ; basis for: Date plate - metal plate embedded in concrete.
Original owner: ; use: .
Present owner: ; use: Vehicular.

Historical or Technological Significance

X Unique/Unusual in its time: Horseshoe arch: at spring point arch turns inward.

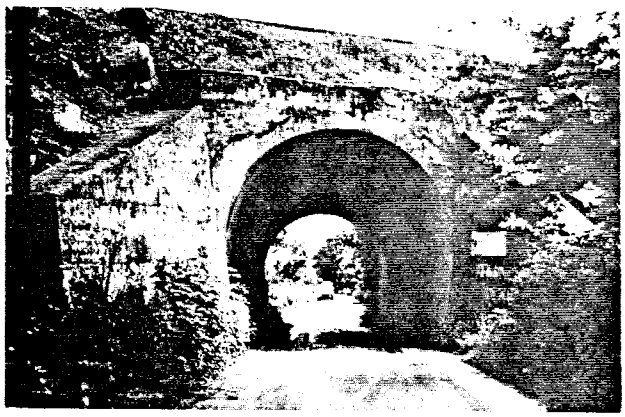
___ Rare survivor though of standard design: .

X Typical example of its time and a common survivor: Single circular barrel RR underpass.

X Other Remarks/Explanation: All RR underpasses in Montgomery County of this horseshoe arch design -only metal date plate on this arch - Bates and Rogers Construction Company 1906.

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero.
Date: August 1981.
Affiliation: V.H. & T.R.C.

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 1 ; length overall: _____.

Span types:

(1) Arch ; length: 15' .
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 1 ; Roadway width: 12'-0"

Structural Information

Substructure:

Material: _____. Abutments: Concrete .
Foundations: _____. Wings: Concrete .
Piers: _____. Seats: _____.

Superstructure:

Material: Stone _____ Concrete X

Configuration:

A. Arch _____ Barrel X Ribs (no.) _____; Spandrel: Open _____ Solid X
Circular X Segmental _____ Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

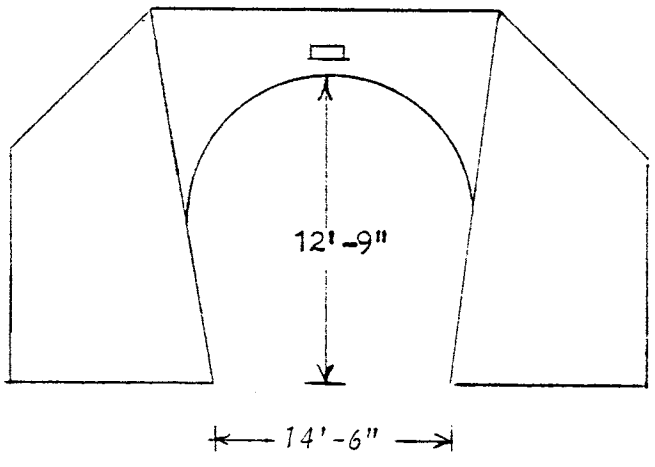
Reinforcing System: _____

Parapets: _____

Sketch

Side Elevation

Section A-A



R-383

A-37

Photo Numbers: 1 - 1 1

A12:29-33

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Salem ; No. 2 .
County: Pulaski ; No. 77 .
City/Town: .
Street/Road: Route 600 .
River/Stream/Railroad (crossing): Back Creek .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: Luten Bridge Company, Clarksburg, West Virginia; Knoxville, Tennessee .
Builder: .
Date: 1930 ; basis for: Bridge plate .
Original owner: Dublin District ; use: Vehicular .
Present owner: Virginia Dept. of Highway & Transp. use: Vehicular .

Historical or Technological Significance

_____ Unique/Unusual in its time: _____

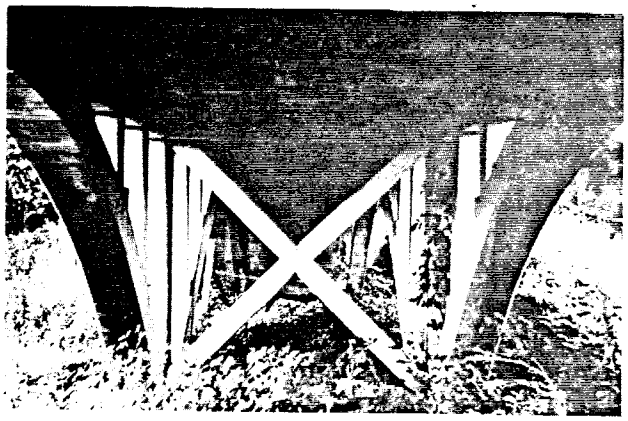
_____ Rare survivor though of standard design: _____

X Typical example of its time and a common survivor: 2 span, 2 ribbed open spandrel arch, without lateral bracing (only at 2 center posts).

_____ Other Remarks/Explanation: _____

Nature/Degree of any destructive threats: _____

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: August 1981 .
Affiliation: V.H. & T.R.C. .

Design Information

Compass orientation of axis: _____. Architectural or decorative features:

No. of spans: 2 ; length overall: 121'-8"
Span types:
(1) Arch ; length: 60'.
(2) Arch ; length: 60'.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 2 ; Roadway width: 19'-2".

Structural Information

Substructure:
Material: _____. Abutments: Concrete.
Foundations: _____. Wings: Concrete.
Piers: _____. Seats: _____.

Superstructure:
Material: Stone _____ Concrete X

Configuration:
A. Arch X Barrel _____ Ribs(no.) 2 ; Spandrel: Open X Solid _____
Circular _____ Segmental X Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

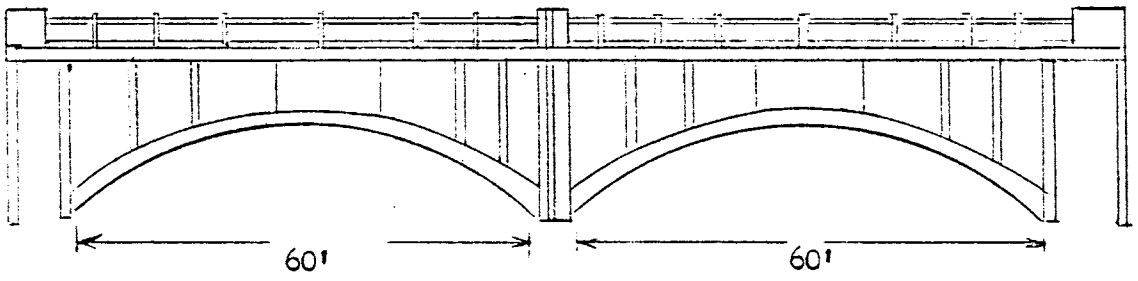
D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

Parapets: Post and rail concrete

Sketch

Side Elevation Section A-A



R-383

A-39

Photo Numbers: C 1[illegible] 3

A12:34,35
A13:1

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Salem ; No. 2 .
County: Pulaski ; No. 77 .
City/Town: .
Street/Road: Route 755 .
River/Stream/Railroad (crossing): N & W RR .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: .
Builder: .
Date: c. 1881-1882 ; basis for: N & W RR history .
Original owner: ; use: .
Present owner: ; use: .

Historical or Technological Significance

____ Unique/Unusual in its time: .

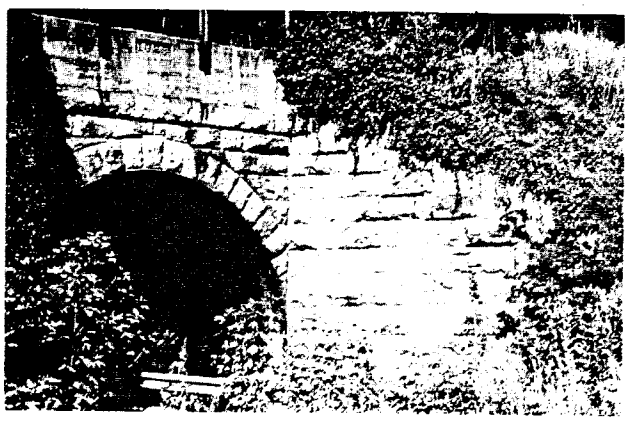
X Rare survivor though of standard design: Masonry circular barrel underpass, carrying road and stream .

____ Typical example of its time and a common survivor: .

X Other Remarks/Explanation:
-Concrete added to raise railroad bed in 1928, formed in concrete.
-Stream diverted in lined depression, at edge of barrel.

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: July 1981 .
Affiliation: V.H. & T.R.C. .

Design Information

Compass orientation of axis: _____. Architectural or decorative features:

No. of spans: 1 ; length overall: 20'-0"
Span types:
(1) Arch ; length: 20'-0" .
(2) _____ ; length: _____ .
(3) _____ ; length: _____ .
(4) _____ ; length: _____ .
(5) _____ ; length: _____ .
(6) _____ ; length: _____ .

No. of lanes: 1 ; Roadway width: 12'-0"

Structural Information

Substructure:
Material: _____ . Abutments: Masonry .
Foundations: _____ . Wings: Masonry .
Piers: _____ . Seats: _____ .

Superstructure:
Material: Stone X Concrete X (Concrete added to raise RR bed)

Configuration:
A. Arch _____ Barrel X Ribs(no.) _____ ; Spandrel: Open _____ Solid X
Circular X Segmental _____ Other _____ ; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

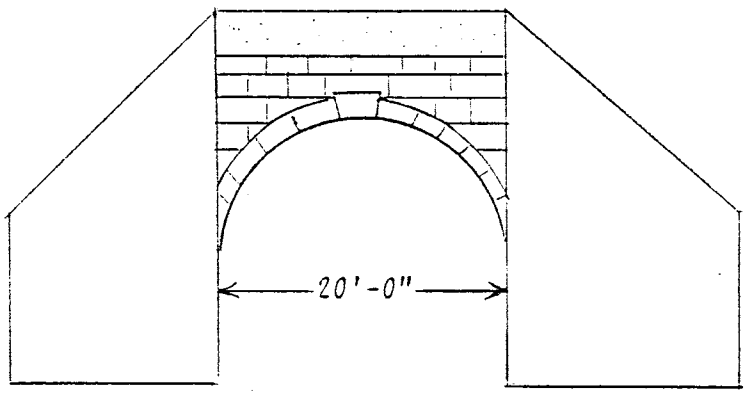
D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

Parapets: _____

Sketch

Side Elevation Section A-A



R-383

A-41

Photo Numbers:

12-5

A13:33-36
A14:1-7

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Salem ; No. 2.
County: Roanoke ; No. 80.
City/Town: Roanoke.
Street/Road: Route 116.
River/Stream/Railroad (crossing): 3rd St. & N & W RR.
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: W. P. Wiltsee, (N&W Engr.); Benjamin Davis, consulting engineer; Ambrose West
Builder: R. C. Churchill Company, Inc.
Date: 1927 ; basis for: Bridge plate.
Original owner: City of Roanoke, and N & W RR ; use: Vehicular.
Present owner: ; use: Vehicular

Historical or Technological Significance

___ Unique/Unusual in its time: .

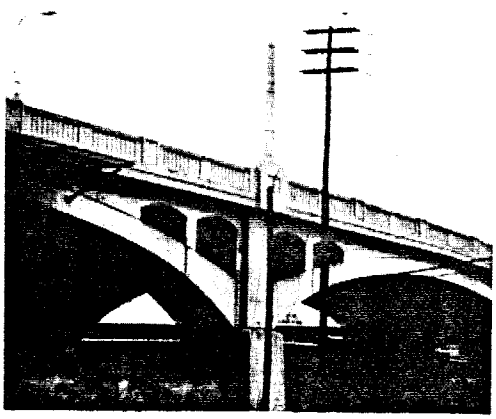
___ Rare survivor though of standard design: .

X Typical example of its time and a common survivor: 2 ribbed open spandiel arch.

X Other Remarks/Explanation: Monumental metropolitan highway bridge, highly ornamental, typical of the time.
"Egypto-Babulonian" parapets
-Posts at pier obelisk shaped.

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero.
Date: August 1981.
Affiliation: V.H. & T.R.C.

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 5 ; length overall: _____.
Span types:
(1) Arch ; length: 177'.
(2) Arch ; length: 177'.
(3) Arch ; length: 177'.
(4) Arch ; length: 177'.
(5) Arch ; length: 177'.
(6) _____ ; length: _____.

No. of lanes: 2 ; Roadway width: _____.

Structural Information

Substructure:
Material: _____.
Foundations: _____.
Piers: _____.
Abutments: Concrete.
Wings: Concrete.
Seats: _____.

Superstructure:
Material: Stone _____ Concrete X

Configuration:
A. Arch X Barrel _____ Ribs(no.) 2 ; Spandrel: Open X Solid _____
Circular _____ Segmental X Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

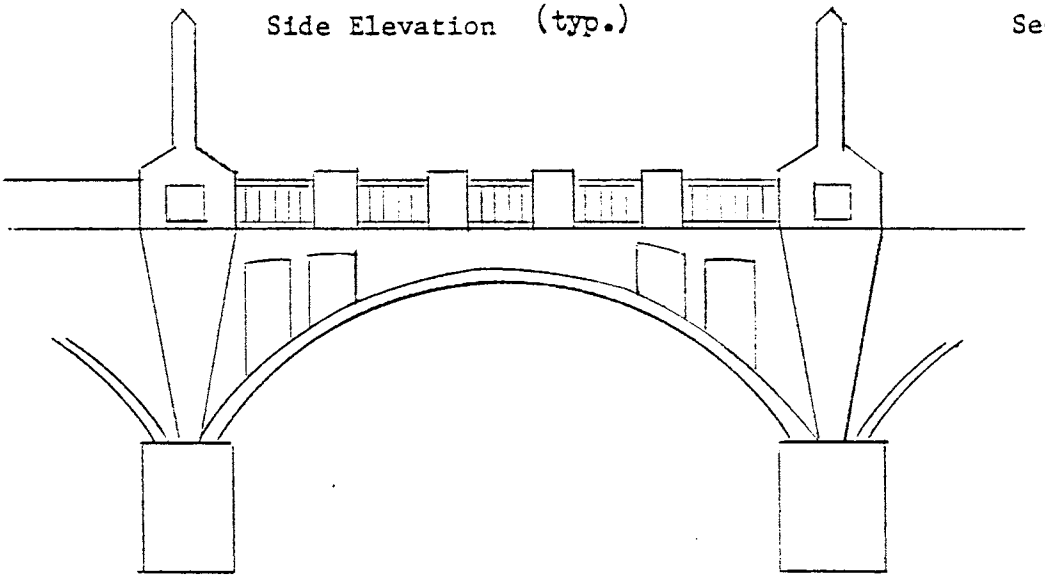
Reinforcing System: _____

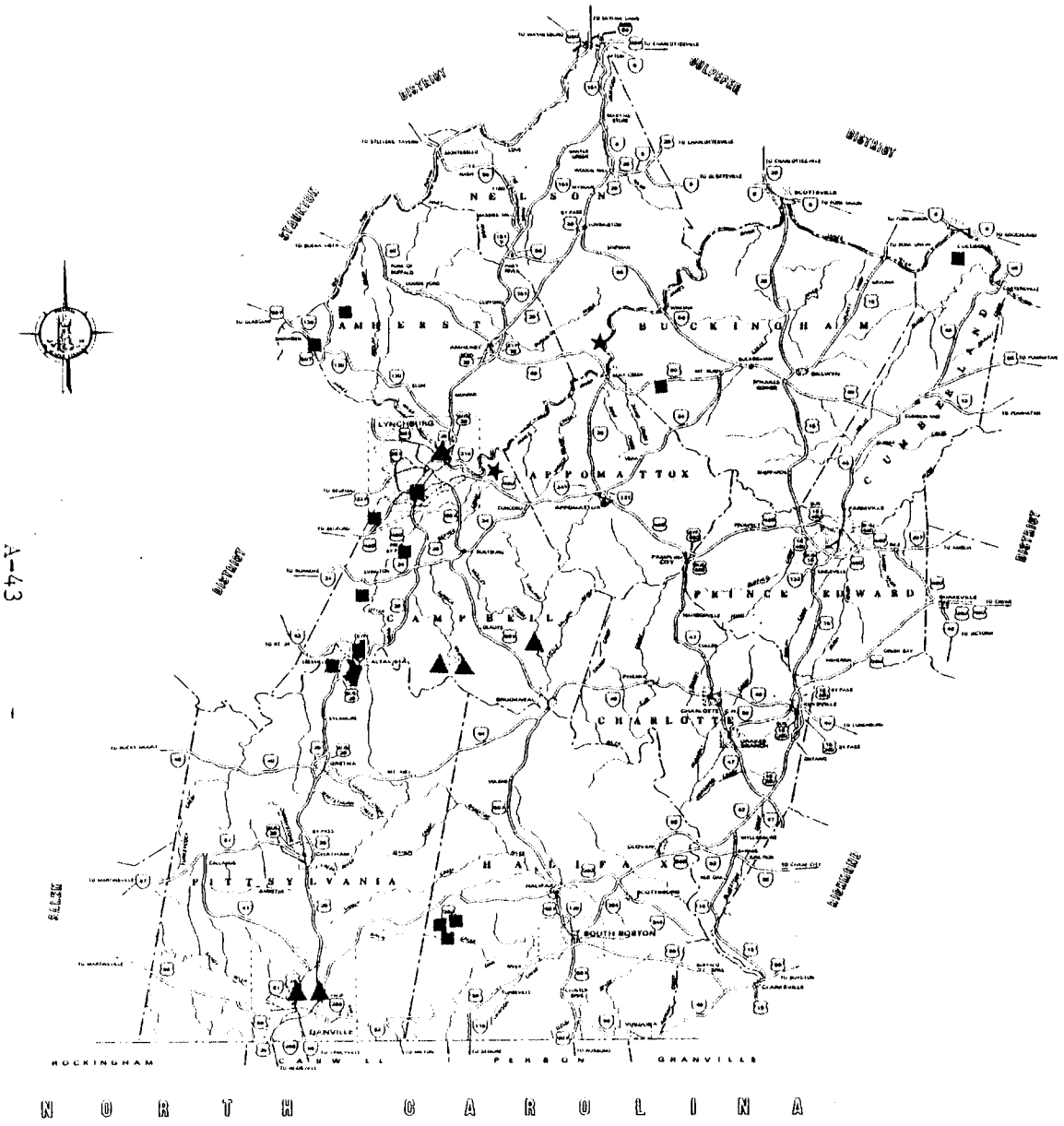
Parapets: Solid concrete, formed to look like posts and rails, some smooth, some rough with exposed aggregate.

Sketch

Side Elevation (typ.)

Section A-A





LYNCHBURG DISTRICT

★ — STONE OR BRICK ARCH

□ — CONCRETE: FILLED SPANDREL ARCH (SOLID BARREL)

● — CONCRETE: CLOSED SPANDREL ARCH (RIBBED)

▲ — CONCRETE: OPEN SPANDREL ARCH (RIBBED)

☆ — CONCRETE: OTHER (RAINBOW ARCH)

R-383

A-45

Photo Numbers: 1 2 9

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

A7:30-36

Geographic Information

State: Virginia
Va. Dept. of Highways District: Lynchburg ; No. 3.
County: Campbell ; No. 15.
City/Town: .
Street/Road: Route 609.
River/Stream/Railroad (crossing): N & W RR (ab'd.).
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: .
Builder: .
Date: c. 1854 ; basis for: Southside RR construction nearby, at Concorde.
Original owner: Southside Railroad ; use: .
Present owner: ; use: Vehicular.

Historical or Technological Significance

_____ Unique/Unusual in its time: .

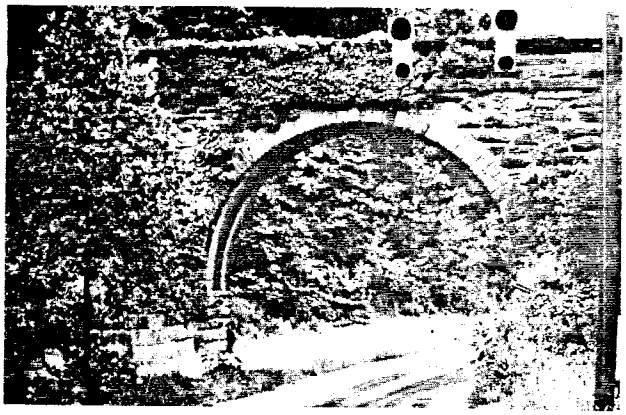
_X_ Rare survivor though of standard design: Very thin ringed masonry barrel with articulated voussiors; skewback is articulated and course above arch deteriorated.

_____ Typical example of its time and a common survivor: .

_X_ Other Remarks/Explanation: This underpass is next to a rock quarry and would have been easy to build at this location.
-Arch ring is smooth cut, picked; very rough-faced, projecting masonry on remainder.
-Arch ring is 10' wide at skewback; narrowing to approximately 8' at crown.
-Railroad line from Petersburg to Lynchburg, Southside RR, constructed at this time.

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero.
Date: July 1983.
Affiliation: V.H. & T.R.C.

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 1 ; length overall: 30'.
Span types:
(1) _____; length: _____.
(2) _____; length: _____.
(3) _____; length: _____.
(4) _____; length: _____.
(5) _____; length: _____.
(6) _____; length: _____.

No. of lanes: 2 ; Roadway width: 30'.

Structural Information

Substructure:
Material: _____.
Foundations: _____.
Piers: _____.
Abutments: Masonry.
Wings: _____.
Seats: _____.

Superstructure:
Material: Stone X Concrete _____

Configuration:
A. Arch X Barrel X Ribs(no.) _____; Spandrel: Open _____ Solid _____
Circular X Segmental _____ Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

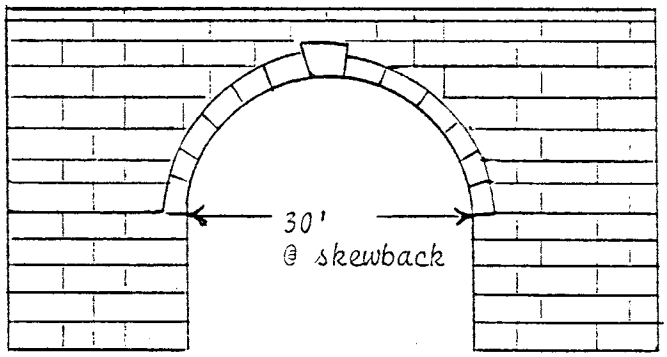
Reinforcing System: _____

Parapets: _____

Sketch

Side Elevation

Section A-A



R-383

A-47 1?:1
Photo Numbers:

A3:7-20
A4:1-13

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Lynchburg ; No. 3 .
County: Campbell ; No. 15 .
City/Town: .
Street/Road: Route 704 .
River/Stream/Railroad (crossing): .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: Luten Bridge Company, York, Pennsylvania; Knoxville, Tennessee .
Builder: .
Date: 1928 ; basis for: Bridge plate .
Original owner: ; use: Vehicular .
Present owner: V.D.H & T ; use: Vehicular .

Historical or Technological Significance

_____ Unique/Unusual in its time: .

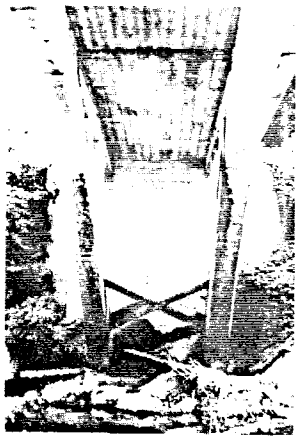
_____ Rare survivor though of standard design: .

X Typical example of its time and a common survivor: 2 ribbed open spandiel arch.

_____ Other Remarks/Explanation: .

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: July 1981 .
Affiliation: V.H. & T.R.C. .

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 1 ; length overall: _____.

Span types:

(1) Arch ; length: 86' .
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 1 ; Roadway width: 11'-6".

Structural Information

Substructure:

Material: _____. Abutments: Concrete .
Foundations: _____. Wings: Concrete .
Piers: _____. Seats: _____.

Superstructure:

Material: Stone _____ Concrete X

Configuration:

A. Arch X Barrel _____ Ribs(no.) 2 ; Spandrel: Open X Solid _____
Circular _____ Segmental X Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

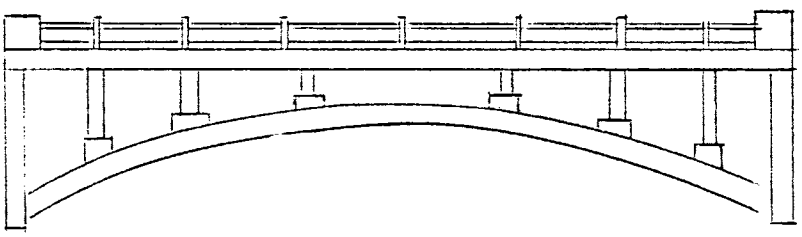
Parapets: Concrete post and rail

Sketch

Side Elevation

85'-11"

Section A-A



R-383

A-49

Photo Numbers: [illegible]

A5:8-10

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Lynchburg ; No. 3 .
County: Halifax ; No. 41 .
City/Town: .
Street/Road: Route 663 .
River/Stream/Railroad (crossing): Birch Creek .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: .
Builder: .
Date: ; basis for: .
Original owner: ; use: Vehicular .
Present owner: V.D.H. & T ; use: Vehicular .

Historical or Technological Significance

____ Unique/Unusual in its time: .

_X_ Rare survivor though of standard design: Concrete barrel faced with ashlar masonry, masonry wing walls and parapet walls.

____ Typical example of its time and a common survivor: .

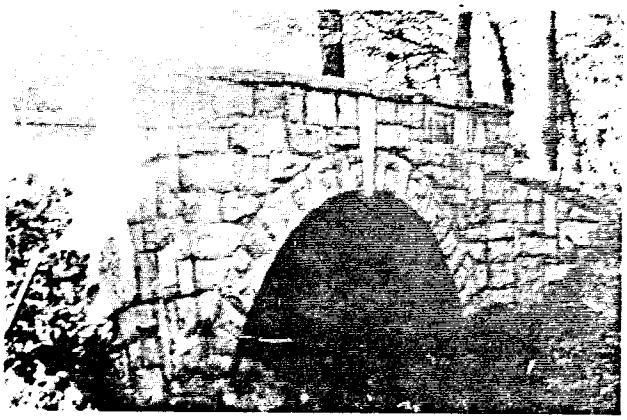
_X_ Other Remarks/Explanation: Very attractive small span bridge, though of relatively late construction.

Nature/Degree of any destructive threats: Exposed reinforcement in barrel

Reference materials and contemporary photos/illustrations with their respective locations:

NOTE: Not on computer inventroy

Recorder: P. A. C. Spero .
Date: July 1981 .
Affiliation: V.H. & T.R.C. .



A-50 134

Design Information

Compass orientation of axis: _____.

No. of spans: 1 ; length overall: 21'-6".
Span types:
(1) Arch ; length: 13'-11".
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 1 ; Roadway width: 18'-5".

Architectural or decorative features:

Keystone extends to top of parapet wall.

Structural Information

Substructure:
Material: _____.
Foundations: _____.
Piers: _____.

Abutments: _____.
Wings: *Stone masonry*.
Seats: _____.

Superstructure:
Material: Stone X Concrete X

Configuration:
A. Arch X Barrel X Ribs(no.)____; Spandrel: Open____ Solid X
Circular X Segmental____ Other_____; Fixed____ Hinged____
Infilling: Earth____ Ballast____ None____

B. Slab____ C. Rigid Frame____

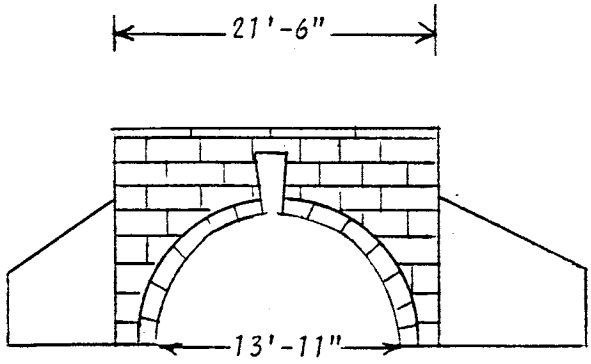
D. Beam____ Type_____ Size_____ No./Spacing_____
Floorbeam____ Type_____ Size_____ No./Spacing_____

Reinforcing System: _____

Parapets: *Stone masonry*

Sketch

Side Elevation



Section A-A

P-383

A-51 ~~1~~ 5

Photo Numbers:

A2:6-21

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Lynchburg ; No. 3 .
County: Nelson ; No. 62 .
City/Town: .
Street/Road: Route 606 .
River/Stream/Railroad (crossing): Owen's Creek .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: .
Builder: .
Date: c. 1830-1840 ; basis for: Construction of James River and Kanawha Canal .
Original owner: ; use: Canal .
Present owner: V.D.H. & T. ; use: Vehicular .

Historical or Technological Significance

____ Unique/Unusual in its time: .

__X__ Rare survivor though of standard design: Many James River and Kanawha Canal aquaducts exant, but this is the only one surveyed which now carries vehicular. traffi

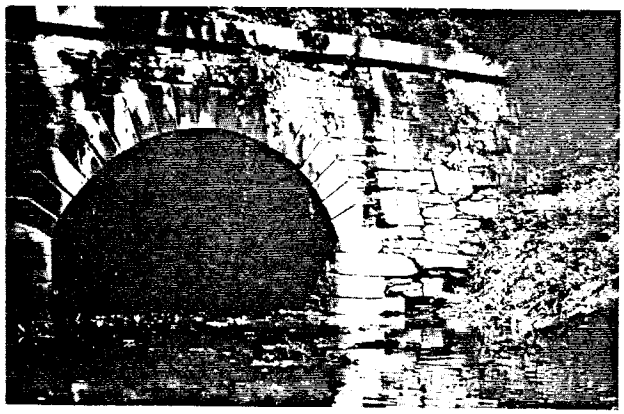
____ Typical example of its time and a common survivor: .

__X__ Other Remarks/Explanation: Masonry 2 span arch.

Nature/Degree of any destructive threats: .

Reference materials and contamporary photos/illustrations with their respective locations:

NOTE: Listed in computer inventory as 1 car 37.



Recorder: P. A. C. Spero .
Date: July 1981 .
Affiliation: V.H. & T.R.C. .

Design Information

Compass orientation of axis:_____. Architectural or decorative features:

No. of spans: 2 ;length overall:_____.
Span types:
(1) Arch ; length:_____.
(2) Arch ; length:_____.
(3)_____; length:_____.
(4)_____; length:_____.
(5)_____; length:_____.
(6)_____; length:_____.

No. of lanes:_____; Roadway width:_____.

Structural Information

Substructure:
Material:_____. Abutments: Stone .
Foundations:_____. Wings: Stone .
Piers:_____. Seats:_____.

Superstructure:
Material: Stone X Concrete_____

Configuration:
A. Arch X Barrel X Ribs(no.)_____; Spandrel: Open_____ Solid_____
Circular_____ Segmental_____ Other_____; Fixed_____ Hinged_____
Infilling: Earth_____ Ballast_____ None_____

B. Slab_____ C. Rigid Frame_____

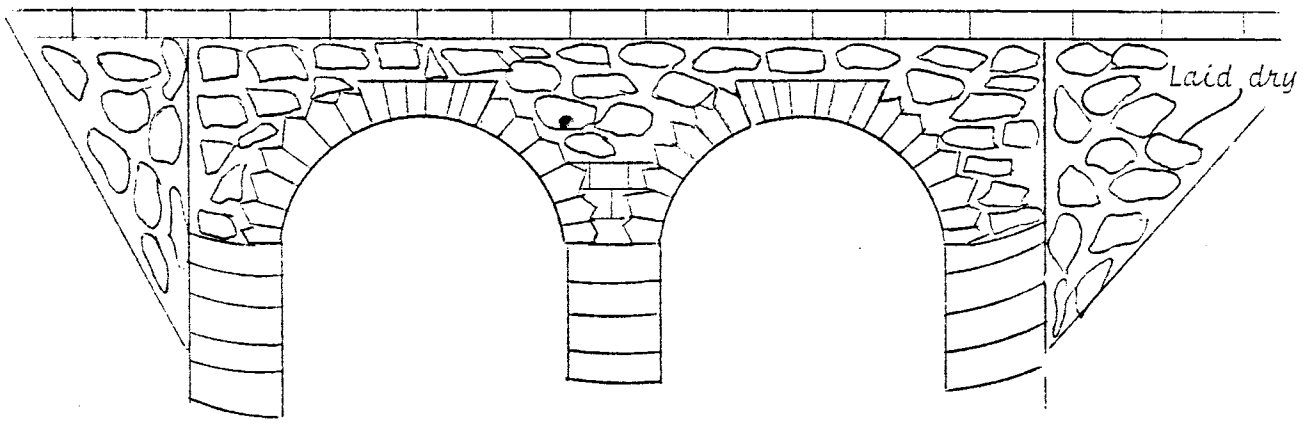
D. Beam_____ Type_____ Size_____ No./Spacing_____
Floorbeam_____ Type_____ Size_____ No./Spacing_____

Reinforcing System:_____

Parapets:_____

Sketch

Side Elevation Section A-A



R-383

A-53

Photo Numbers:

A6:1-5
10, 11

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Lynchburg ; No. 3 .
County: Pittsylvania ; No. 71 .
City/Town: Danville .
Street/Road: Route 29 - Main Street .
River/Stream/Railroad (crossing): Dan River .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: Main Street Bridge .
Designer: Daniel B. Luten .
Builder: Concrete Steel Bridge Company, Clarksville, West Virginia .
Date: 1927 ; basis for: Bridge plate .
Original owner: ; use: Vehicular .
Present owner: V.D.H. & T ; use: Vehicular

Historical or Technological Significance

_____ Unique/Unusual in its time: .

X Rare survivor though of standard design: Danville bridges are only long span open spandrel Luten bridges in Virginia .

_____ Typical example of its time and a common survivor: .

_____ Other Remarks/Explanation: .

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:

Recorder: P. A. C. Spero .
Date: July 1981 .
Affiliation: V.H. & T.R.C. .

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 7 ; length overall: 829' .
Span types:
(1) Arch ; length: _____.
(2) Arch ; length: _____.
(3) Arch ; length: _____.
(4) Arch ; length: _____.
(5) Arch ; length: _____.
(6) Arch ; length: _____.
(7) Arch

No. of lanes: _____; Roadway width: _____.

Structural Information

Substructure:
Material: _____.
Foundations: _____.
Piers: _____.
Abutments: Concrete .
Wings: Concrete .
Seats: _____.

Superstructure:
Material: Stone _____ Concrete X

Configuration:
A. Arch X Barrel _____ Ribs(no.) 2 ; Spandrel: Open X Solid _____
Circular _____ Segmental X Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

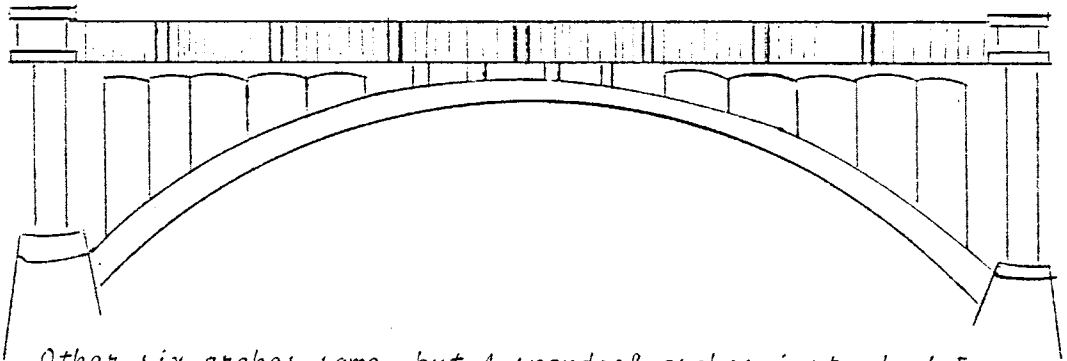
Reinforcing System: _____

Parapets: Balustrade concrete type, typical Luten details

Sketch

Side Elevation - Center Arch

Section A-A



Other six arches same, but 4 spandrel arches instead of 5

R-383

A-55

Photo Numbers: [illegible]

A6:19, 20

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Lynchburg ; No. 3 .
County: Pittsylvania ; No. 77 .
City/Town: Danville .
Street/Road: .
River/Stream/Railroad (crossing): Southern RR .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: .
Builder: .
Date: 1915 ; basis for: Date plate .
Original owner: ; use: Vehicular .
Present owner: ; use: Vehicular .

Historical or Technological Significance

____ Unique/Unusual in its time: .

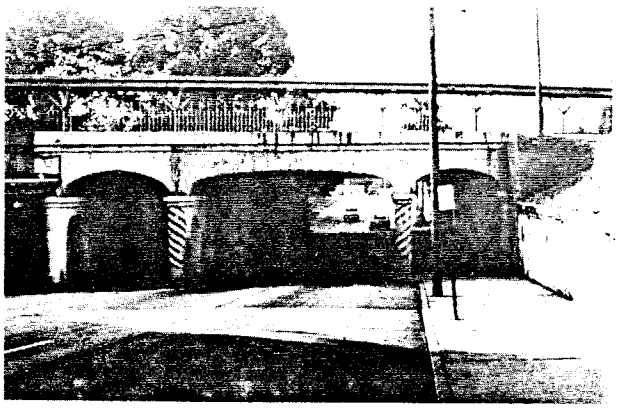
__X__ Rare survivor though of standard design: .

____ Typical example of its time and a common survivor: .

____ Other Remarks/Explanation: .

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: July 1981 .
Affiliation: V.H. & T.R.C. .

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 3 ; length overall: _____.

Span types:

(1) _____; length: _____.
(2) _____; length: _____.
(3) _____; length: _____.
(4) _____; length: _____.
(5) _____; length: _____.
(6) _____; length: _____.

No. of lanes: _____; Roadway width: _____.

Structural Information

Substructure:

Material: _____.
Foundations: _____.
Piers: _____.

Abutments: Concrete.
Wings: Concrete.
Seats: _____.

Superstructure:

Material: Stone _____ Concrete X

Configuration:

A. Arch _____ Barrel X Ribs(no.) _____; Spandrel: Open _____ Solid X
Circular _____ Segmental X Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

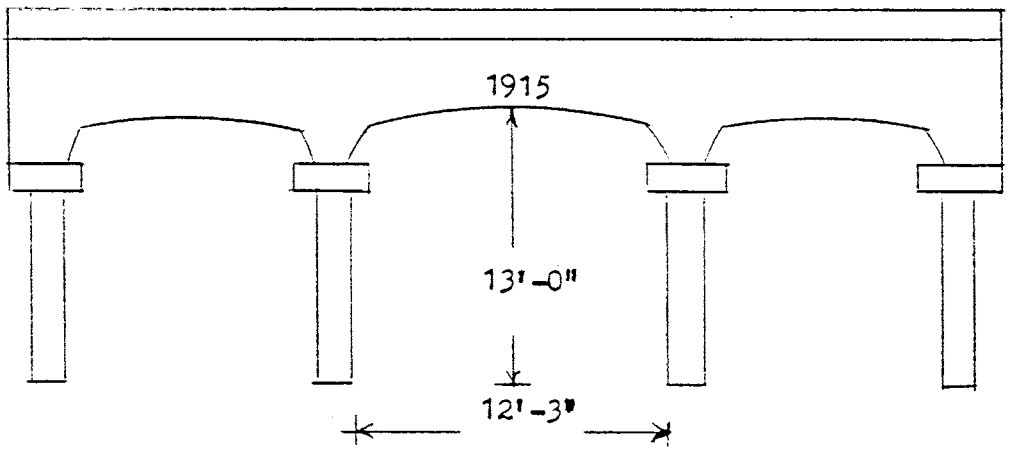
Reinforcing System: _____

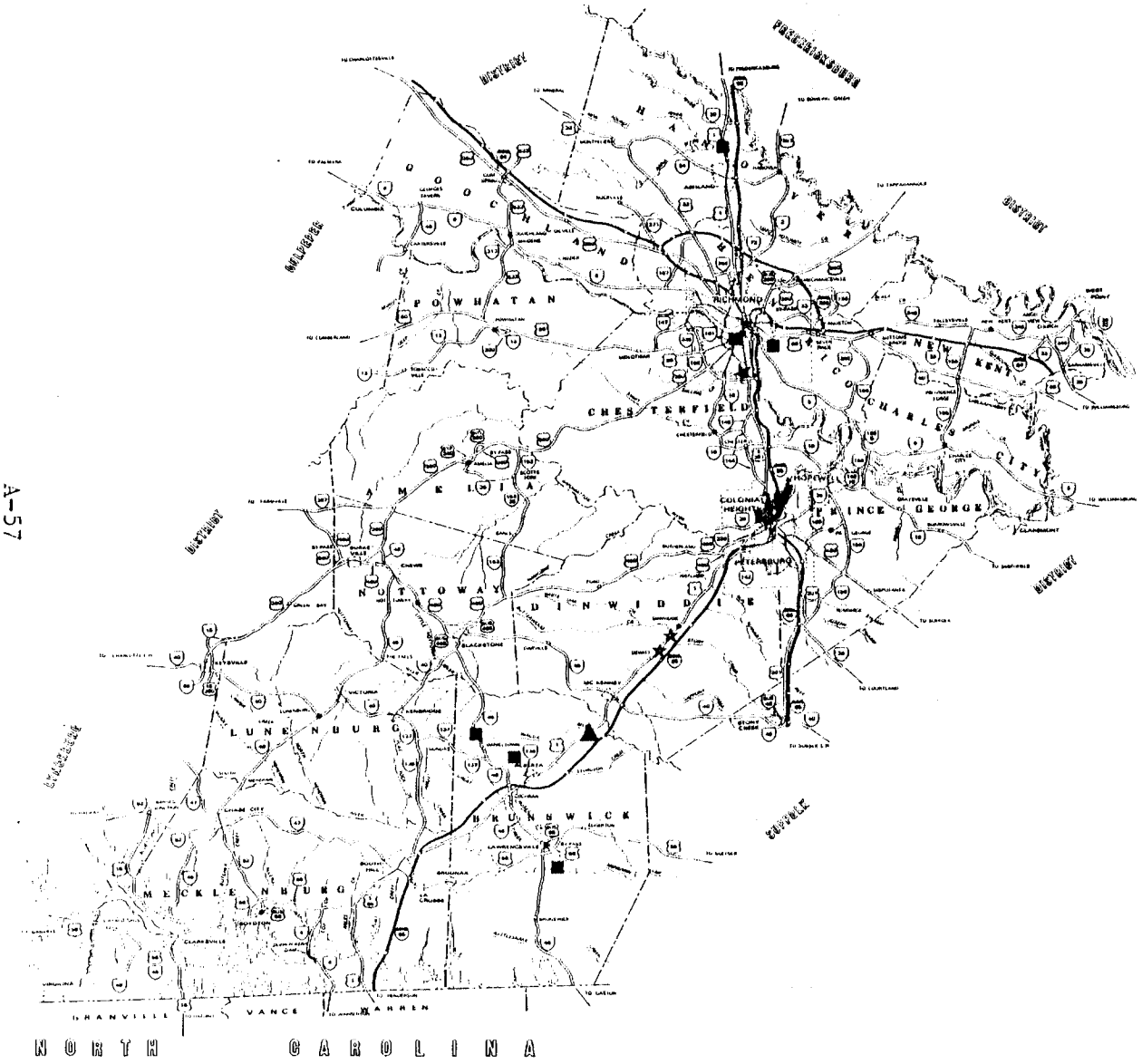
Parapets: _____

Sketch

Side Elevation

Section A-A





RICHMOND DISTRICT

★ — STONE OR BRICK ARCH

■ — CONCRETE: FILLED SPANDREL ARCH (SOLID BARREL)

● — CONCRETE: CLOSED SPANDREL ARCH (RIBBED)

▲ — CONCRETE: OPEN SPANDREL ARCH (RIBBED)

☆ — CONCRETE: OTHER (RAINBOW ARCH)

R-383

A-59

Photo Numbers: 1 3

A15:7-10

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Richmond ; No. 4 .
County: Brunswick ; No. 12 .
City/Town: .
Street/Road: Route 673 .
River/Stream/Railroad (crossing): Allen Creek .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: Luten Bridge Company, Knoxville, Tennessee .
Builder: .
Date: 1923 ; basis for: Bridge plate .
Original owner: ; use: .
Present owner: ; use: .

Historical or Technological Significance

____ Unique/Unusual in its time: .

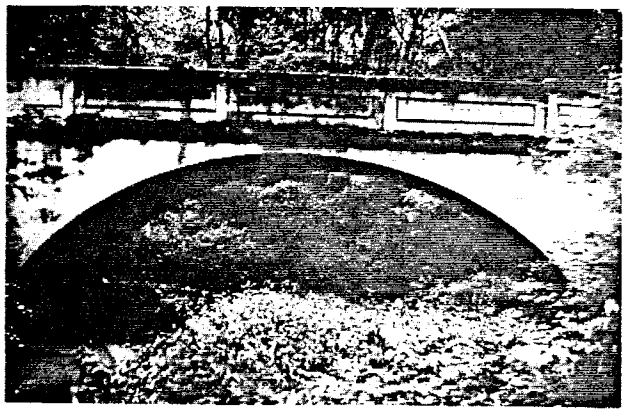
____ Rare survivor though of standard design: .

X Typical example of its time and a common survivor: Single segmental barrel, simple and typical Luten design .

____ Other Remarks/Explanation: .

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: August 1981 .
Affiliation: V.H. & T.R.C. .

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 1 ; length overall: 32'-0"
Span types:
(1) Arch ; length: 32'-0" .
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 1 ; Roadway width: 15'-0".

Structural Information

Substructure:
Material: Concrete .
Foundations: _____.
Piers: _____.
Abutments: Concrete .
Wings: Concrete .
Seats: _____.

Superstructure:
Material: Stone _____ Concrete X

Configuration:
A. Arch _____ Barrel X Ribs(no.) _____; Spandrel: Open _____ Solid X
Circular _____ Segmental X Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

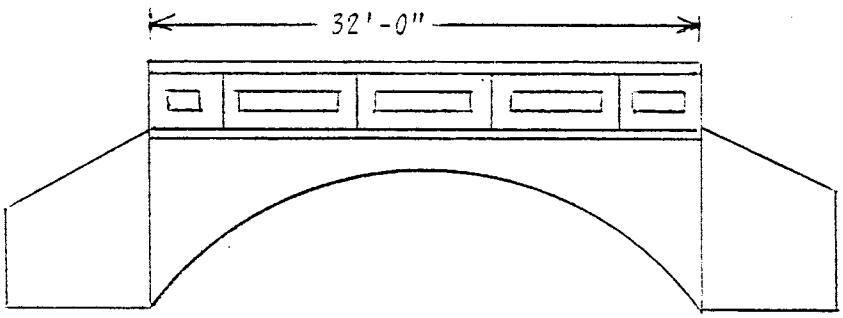
D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

Parapets: Solid concrete with typical Luten panel articulation

Sketch

Side Elevation



Section A-A

R-383

Photo Numbers:

A16:07

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Richmond ; No. 4 .
County: Dinwiddie ; No. 26 .
City/Town: _____ .
Street/Road: Route 1 .
River/Stream/Railroad (crossing): Stony Creek .
UTM/KGS Coordinates: _____ .

Historical Information

Formal designation: _____ .
Local designation: _____ .
Designer: _____ .
Builder: _____ .
Date: 1926 ; basis for: _____ .
Original owner: _____ ; use: _____ .
Present owner: V.D.H. & T ; use: Vehicular .

Historical or Technological Significance

__X__ Unique/Unusual in its time: Through arch, rainbow type .

_____ Rare survivor though of standard design: _____ .

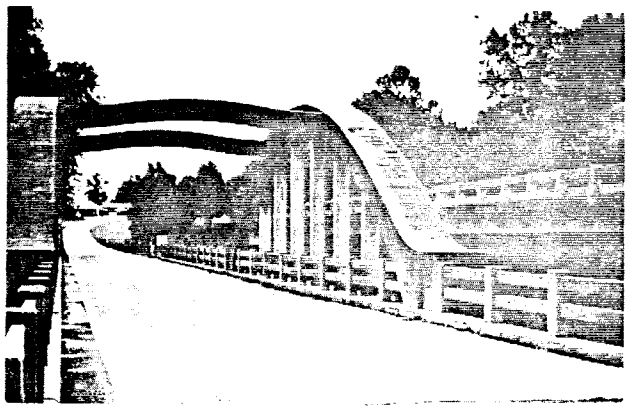
_____ Typical example of its time and a common survivor: _____ .

__X__ Other Remarks/Explanation: One of two through arches surveyed .

Nature/Degree of any destructive threats: _____ .

Reference materials and contemporary photos/illustrations with their respective locations:

Recorder: P. A. C. Spero .
Date: August 1981 .
Affiliation: V.H. & T.R.C. .



Design Information

Compass orientation of axis: _____. Architectural or decorative features:

No. of spans: 3 ; length overall: _____.
Span types:
(1) Concrete T-beam length: _____.
(2) Thru arch ; length: _____.
(3) Concrete T-beam length: _____.
(4) _____; length: _____.
(5) _____; length: _____.
(6) _____; length: _____.

No. of lanes: 2 ; Roadway width: _____.

Structural Information

Substructure:
Material: Concrete. Abutments: Concrete.
Foundations: _____. Wings: Concrete.
Piers: _____. Seats: _____.

Superstructure:
Material: Stone_____ Concrete X

Configuration:
A. Arch X Barrel_____ Ribs(no.) 2 ; Spandrel: Open_____ Solid_____
Circular_____ Segmental X Other_____; Fixed_____ Hinged_____
Infilling: Earth_____ Ballast_____ None_____

B. Slab_____ C. Rigid Frame_____

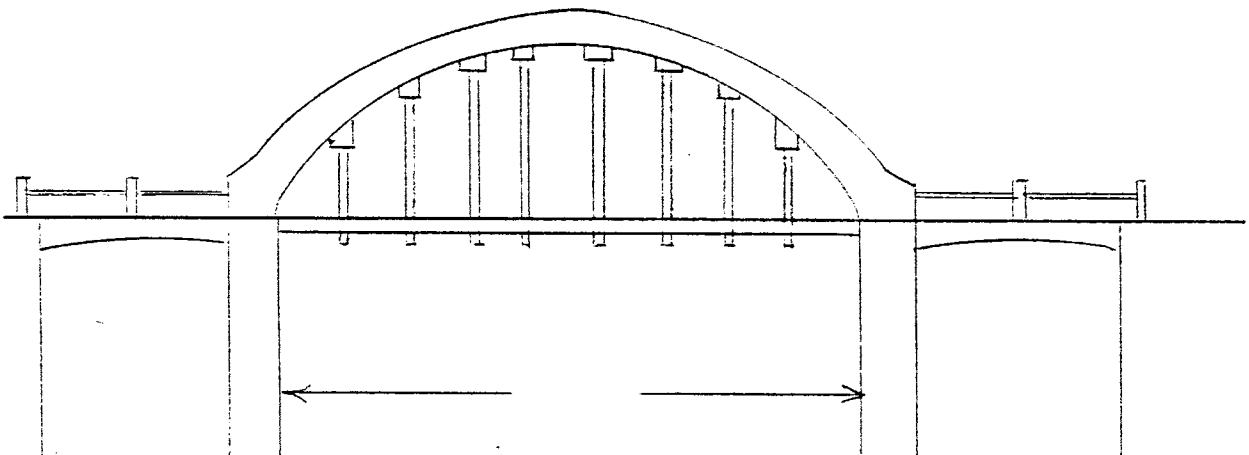
D. Beam_____ Type_____ Size_____ No./Spacing_____
Floorbeam_____ Type_____ Size_____ No./Spacing_____

Reinforcing System: _____

Parapets: Concrete post and rail

Sketch

Side Elevation Section A-A



R-383

Photo Numbers:

A16:29-34

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Richmond ; No. 4 .
County: Henrico ; No. 43 .
City/Town: .
Street/Road: Route 1, Falling Creek Wayside .
River/Stream/Railroad (crossing): Falling Creek .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: .
Builder: .
Date: 1823 ; basis for: Manchester & Petersburg Turnpike construction records
Original owner: M&P Turnpike Company ; use: Vehicular .
Present owner: V.D.H. & T. ; use: Wayside

Historical or Technological Significance

_____ Unique/Unusual in its time: .

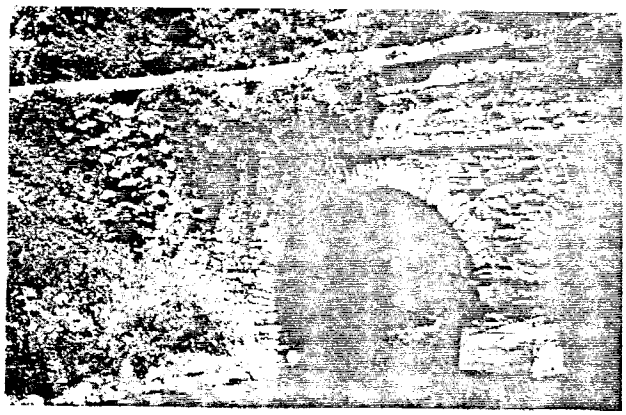
X Rare survivor though of standard design: Oldest masonry arch surveyed, 2 span circular arches. Turnpike bridge.

_____ Typical example of its time and a common survivor: .

X Other Remarks/Explanation:
-Approaches are angled out to 47'-6"; roadbed is 20' wide from parapet wall to parapet wall.
-Iron bar bolted above arches extends above both arches, where roadbed fill begins.
-Upper 3-5 feet could be built later, different masonry work.

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: August 1981 .
Affiliation: V.H.& T.R.C. .

Design Information

Compass orientation of axis: _____. Architectural or decorative features:

No. of spans: 2 ; length overall: 134'-0"
Span types:
(1) Arch ; length: _____.
(2) Arch ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: _____ ; Roadway width: 20'-6"

Structural Information

Substructure:
Material: _____. Abutments: Masonry.
Foundations: _____. Wings: Masonry.
Piers: _____. Seats: _____.

Superstructure:
Material: Stone X Concrete _____

Configuration:
A. Arch _____ Barrel X Ribs(no.) _____; Spandrel: Open _____ Solid X
Circular X Segmental _____ Other _____; Fixed _____ Hinged _____
Infilling: Earth x Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

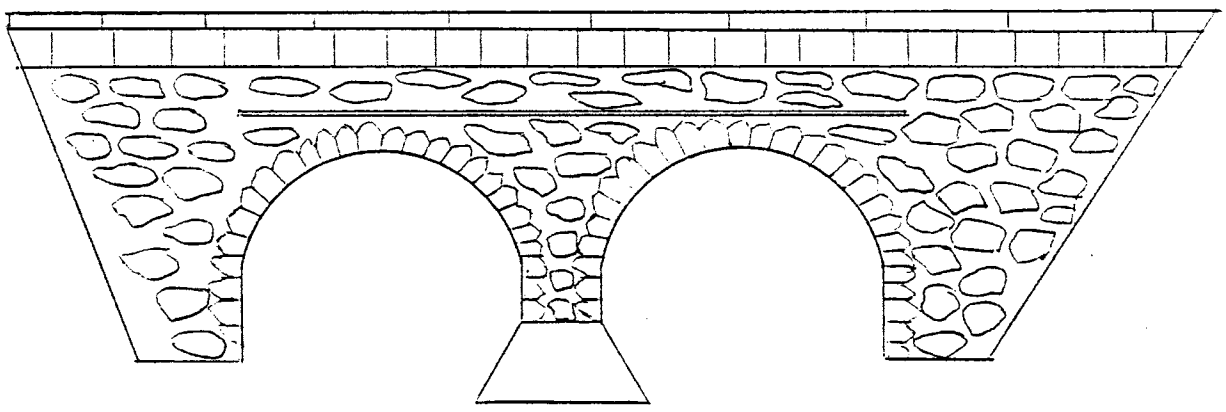
Parapets: Masonry wall with large coping stones

Sketch

Side Elevation

Section A-A

48'-0"



R-283

Photo Numbers:

A16:15-24

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Richmond ; No. 4 .
County: Henrico ; No. 43 .
City/Town: Richmond .
Street/Road: Route 360, 14th Street .
River/Stream/Railroad (crossing): James River .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: Mayo Bridge .
Designer: Concrete Steel Engineering Company, New York .
Builder: T.J. Smith and Company, Richmond, Virginia .
Date: 1911-1913 ; basis for: .
Original owner: City of Richmond ; use: Vehicular .
Present owner: ; use: Vehicular .

Historical or Technological Significance

____ Unique/Unusual in its time: .

X Rare survivor though of standard design: Early long span concrete bridge. Segmental arches are very shallow. Decorative, monumental metropolitan vehicular

____ Typical example of its time and a common survivor: .

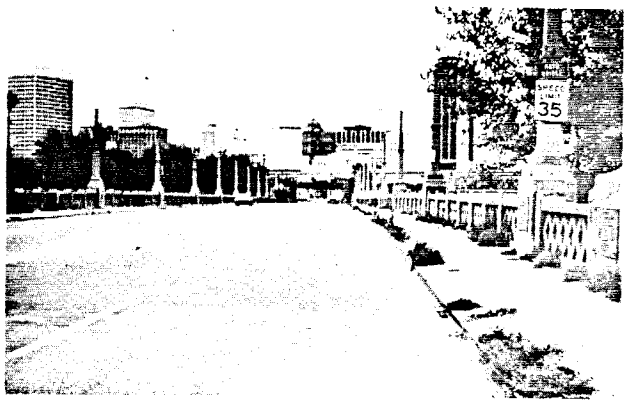
X Other Remarks/Explanation: bridge of relatively early date.

-Original structure at this crossing erected by John Mayo, October 26, 1788.

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:

Recorder: P. A. C. Spero .
Date: August 1981 .
Affiliation: V.H. & T.R.C. .



1240

Design Information

Compass orientation of axis:_____. Architectural or decorative features:

No. of spans: 11 ;length overall:_____.
Span types:
(1)_____; length:_____.
(2)_____; length:_____.
(3)_____; length:_____.
(4)_____; length:_____.
(5)_____; length:_____.
(6)_____; length:_____.

No. of lanes:_____; Roadway width:_____.

Structural Information

Substructure:
Material:_____. Abutments: Concrete and masonry.
Foundations:_____. Wings: Concrete.
Piers:_____. Seats:_____.

Superstructure:
Material: Stone_____ Concrete X

Configuration:
A. Arch_____ Barrel X Ribs(no.)_____; Spandrel: Open_____ Solid X
Circular_____ Segmental X Other_____; Fixed_____ Hinged_____
Infilling: Earth_____ Ballast_____ None_____

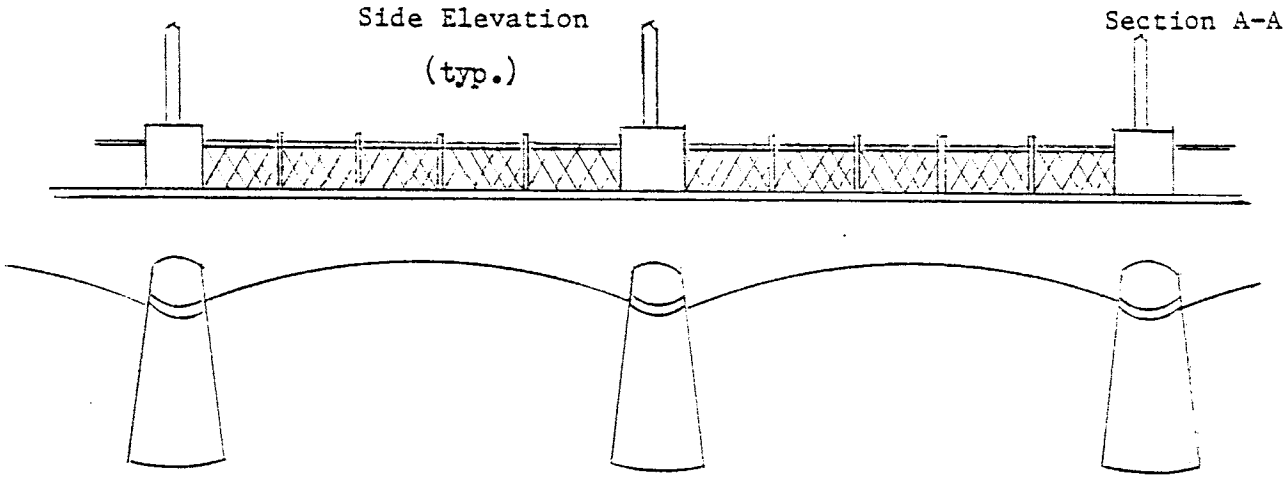
B. Slab_____ C. Rigid Frame_____

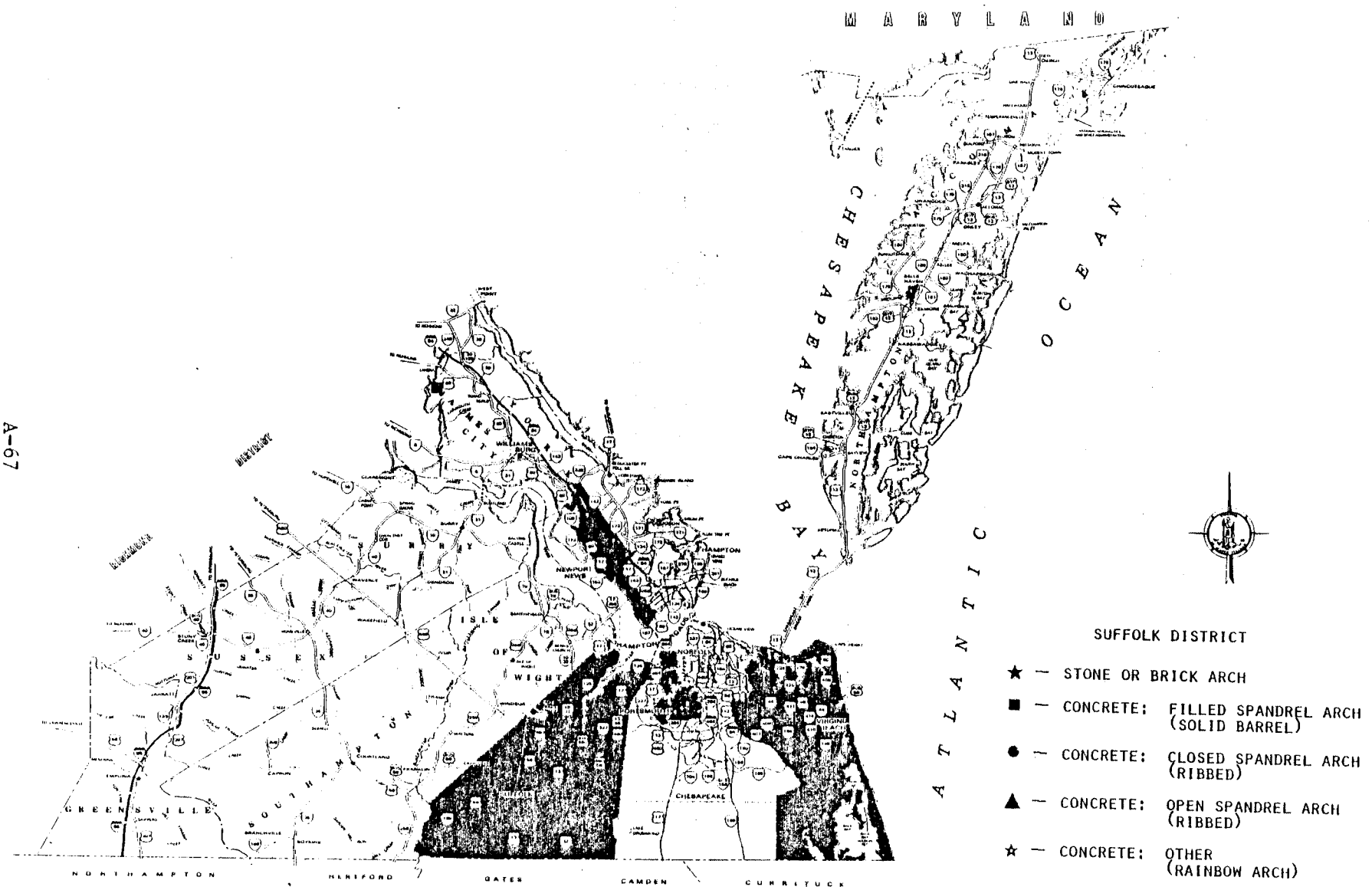
D. Beam_____ Type_____ Size_____ No./Spacing_____
Floorbeam_____ Type_____Size_____ No./Spacing_____

Reinforcing System:_____

Parapets: Solid concrete with lattice and "obelisk" posts above each pier.

Sketch




MARYLAND
ATLANTIC OCEAN
CHESAPEAKE BAY
SUFFOLK DISTRICT
★ — STONE OR BRICK ARCH
■ — CONCRETE: FILLED SPANDREL ARCH (SOLID BARREL)
● — CONCRETE: CLOSED SPANDREL ARCH (RIBBED)
▲ — CONCRETE: OPEN SPANDREL ARCH (RIBBED)
☆ — CONCRETE: OTHER (RAINBOW ARCH)
NORTHAMPTON
HERTFORD
GATES
CAMDEN
CURRITUCK
GREENSVILLE
SUSSEX
SOUTHAMPTON
ISLE OF WIGHT
NORFOLK
CHESAPEAKE
PORTSMOUTH
NEWPORT NEWS
HAMPTON
YORK
JAMES CITY
WILLIAMSBURG

R-383

Photo Numbers:

A16:11, 12

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Suffolk ; No. 5 .
County: James City ; No. 47 .
City/Town: _____ .
Street/Road: Route 601 .
River/Stream/Railroad (crossing): C & O Railway .
UTM/KGS Coordinates: _____ .

Historical Information

Formal designation: _____ .
Local designation: _____ .
Designer: _____ .
Builder: _____ .
Date: _____ ; basis for: _____ .
Original owner: _____ ; use: _____ .
Present owner: _____ ; use: _____ .

Historical or Technological Significance

_____ Unique/Unusual in its time: _____ .

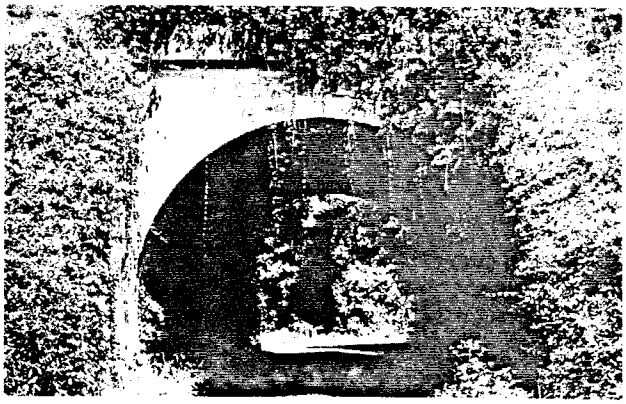
_____ Rare survivor though of standard design: _____ .

X Typical example of its time and a common survivor: Concrete circular barrel Railroad underpass .

_____ Other Remarks/Explanation: _____ .

Nature/Degree of any destructive threats: _____ .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: August 1981 .
Affiliation: V.H. & T.R.C. .

1345

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 1 ; length overall: _____.

Span types:

(1) Arch ; length: 16' .
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 1 ; Roadway width: _____.

Structural Information

Substructure:

Material: Concrete .
Foundations: _____.
Piers: _____.

Abutments: Concrete .
Wings: Concrete .
Seats: _____.

Superstructure:

Material: Stone _____ Concrete X

Configuration:

A. Arch _____ Barrel X Ribs (no.) _____; Spandrel: Open _____ Solid X
Circular X Segmental _____ Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

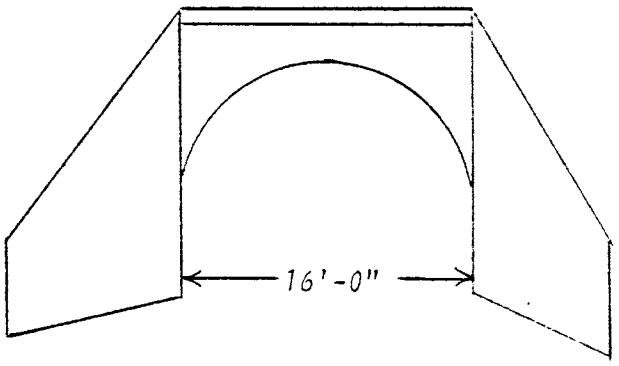
D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

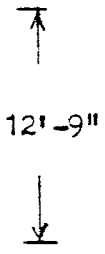
Reinforcing System: _____

Parapets: _____

Sketch

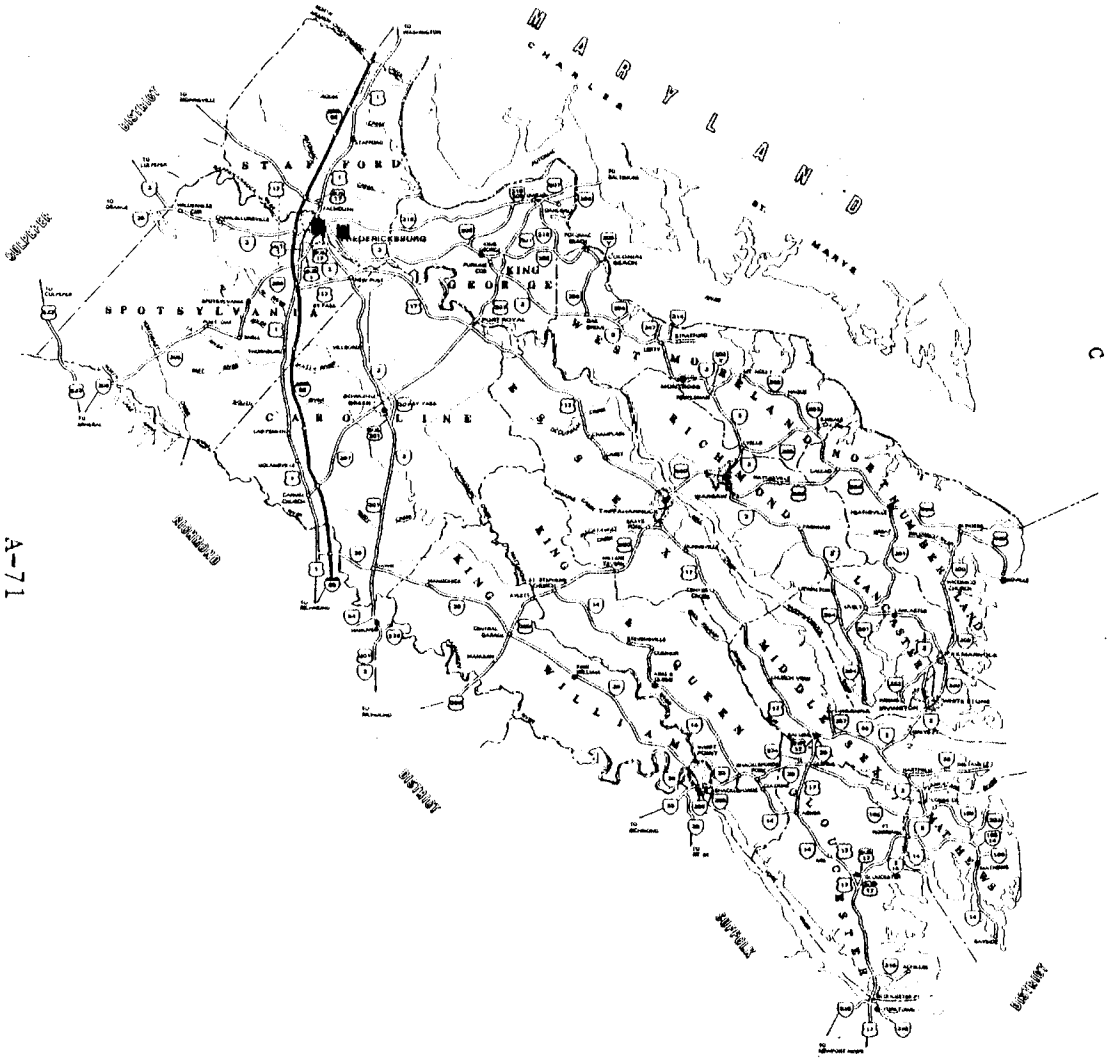
Side Elevation





Section A-A

Barrel is 38' long



FREDERICKSBURG DISTRICT

★ — STONE OR BRICK ARCH

■ — CONCRETE: FILLED SPANDREL ARCH (SOLID BARREL)

● — CONCRETE: CLOSED SPANDREL ARCH (RIBBED)

▲ — CONCRETE: OPEN SPANDREL ARCH (RIBBED)

☆ — CONCRETE: OTHER (RAINBOW ARCH)

R-383

Photo Numbers:

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Fredericksburg No. 6.
County: Stafford ; No. 89.
City/Town: .
Street/Road: Route 607.
River/Stream/Railroad (crossing): R F & P RR.
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: .
Builder: .
Date: 1904 ; basis for: Date plate.
Original owner: ; use: Vehicular.
Present owner: ; use: Vehicular.

Historical or Technological Significance

____ Unique/Unusual in its time: .

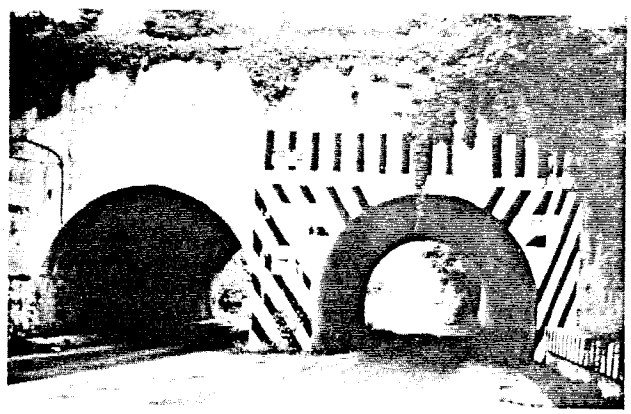
X Rare survivor though of standard design: Very early concrete railroad underpass, earliest concrete bridge surveyed.

____ Typical example of its time and a common survivor: .

X Other Remarks/Explanation: Simple 2 barrel configuration with no articulation.

Nature/Degree of any destructive threats: .

Reference materials and contamporary photos/illustrations with their respective locations:



Recorder: P A C Spero.
Date: July 1981.
Affiliation: V H & T R C.

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 2 ; length overall: 21'-2"

Span types:

(1) Arch ; length: 10'-7".
(2) Arch ; length: 10'-7".
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: _____ ; Roadway width: _____.

Structural Information

Substructure:

Material: _____.
Foundations: _____.
Piers: _____.

Abutments: _____.
Wings: Concrete.
Seats: _____.

Superstructure:

Material: Stone _____ Concrete X

Configuration:

A. Arch _____ Barrel X Ribs (no.) _____ ; Spandrel: Open _____ Solid _____
Circular X Segmental _____ Other _____ ; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

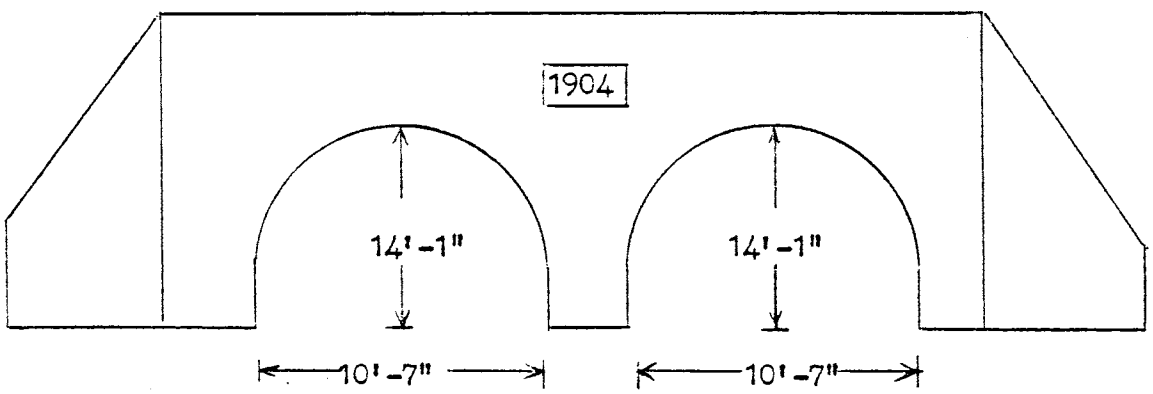
Reinforcing System: _____

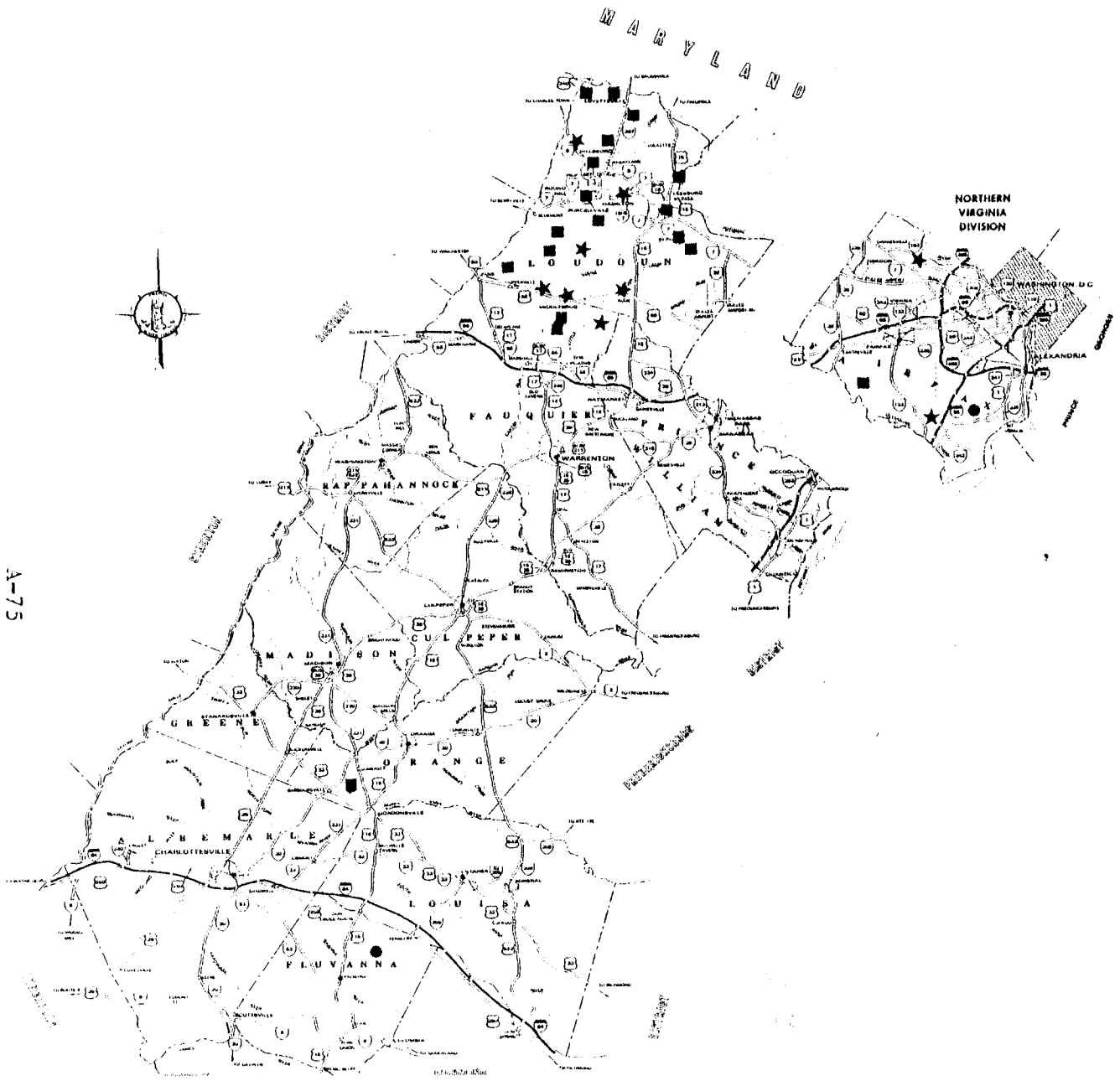
Parapets: _____

Sketch

Side Elevation

Section A-A





CULPEPER DISTRICT

★ — STONE OR BRICK ARCH

■ — CONCRETE: FILLED SPANDREL ARCH (SOLID BARREL)

● — CONCRETE: CLOSED SPANDREL ARCH (RIBBED)

▲ — CONCRETE: OPEN SPANDREL ARCH (RIBBED)

☆ — CONCRETE: OTHER (RAINBOW ARCH)

R-383

Photo Numbers: [illegible]

A18:26-29

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Culpeper ; No. 7 .
County: Fairfax ; No. 29 .
City/Town: _____ .
Street/Road: Route 193, Georgetown Pike .
River/Stream/Railroad (crossing): Bull Neck Run .
UTM/KGS Coordinates: _____ .

Historical Information

Formal designation: _____ .
Local designation: _____ .
Designer: _____ .
Builder: "J.S." .
Date: 1893 ; basis for: Keystone carving .
Original owner: _____ ; use: Vehicular .
Present owner: V.D.H. & T ; use: Vehicular .

Historical or Technological Significance

_____ Unique/Unusual in its time: _____ .

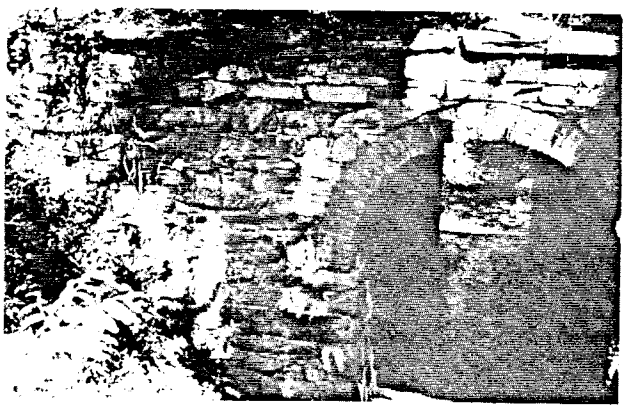
X Rare survivor though of standard design: Small span stone masonry arch lined with brick .

_____ Typical example of its time and a common survivor: _____ .

_____ Other Remarks/Explanation: _____ .

Nature/Degree of any destructive threats: _____ .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Data: September 1981 .
Affiliation: V.H. & T.R.C. .

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 1 ; length overall: _____.

Span types:

(1) Arch ; length: 8'-0".
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: _____; Roadway width: _____.

Structural Information

Substructure:

Material: _____.
Foundations: _____.
Piers: _____.

Abutments: Masonry.
Wings: _____.
Seats: _____.

Superstructure:

Material: Stone X Concrete _____

Configuration:

A. Arch _____ Barrel X Ribs(no.) _____; Spandrel: Open _____ Solid _____
Circular X Segmental _____ Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

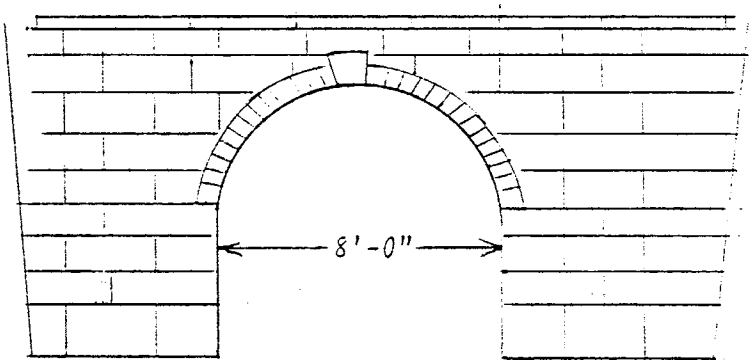
Reinforcing System: _____

Parapets: _____

Sketch

Side Elevation

Section A-A



R-383

Photo Numbers: [illegible]

A19:1, 2

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Culpeper ; No. 7 .
County: Fairfax ; No. 29 .
City/Town: .
Street/Road: Route 611 .
River/Stream/Railroad (crossing): Abandonned Railroad .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: .
Builder: .
Date: ; basis for: .
Original owner: ; use: Vehicular .
Present owner: ; use: Vehicular .

Historical or Technological Significance

____ Unique/Unusual in its time: .

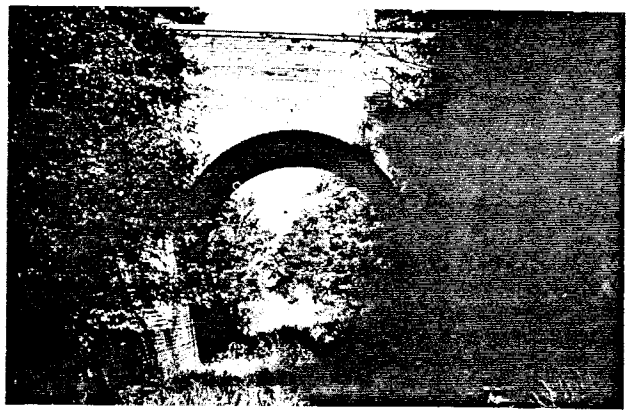
X Rare survivor though of standard design: Only brick masonry arch bridge surveyed in State.

____ Typical example of its time and a common survivor: .

X Other Remarks/Explanation: Arch is in good condition

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: September 1981 .
Affiliation: V.H. & T.R.C. .

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 1 ; length overall: _____.
Span types:
(1) Arch ; length: _____.
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 2 ; Roadway width: _____.

Structural Information

Substructure:
Material: _____.
Foundations: _____.
Piers: _____.
Abutments: Brick.
Wings: Brick.
Seats: _____.

Superstructure:
Material: Stone_____ Concrete_____ Brick X

Configuration:
A. Arch_____ Barrel X Ribs(no.)_____; Spandrel: Open_____ Solid_____
Circular X Segmental_____ Other_____; Fixed_____ Hinged_____
Infilling: Earth_____ Ballast_____ None_____

B. Slab_____ C. Rigid Frame_____

D. Beam_____ Type_____ Size_____ No./Spacing_____
Floorbeam_____ Type_____ Size_____ No./Spacing_____

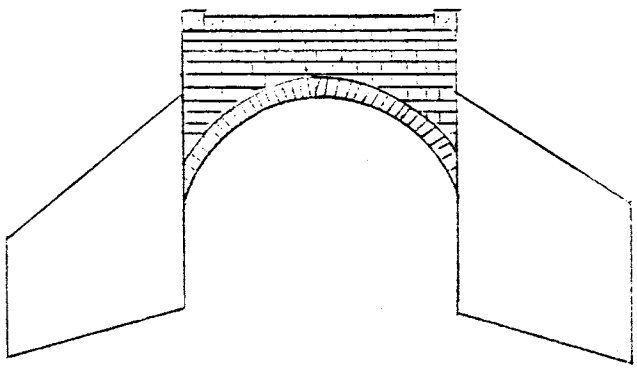
Reinforcing System: _____

Parapets: Solid brick masonry, concrete capstone across top.

Sketch

Side Elevation

Section A-A



R-383

Photo Numbers:

A18:32-35

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Culpeper ; No. 7 .
County: Fairfax ; No. 29 .
City/Town: _____ .
Street/Road: Route 613 .
River/Stream/Railroad (crossing): Military RR .
UTM/KGS Coordinates: _____ .

Historical Information

Formal designation: _____ .
Local designation: _____ .
Designer: _____ .
Builder: _____ .
Date: _____ ; basis for: _____ .
Original owner: _____ ; use: _____ .
Present owner: _____ ; use: Vehicular .

Historical or Technological Significance

__X__ Unique/Unusual in its time: Skewed, 2 ribbed, closed spandrel high arches .

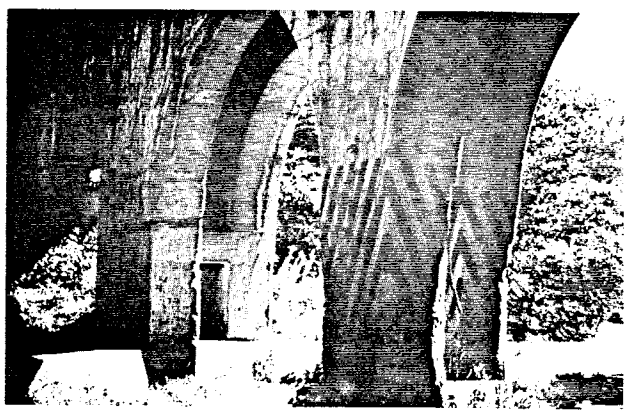
_____ Rare survivor though of standard design: _____ .

_____ Typical example of its time and a common survivor: _____ .

_____ Other Remarks/Explanation: _____ .

Nature/Degree of any destructive threats: _____ .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: September 1981 .
Affiliation: V. H. & T. R. C. .

Design Information

Compass orientation of axis: _____. Architectural or decorative features:

No. of spans: 5 ; length overall: _____.
Span types:
(1) Arch ; length: 13'.
(2) Arch ; length: 20'.
(3) Arch ; length: 20'.
(4) Arch ; length: 13'.
(5) Arch ; length: 10'.
(6) _____ ; length: _____.

No. of lanes: _____; Roadway width: _____.

Structural Information

Substructure:
Material: _____. Abutments: Concrete.
Foundations: _____. Wings: _____.
Piers: _____. Seats: _____.

Superstructure:
Material: Stone _____ Concrete X

Configuration:
A. Arch X Barrel _____ Ribs (no.) 2 ; Spandrel: Open _____ Solid X
Circular X Segmental _____ Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

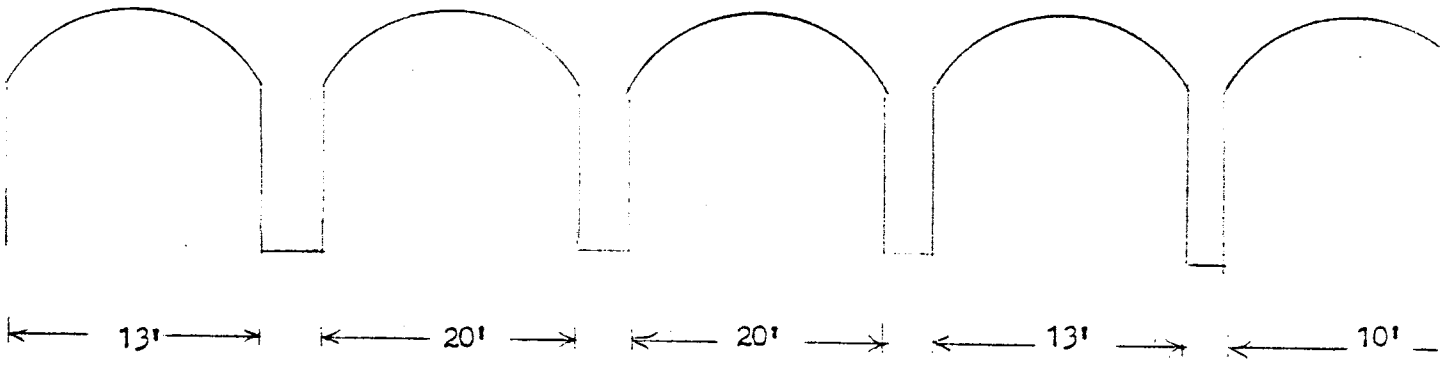
D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

Parapets: _____

Sketch

Side Elevation Section A-A



R-383

Photo Numbers:

A19:11, 12

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Culpeper ; No. 7 .
County: Fauquier ; No. 30 .
City/Town: .
Street/Road: Route 628 .
River/Stream/Railroad (crossing): Barton Creek Branch .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: .
Builder: .
Date: ; basis for: .
Original owner: ; use: .
Present owner: V.D.H. & T ; use: Vehicular .

Historical or Technological Significance

____ Unique/Unusual in its time: .

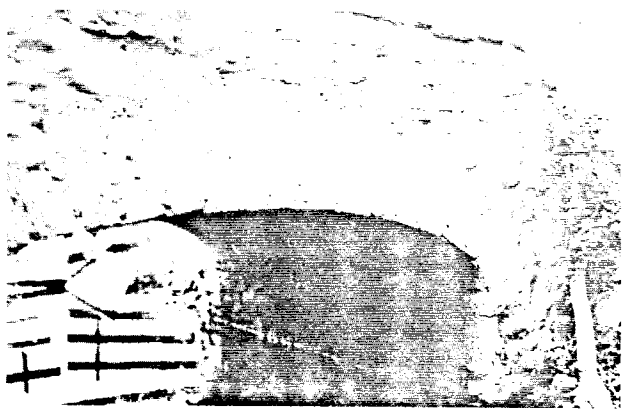
X Rare survivor though of standard design: Small masonry arch .

____ Typical example of its time and a common survivor: .

X Other Remarks/Explanation: Barrel is on a skew .
-Also, parapet wall is damaged.

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: September 1981 .
Affiliation: V.H. & T.R.C. .

Design Information

Compass orientation of axis: _____. Architectural or decorative features:

No. of spans: 1 ; length overall: 18'-0"
Span types:
(1) Arch ; length: 18'-0" .
(2) _____ ; length: _____ .
(3) _____ ; length: _____ .
(4) _____ ; length: _____ .
(5) _____ ; length: _____ .
(6) _____ ; length: _____ .

No. of lanes: 1 ; Roadway width: 12'-3"

Structural Information

Substructure:
Material: _____ . Abutments: _____ .
Foundations: _____ . Wings: Masonry .
Piers: _____ . Seats: _____ .

Superstructure:
Material: Stone X Concrete _____

Configuration:
A. Arch _____ Barrel X Ribs (no.) _____ ; Spandrel: Open _____ Solid _____
Circular _____ Segmental _____ Other _____ ; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

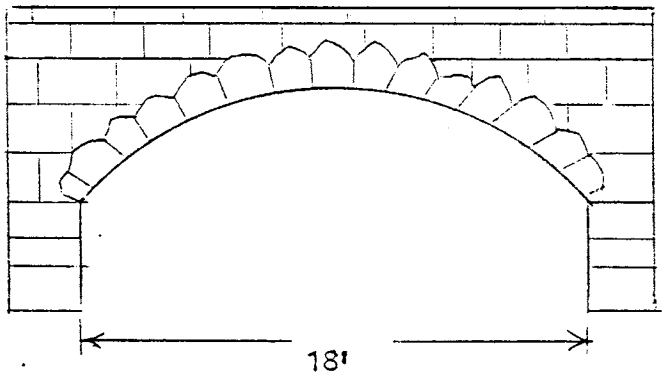
D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

Parapets: Solid masonry

Sketch

Side Elevation



Section A-A

R-383

Photo Numbers:

A1:12-20
A2:1

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Culpeper ; No. 7 .
County: Fluvanna ; No. 32 .
City/Town: .
Street/Road: Route 601 .
River/Stream/Railroad (crossing): Phill's Creek .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: R. S. Campbell's Bridge .
Designer: .
Builder: .
Date: 1926 ; basis for: Date plate .
Original owner: ; use: .
Present owner: V.D.H. & T. ; use: Vehicular .

Historical or Technological Significance

__X__ Unique/Unusual in its time: Illustrates regional diversities in Virginia bridge design.

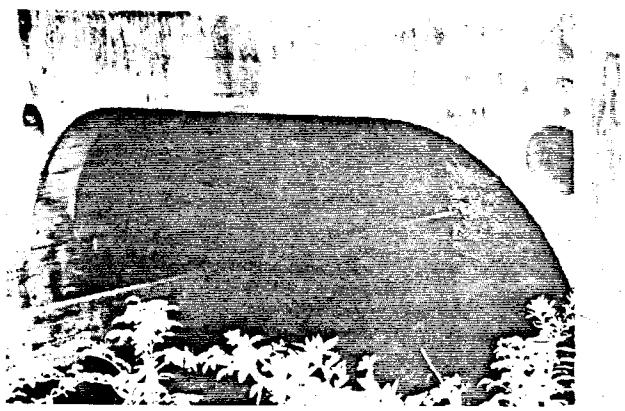
_____ Rare survivor though of standard design: .

_____ Typical example of its time and a common survivor: .

__X__ Other Remarks/Explanation:
Bridge plate reads:
Phill's Creek
Venables Road
R.S. Campbell's Bridge
1926
-3 arch ribs with 3 steel I-beams in between ribs, I-beams anchored into abutment

Nature/Degree of any destructive threats: .

Reference materials and contamporary photos/illustrations with their respective locations:



Recorder: P. A? C? Spero .
Date: July 20, 1981 .
Affiliation: V.H. & T.R.C. .

Design Information

Compass orientation of axis: _____.

No. of spans: 1 ; length overall: 23'.
Span types:
(1) Arch ; length: 19'-3".
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 1 ; Roadway width: 15'-4"

Architectural or decorative features:

End posts formed in corrugated steel; steel remains; post capped with stacked formed concrete

Structural Information

Substructure:
Material: _____.
Foundations: _____.
Piers: _____.
Abutments: _____.
Wings: Concrete.
Seats: _____.

Superstructure:
Material: Stone_____ Concrete X

Configuration:
A. Arch X Barrel_____ Ribs (no.) 3 ; Spandrel: Open X Solid_____
Circular_____ Segmental X Other_____; Fixed_____ Hinged_____
Infilling: Earth_____ Ballast_____ None_____

B. Slab_____ C. Rigid Frame_____

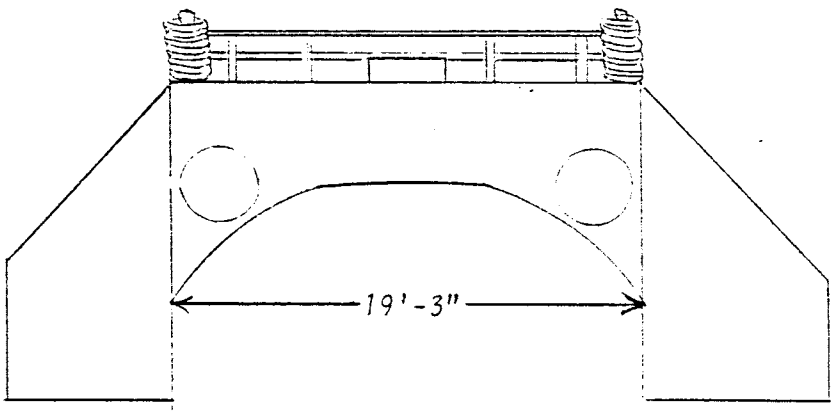
D. Beam_____ Type_____ Size_____ No./Spacing_____
Floorbeam_____ Type_____ Size_____ No./Spacing_____

Reinforcing System: _____

Parapets: _____

Sketch

Side Elevation



Section A-A

R-383

Photo Numbers:

A17:14-17

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Culpeper ; No. 7 .
County: Loudon ; No. 53 .
City/Town: .
Street/Road: Route 7 .
River/Stream/Railroad (crossing): W & OD RR .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: .
Designer: .
Builder: .
Date: ; basis for: .
Original owner: ; use: .
Present owner: V.D.H. & T. ; use: Vehicular .

Historical or Technological Significance

____ Unique/Unusual in its time: .

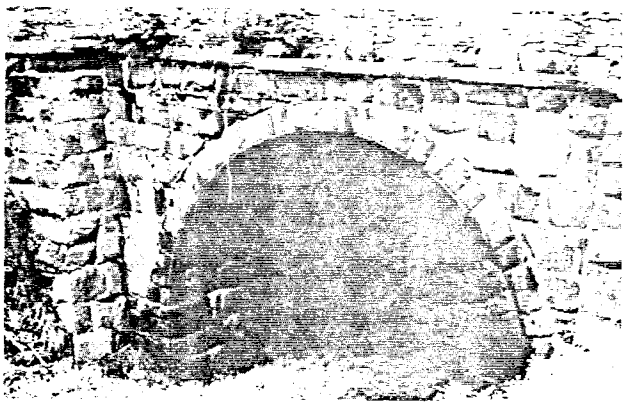
X Rare survivor though of standard design: Solid masonry arch, very high clearance and fairly long span.

____ Typical example of its time and a common survivor: .

X Other Remarks/Explanation: Parapet wall added later, of rubble masonry. -This is not one of the finer RR overpasses seen, work is very rough.

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: September 1981 .
Affiliation: V.H. & T.R.C. .

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 1 ; length overall: _____.

Span types:

(1) Arch ; length: 26'-0" .
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: _____; Roadway width: _____.

Structural Information

Substructure:

Material: _____.
Foundations: _____.
Piers: _____.

Abutments: Masonry .
Wings: Masonry .
Seats: _____.

Superstructure:

Material: Stone X Concrete _____

Configuration:

A. Arch _____ Barrel X Ribs(no.) _____; Spandrel: Open _____ Solid X
Circular X Segmental _____ Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

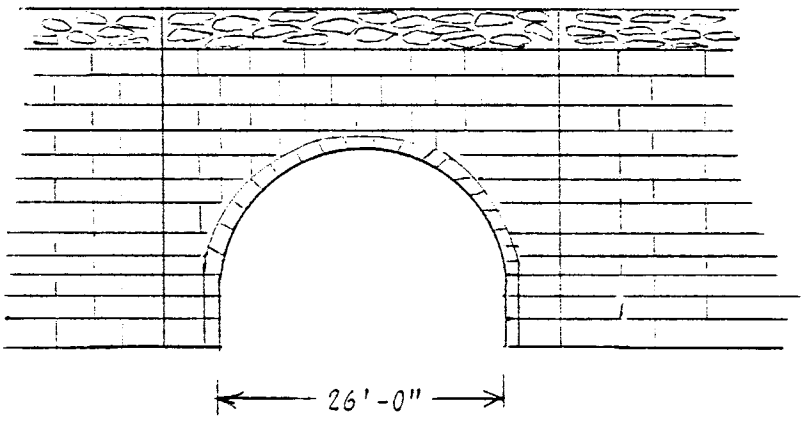
D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

Parapets: Rubble masonry

Sketch

Side Elevation



Section A-A

Barrell is 30'-0" long

R-383

Photo Numbers:

A17:20-25

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Culpeper ; No. 7 .
County: Loudon ; No. 53 .
City/Town: _____ .
Street/Road: Route 734 .
River/Stream/Railroad (crossing): Beaverdam Creek .
UTM/KGS Coordinates: _____ .

Historical Information

Formal designation: _____ .
Local designation: _____ .
Designer: _____ .
Builder: _____ .
Date: pre-1830 ; basis for: Turnpike Company construction records .
Original owner: Snicker's Gap Turnpike Company ; use: Vehicular .
Present owner: V.D.H. & T. ; use: Vehicular .

Historical or Technological Significance

____ Unique/Unusual in its time: _____ .

__X__ Rare survivor though of standard design: Rubble masonry, 2 span with protruding conical pier accents (see 17:25) .

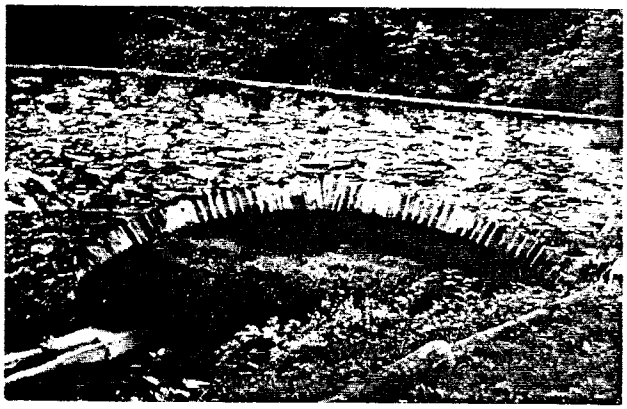
____ Typical example of its time and a common survivor: _____ .

__X__ Other Remarks/Explanation: Piers have been repaired/covered with concrete

-One one bank bridge is built out of a huge existing boulder

Nature/Degree of any destructive threats: _____ .

Reference materials and contemporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: September 1981 .
Affiliation: V.H. & T.R.C. .

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 2 ; length overall: 124' .

Span types:

(1) Arch ; length: _____.
(2) Arch ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 2 ; Roadway width: 22'-6"

Structural Information

Substructure:

Material: _____.
Foundations: _____.
Piers: _____.

Abutments: Masonry - rubble.
Wings: Rubble masonry.
Seats: _____.

Superstructure:

Material: Stone X Concrete _____

Configuration:

A. Arch _____ Barrel X Ribs(no.) _____; Spandrel: Open _____ Solid X
Circular _____ Segmental X Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

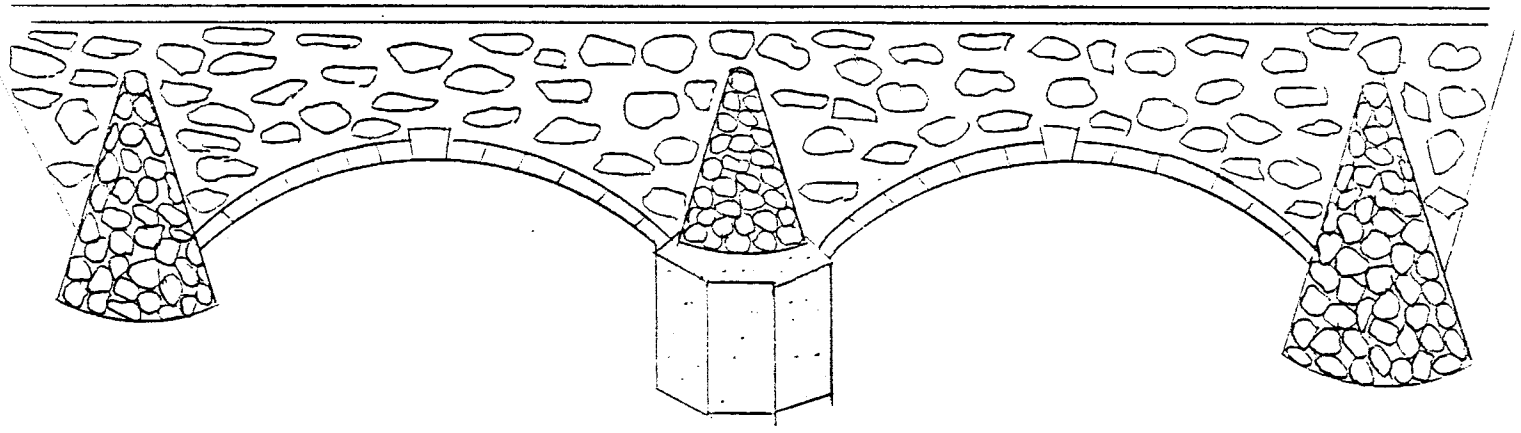
Reinforcing System: _____

Parapets: _____

Sketch

Side Elevation

Section A-A



R-383

Photo Numbers:

A18:7-10

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Culpeper ; No. 7 .
County: Loudon Co. ; No. 53 .
City/Town: Aldie .
Street/Road: Ashby's Gap Turnpike, Route 50 .
River/Stream/Railroad (crossing): _____ .
UTM/KGS Coordinates: _____ .

Historical Information

Formal designation: _____ .
Local designation: _____ .
Designer: _____ .
Builder: _____ .
Date: c. 1824 ; basis for: Ashby's Gap Turnpike Company records .
Original owner: Ashby's Gap Turnpike Company ; use: Vehicular .
Present owner: V.D.H. & T. ; use: Vehicular .

Historical or Technological Significance

____ Unique/Unusual in its time: _____ .

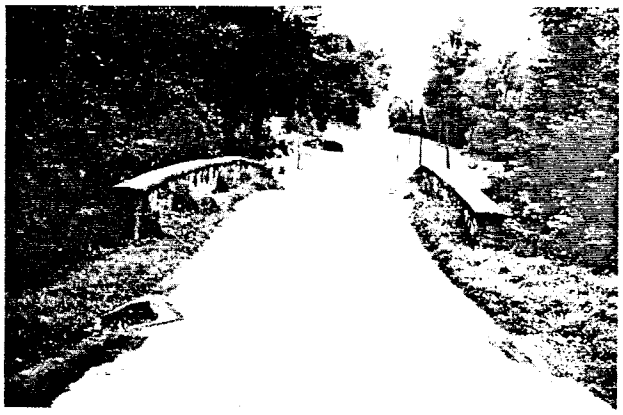
X Rare survivor though of standard design: 2 span random coursed masonry, pier projects considerably far upstream; bridge structure arches to a peak at center pier.

____ Typical example of its time and a common survivor: _____ .

X Other Remarks/Explanation: Voussoirs are slightly more refined than rest of masonry. Camelback arch.

Nature/Degree of any destructive threats: _____ .

Reference materials and contamporary photos/illustrations with their respective locations:



Recorder: P. A. C. Spero .
Date: September 1981 .
Affiliation: V.H. & T.R.C. .

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 2 ; length overall: _____.

Span types:

(1) Arch ; length: 30'.
(2) Arch ; length: 30'.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 2 ; Roadway width: _____.

Structural Information

Substructure:

Material: _____.
Foundations: _____.
Piers: _____.

Abutments: Stone.
Wings: _____.
Seats: _____.

Superstructure:

Material: Stone X Concrete _____

Configuration:

A. Arch _____ Barrel X Ribs(no.) _____; Spandrel: Open _____ Solid X
Circular _____ Segmental X Other _____; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

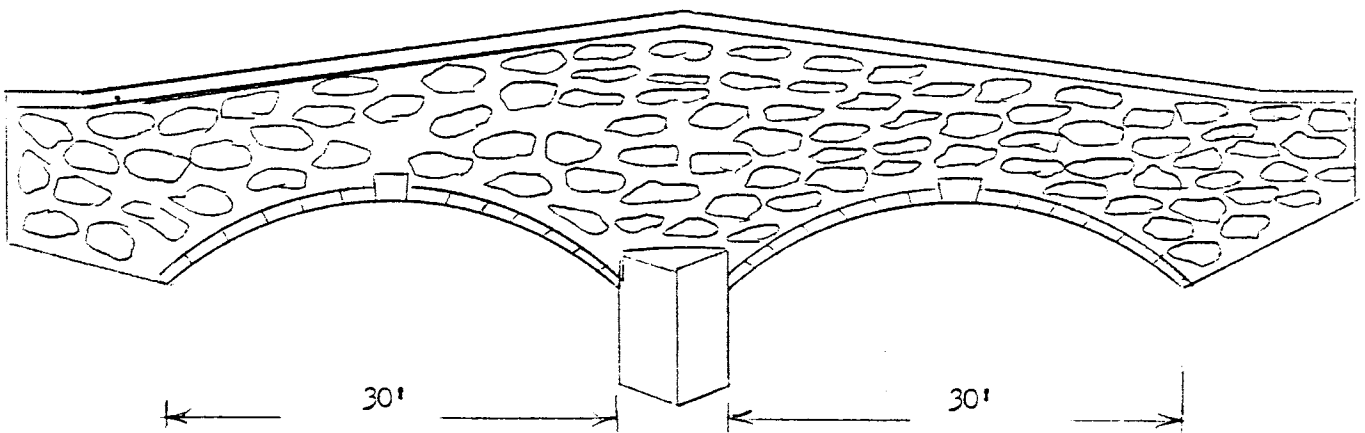
Reinforcing System: _____

Parapets: _____

Sketch

Side Elevation

Section A-A



R-383

Photo Numbers:

A17:8, 9

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Culpeper; No. 7.
County: Loudon; No. 53.
City/Town: .
Street/Road: Route 751.
River/Stream/Railroad (crossing): Stream.
~~UTM/KGS Coordinates:~~ .

Historical Information

Formal designation: .
Local designation: .
Designer: .
Builder: .
Date: ; basis for: .
Original owner: ; use: Vehicular.
Present owner: V.D.H. & T.; use: Vehicular.

Historical or Technological Significance

___ Unique/Unusual in its time: .

X Rare survivor though of standard design: Masonry barrel, segmental arch, small span.

___ Typical example of its time and a common survivor: .

X Other Remarks/Explanation:
-Random masonry, rough voussoirs
-Looks like a small turnpike bridge

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:

Recorder: P. A. C. Spero.
Date: September 1981.
Affiliation: V.H. & T.R.C.

Design Information

Compass orientation of axis: _____. Architectural or decorative features:

No. of spans: 1 ; length overall: 16'-0"
Span types:
(1) Arch ; length: 16' .
(2) _____ ; length: _____ .
(3) _____ ; length: _____ .
(4) _____ ; length: _____ .
(5) _____ ; length: _____ .
(6) _____ ; length: _____ .

No. of lanes: 1 ; Roadway width: 20'-0"

Structural Information

Substructure:
Material: _____ . Abutments: Masonry .
Foundations: _____ . Wings: Masonry .
Piers: _____ . Seats: _____ .

Superstructure:
Material: Stone X Concrete _____

Configuration:
A. Arch _____ Barrel X Ribs(no.) _____ ; Spandrel: Open _____ Solid X
Circular _____ Segmental X Other _____ ; Fixed _____ Hinged _____
Infilling: Earth _____ Ballast _____ None _____

B. Slab _____ C. Rigid Frame _____

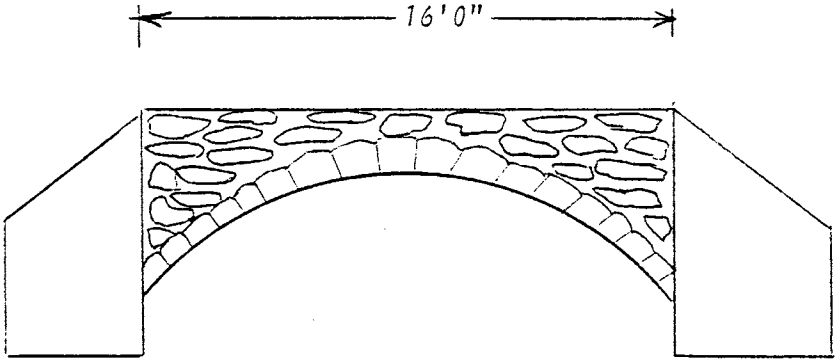
D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

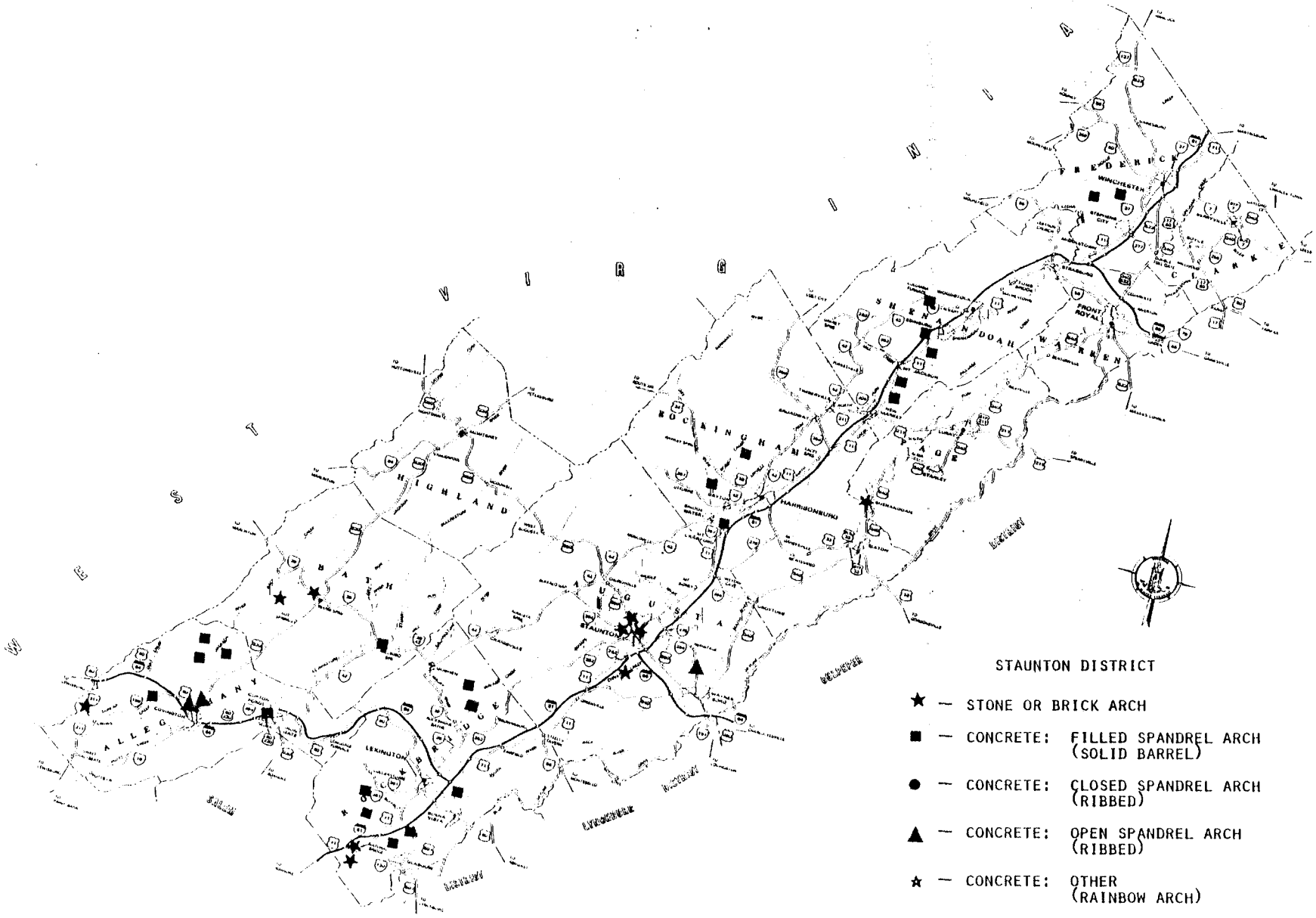
Parapets: Masonry

Sketch

Side Elevation



Section A-A


STAUNTON DISTRICT
★ — STONE OR BRICK ARCH
■ — CONCRETE: FILLED SPANDREL ARCH (SOLID BARREL)
● — CONCRETE: CLOSED SPANDREL ARCH (RIBBED)
▲ — CONCRETE: OPEN SPANDREL ARCH (RIBBED)
☆ — CONCRETE: OTHER (RAINBOW ARCH)

R-383

Photo Numbers:

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Staunton ; No. 8
County: Alleghany ; No. 3
City/Town:
Street/Road: 60
River/~~Stream/Creek~~(crossing): Jackson River
UTM/RGS Coordinates:

Historical Information

Formal designation: 8562
Local designation: 1923
Designer:
Builder:
Date: 1925 ; basis for: Bridge plate
Original owner: VDH&T ; use: Vehicular bridge
Present owner: VDH&T ; use: Vehicular bridge

Historical or Technological Significance

_____ Unique/Unusual in its time:

_____ Rare survivor though of standard design:

_____ Typical example of its time and a common survivor:

_____ Other Remarks/Explanation: 7.5 in. thick concrete base deck with 2 in. thick concrete wearing surface.

Nature/Degree of any destructive threats: Spalling on underside of deck and rails.

Reference materials and contemporary photos/illustrations with their respective locations:

FAS; Bridge safety inspection file.

Plans

Recorder: Tyson
Date: 4/5/79
Affiliation: VHTRC

Design Information

Compass orientation of axis: E/W.

No. of spans: 7 ; length overall: 326ft

Span types:

(1) Beam ; length: 15ft.
(2) Arch ; length: 64ft.
(3) Arch ; length: 64ft.
(4) Arch ; length: 64ft.
(5) Arch ; length: 64ft.
(6) Beam ; length: 29ft.
Beam 28ft

No. of lanes: 2 ; Roadway width: 22ft.

Architectural or decorative features:

Concrete lamp posts, 8 1/2" height.

Structural Information

Substructure:

Material: Concrete.
Foundations: Solid rock.
Piers: Concrete.
Abutments: Concrete.
Wings: Concrete.
Seats: —.

Superstructure:

Material: Stone ____ Concrete X

Configuration:

A. Arch X Barrel ____ Ribs (no.) ____ ; Spandrel: Open X Solid ____
Circular ____ Segmental X Other ____ ; Fixed ____ Hinged ____
Infilling: Earth ____ Ballast ____ None ____

B. Slab ____ C. Rigid Frame ____

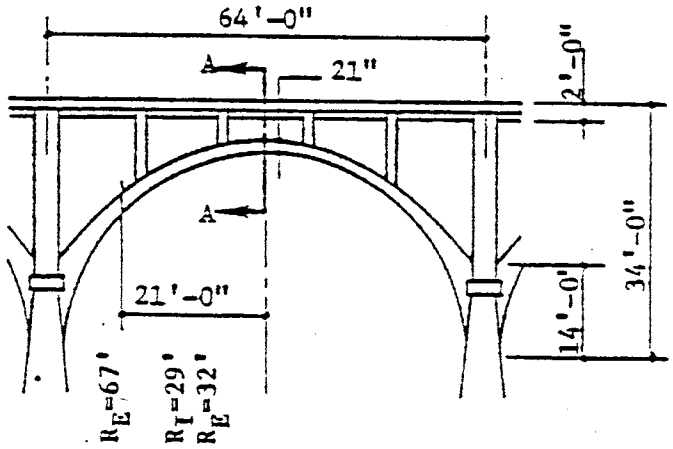
D. Beam X Type 4-tee Size ____ No./Spacing ____
Floorbeam ____ Type ____ Size ____ No./Spacing ____

Reinforcing System: 10-1" □ longitudinal bars spaced at 6" in intrados and extrados; tied with 3/8" ø bars spaced at 15".

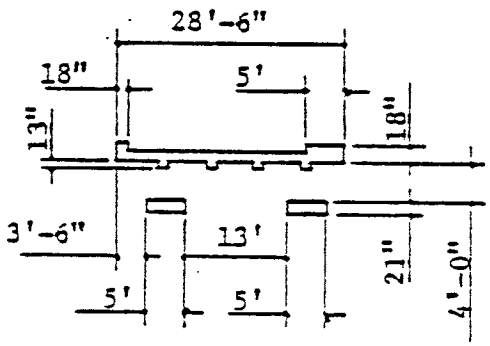
Parapets: Concrete post and double rail.

Sketch

Side Elevation



Section A-A



R-383

Photo Numbers:

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Staunton ; No. 8.
County: Alleghany ; No. 5.
City/Town:
Street/Road: 311
River/Stream/Railroad (crossing): C&O RR
UTM/UGS Coordinates:

Historical Information

Formal designation: 8213
Local designation: 1044
Designer:
Builder:
Date: ; basis for:
Original owner: ; use:
Present owner: C&O RR ; use: Railroad bridge

Historical or Technological Significance

_____ Unique/Unusual in its time:

_____ Rare survivor though of standard design:

_____ Typical example of its time and a common survivor:

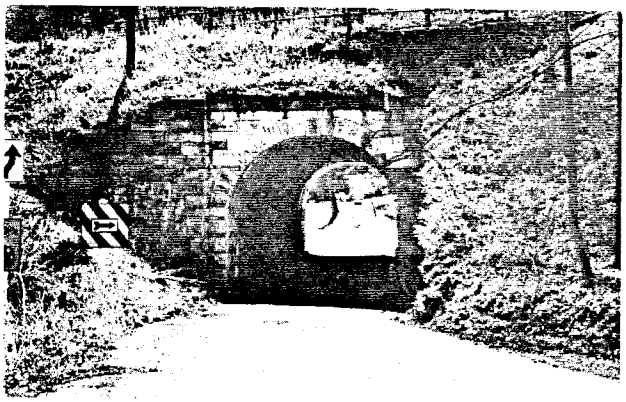
_____ Other Remarks/Explanation:

Nature/Degree of any destructive threats: Severe scaling and cracking of side of concrete arch and cracking of intrados.

Reference materials and contemporary photos/illustrations with their respective locations:

FAS; bridge safety inspection file.

No plans.



Recorder: Tyson
Date: 1/6/79
Affiliation: VHRTRC

Design Information

Compass orientation of axis: E/W.

Architectural or decorative features:

No. of spans: 1 ; length overall: 19ft.

Span types:

(1) Arch ; length: 19ft.
(2) ; length: .
(3) ; length: .
(4) ; length: .
(5) ; length: .
(6) ; length: .

No. of lanes: 1 ; Roadway width: .

Structural Information

Substructure:

North portion
Material: Stone.
Foundations: Firm material.
Piers: .

South portion
Abutments: Concrete.
Wings: Firm material.
Seats: .

Superstructure:

Material: Stone X Concrete X

Configuration:

A. Arch X Barrel Ribs(no.) ; Spandrel: Open Solid
Circular Segmental Other ; Fixed Hinged
Infilling: Earth Ballast None

B. Slab C. Rigid Frame

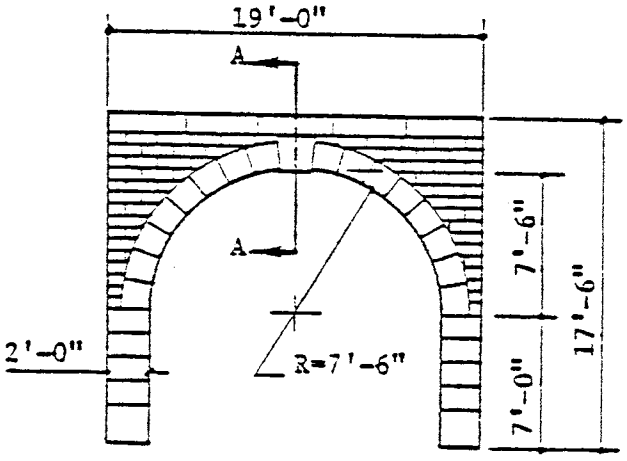
D. Beam Type Size No./Spacing
Floorbeam Type Size No./Spacing

Reinforcing System:

Parapets: Metal pipe.

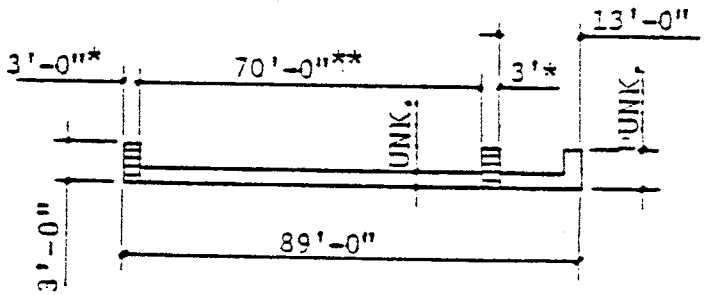
Sketch

Side Elevation



Section A-A

* Stone
** Metal culvert lining under brick



R-383

Photo Numbers:

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Staunton ; No. 8.
County: Augusta ; No. 7.
City/Town: Staunton No. 152.
Street/Road: Middlebrook Avenue/252.
~~River/Stream~~/Railroad (crossing): Under C&O RR.
UTM/KGS Coordinates: .

Historical Information

Formal designation: 7194 (Structure Listing No.).
Local designation: 1807 (District Structure No.).
Designer: .
Builder: .
Date: ; basis for: .
Original owner: ; use: .
Present owner: ; use: Railroad bridge.

Historical or Technological Significance

_____ Unique/Unusual in its time: .

_____ Rare survivor though of standard design: .

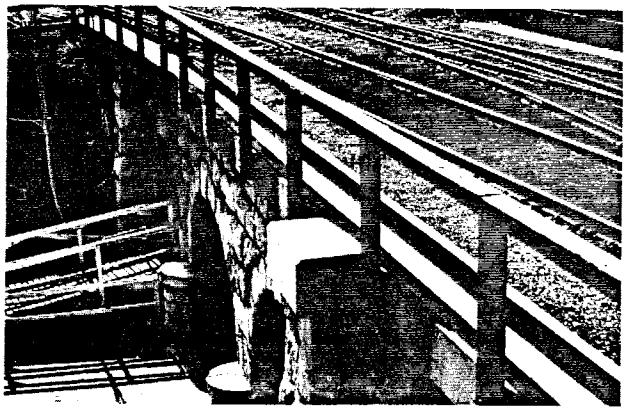
_____ Typical example of its time and a common survivor: .

_____ Other Remarks/Explanation: .

Nature/Degree of any destructive threats: .

Reference materials and contemporary photos/illustrations with their respective locations:

FAS



Recorder: Tyson.
Data: 5/20/79.
Affiliation: VH&TRC.

Design Information

Compass orientation of axis: _____. Architectural or decorative features:

No. of spans: 3 ; length overall: 39ft .
Span types:
(1) Arch ; length: 13ft .
(2) Arch ; length: 13ft .
(3) Arch ; length: 13ft .
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 2* ; Roadway width: 10ft .
*one under each of two arches. Timber walkway under third arch.

Structural Information

Substructure:
Material: Stone .
Foundations: Stone .
Piers: Stone .
Abutments: Stone .
Wings: None .
Seats: — .

Superstructure:
Material: Stone X Concrete X

Configuration:
A. Arch X Barrel ____ Ribs(no.) ____; Spandrel: Open ____ Solid ____
Circular X Segmental ____ Other ____; Fixed ____ Hinged ____
Infilling: Earth ____ Ballast ____ None ____

B. Slab ____ C. Rigid Frame ____

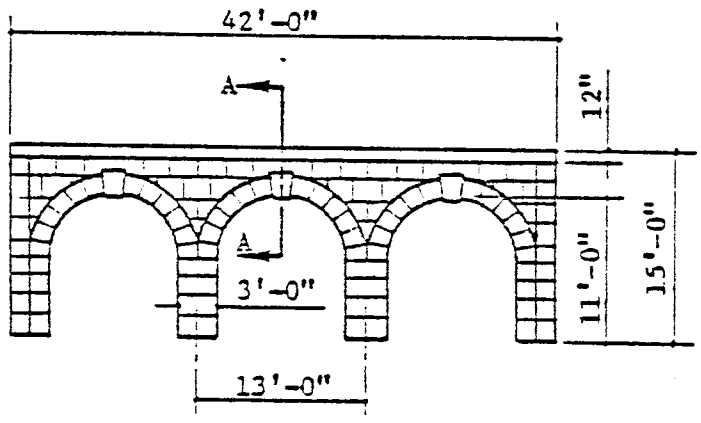
D. Beam ____ Type ____ Size ____ No./Spacing ____
Floorbeam ____ Type ____ Size ____ No./Spacing ____

Reinforcing System: _____

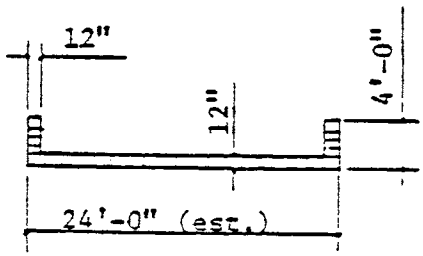
Parapets: Timber on south side.

Sketch

Side Elevation



Section A-A



R-383

Photo Numbers:

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Staunton ; No. 8.
County: Augusta ; No. 7.
City/Town: Staunton.
Street/Road: Middlebrook Avenue/252.
River/Stream/Railroad (crossing): under C&O RR.
UTM/KGS Coordinates: .

Historical Information

Formal designation: 7195 (Structure Listing No.).
Local designation: 1808 (District Structure No.).
Designer: .
Builder: .
Date: ; basis for: .
Original owner: ; use: .
Present owner: ; use: Railroad bridge.

Historical or Technological Significance

_____ Unique/Unusual in its time: .

_____ Rare survivor though of standard design: .

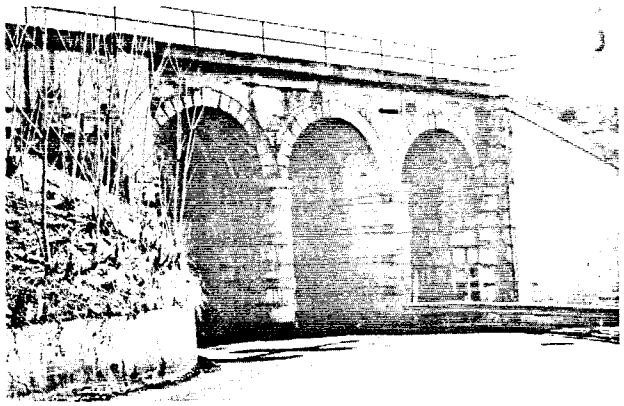
_____ Typical example of its time and a common survivor: .

_____ Other Remarks/Explanation: .

Nature/Degree of any destructive threats: Metal straps required to reinforce piers are in place.

Reference materials and contemporary photos/illustrations with their respective locations:

FAS



Recorder: Tyson.
Date: 5/20/79.
Affiliation: VH&TRC.

Design Information

Compass orientation of axis: _____. Architectural or decorative features:

No. of spans: 3 ; length overall: 39ft.
Span types:
(1) Arch ; length: 13ft.
(2) Arch ; length: 13ft.
(3) Arch ; length: 13ft.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 2* ; Roadway width: 10ft .
*One under each of two arches. Timber walkway under third arch.

Structural Information

Substructure:
Material: Stone .
Foundations: Stone .
Piers: Stone .
Abutments: Stone .
Wings: Concrete .
Seats: — .

Superstructure:
Material: Stone X Concrete X

Configuration:
A. Arch X Barrel ____ Ribs(no.) ____; Spandrel: Open ____ Solid ____
Circular X Segmental ____ Other ____; Fixed ____ Hinged ____
Infilling: ?Earth ____ Ballast ____ None ____

B. Slab ____ C. Rigid Frame ____

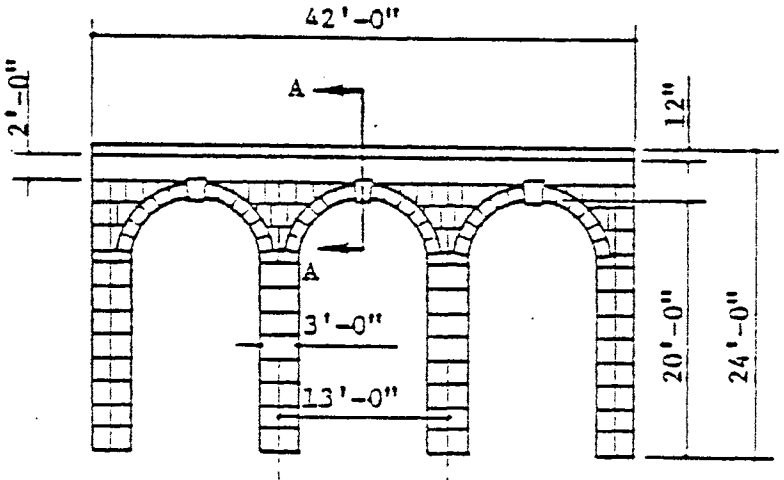
D. Beam ____ Type ____ Size ____ No./Spacing ____
Floorbeam ____ Type ____ Size ____ No./Spacing ____

Reinforcing System: _____

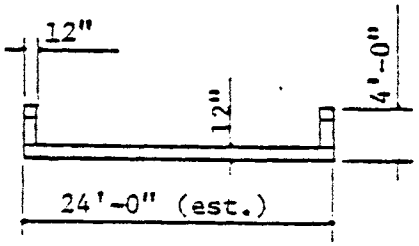
Parapets: Metal pipe on south side

Sketch

Side Elevation



Section A-A



R-383

Photo Numbers:

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Staunton ; No. 8
County: Bath ; No. 3
~~City~~/Town: _____
~~Street~~/Road: 39
~~River~~/Stream/~~Railroad~~ (crossing): Trib. Jackson River
UTM/KGS Coordinates: _____

Historical Information

Formal designation: 8359 (Structure Listing No.)
Local designation: 1034 (District Structure No.)
Designer: _____
Builder: State Forces
Date: _____; basis for: _____
Original owner: _____; use: _____
Present owner: VDHGT; use: Vehicular bridge

Historical or Technological Significance

_____ Unique/Unusual in its time: _____

? Rare survivor though of standard design: _____

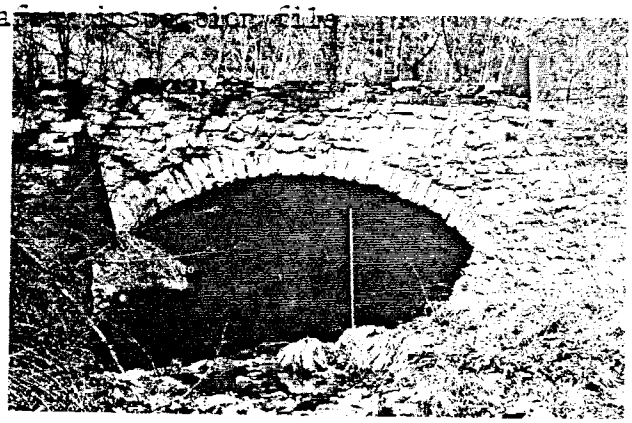
_____ Typical example of its time and a common survivor: _____

_____ Other Remarks/Explanation: Potential sites for rest/picnic area on either

Nature/Degree of any destructive threats: Sand buildup under structure over 3/4 of east side of streambed.

Reference materials and contemporary photos/illustrations with their respective locations:

FAS; No plans. Staunton Construction District: Safety inspection file



Recorder: Tyson
Date: 3/21/79
Affiliation: VHGTRC

Design Information

Compass orientation of axis: _____.

Architectural or decorative features:

No. of spans: 1 ; length overall: 29ft.

Span types:

(1) Arch ; length: 29ft.
(2) _____ ; length: _____.
(3) _____ ; length: _____.
(4) _____ ; length: _____.
(5) _____ ; length: _____.
(6) _____ ; length: _____.

No. of lanes: 2 ; Roadway width: 24ft.

Structural Information

Substructure:

Material: Stone.
Foundations: Firm material.
Piers: —.
Abutments: Stone.
Wings: Stone.
Seats: —.

Superstructure:

Material: Stone X Concrete _____ Masonry X

Configuration:

A. Arch X Barrel _____ Ribs(no.) _____; Spandrel: Open _____ Solid _____
Circular X Segmental _____ Other _____; Fixed _____ Hinged _____
Infilling: Earth X Ballast _____ None _____
(2-3ft. of macadam and earth; rock at mid span).

B. Slab _____ C. Rigid Frame _____

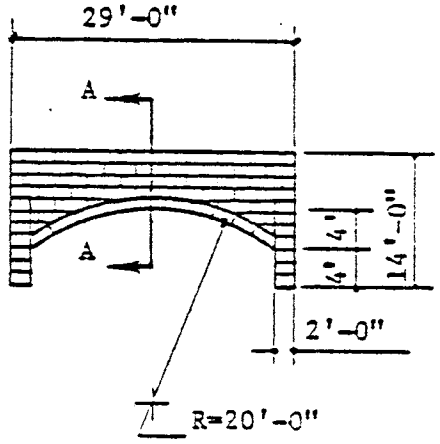
D. Beam _____ Type _____ Size _____ No./Spacing _____
Floorbeam _____ Type _____ Size _____ No./Spacing _____

Reinforcing System: _____

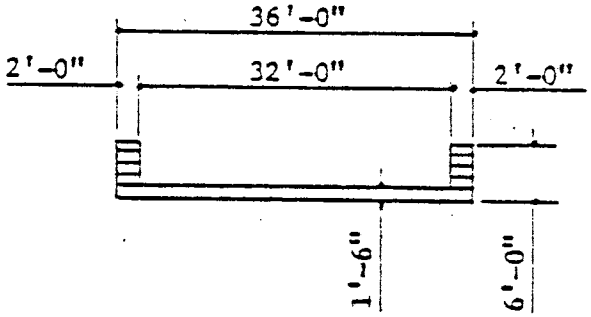
Parapets: Masonry parapets 2 ft. in height.

Sketch

Side Elevation



Section A-A



R-383

Photo Numbers:

SURVEY AND INVENTORY FORM - CONCRETE & STONE BRIDGES

Geographic Information

State: Virginia
Va. Dept. of Highways District: Staunton ; No. 8
County: Rockbridge ; No. 81
~~City~~/Town: Natural Bridge Station
~~Street~~/Road: 773
~~River/Stream~~/Railroad (crossing): under N&W RR
UTM/XGS Coordinates:

Historical Information

Formal designation: 8473 (Structure Listing No.)
Local designation: 6124 (District Structure No.)
Designer:
Builder:
Date: ; basis for:
Original owner: ; use:
Present owner: ; use: Railroad bridge

Historical or Technological Significance

_____ Unique/Unusual in its time:

_____ Rare survivor though of standard design:

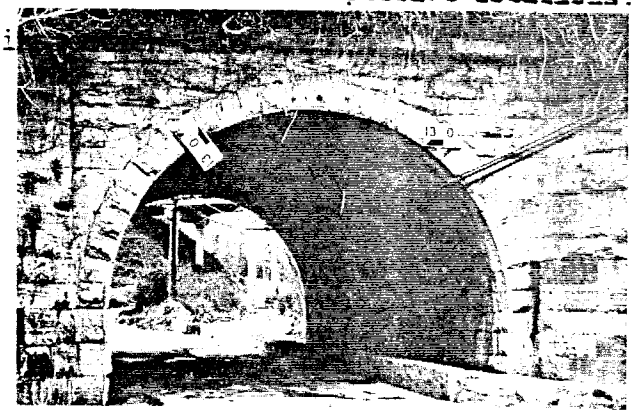
_____ Typical example of its time and a common survivor:

_____ Other Remarks/Explanation:

Nature/Degree of any destructive threats: Moisture seepage through majority of intrados.

Reference materials and contemporary photos/illustrations with their respective locations:

No plans. Staunton Construction District: Safety i



Recorder: Tyson
Date: 5/28/79
Affiliation: VH&TRC

Design Information

Compass orientation of axis: NE/SW. Architectural or decorative features:

No. of spans: 1 ; length overall: 22½ft.
Span types:
(1) Arch ; length: 22½ft.
(2) ; length: .
(3) ; length: .
(4) ; length: .
(5) ; length: .
(6) ; length: .

No. of lanes: 1 ; Roadway width: 17ft.

Structural Information

Substructure:
Material: Stone.
Foundations: Solid rock.
Piers: —.
Abutments: Stone.
Wings: Stone.
Seats: —.

Superstructure:
Material: Stone Y Concrete

Configuration:
A. Arch X Barrel Ribs(no.); Spandrel: Open Solid
Circular Y Segmental Other; Fixed Hinged
Infilling: Earth X Ballast X None

B. Slab C. Rigid Frame

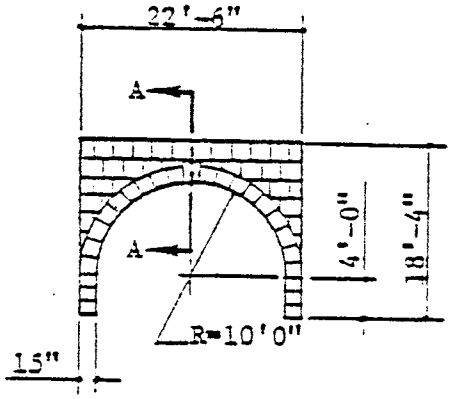
D. Beam Type Size No./Spacing
Floorbeam Type Size No./Spacing

Reinforcing System:

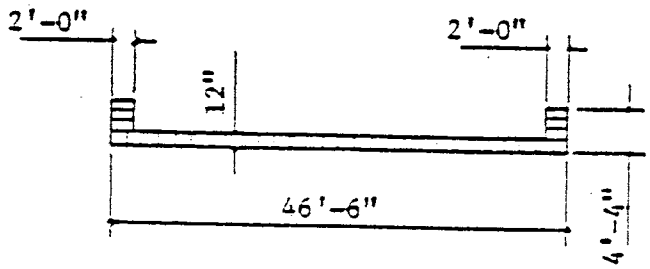
Parapets: Timber and metal cable.

Sketch

Side Elevation



Section A-A



APPENDIX B

VIRGINIA'S CRITERIA AND NUMERICAL RATING SYSTEM FOR
METAL TRUSS BRIDGES
(From reference 23, pages 10-18)

In developing the criteria a number of approaches and factors were considered. Despite the fact that the quantification of "historical significance", a subjective quality, is difficult, it was deemed desirable to develop the rating in some numerical way. After consideration of the various factors that enter into such a subjective evaluation, the characteristics of the bridges were identified into three broad categories as follows:

1) Documentation (age and builder) -- 7 points (26%) maximum

2) Technological significance (technology and geometrics) -- 9 points (33%) maximum

3) Environmental and Historical Factors (aesthetics, history, and integrity) -- 11 points (41%) maximum

While the largest single category relates to environmental factors, the remaining two categories together reflect largely technological factors, and viewed together the three appear to give a fair balance between the significance as viewed by those whose primary interest is technology and those whose primary concern is more general.

Each of the broad categories includes specific features as will be discussed later. Among these features are age, technological innovation, length and number of spans, and uniqueness, as well as history and the evolution of the crossing along with the aesthetics and integrity of the bridge. Establishment of the factors to be included and the numerical weights to be applied to each is complicated by the lack of an adequate data base for determining the ultimate standard for significance. For example, Should the criteria recognize uniqueness on a national, regional, or local level? And, Within what geographical limits, state or local, should the last truss of a given configuration be recognized? These and similar questions require criteria that can be applied at various levels. The tentative rating system proposed here attempts to incorporate these features, as will be discussed.

A broad perspective of historic significance was attempted by considering data and suggestions from other national sources, especially published reports of the Historic American Engineering Record and the National Register of Historic Places. However, because the largest body of data available was that from Virginia's inventory of metal truss bridges, it was decided to use the state of Virginia as the geographical limit.

Unfortunately, Virginia possesses comparatively few nationally significant bridges because of the vast destruction wrought by the Civil War and two disastrous floods in 1870 and 1877. The war probably had minimal impact on metal bridges. In fact, the wooden bridges destroyed during the conflict were often replaced by metal trusses. Natural destruction and progress have replaced most of the rest. The oldest surviving metal truss was built in 1877-78, when truss technology was well developed. In other states, such as New York, examples of Squire Whipple's original patent survive from the 1840s. Despite these limitations, the criteria and weighting provide a basis for quantitative and objective assessments, and the essential format is capable of being extended to include older or more technically significant structures.

The factors considered and the weight given to each are shown in Table B-1, and the rationale for the factors and relative weighting are then discussed.

Table B-1

Factors Comprising the Criteria for Historic Significance of Virginia's Metal Truss Bridges
(This rating system initially was developed by Dan G. Deibler, with minor modifications by the History Research Advisory Committee.)

FACTOR	POINTS ASSIGNED
	Maximum possible -- 7
A. Documentation	
1. Builder	
a. Unknown	0
b. Known, contribution to truss technology undetermined	1
c. Known, prolific builder	2
d. Known, unusual designer	3
2. Date*	
a. Post-1932	0
b. 1918-1932	1
c. 1900-1917	2
d. 1886-1899	3
e. Pre-1885	4
B. Technological Significance	Maximum possible -- 9
1. Technology	
a. Patented technology	1
b. Number of spans	1
c. Individual span lengths	1
d. Materials	1
e. Integrity	1
f. Special features	1
2. Geometry/configuration	
a. Unique	3
b. Unusual	2
c. Novel	1
C. Environmental and Historical Factors	Maximum possible -- 11
1. Aesthetics	4
2. History	3
3. Integrity	4

*When date is estimated, one-half value is assigned.

DOCUMENTATION

The important elements included for documentation are the company or builder and the age of the bridge.

Company

Companies and builders are characterized at three levels of significance. The most significant category is "known, unusual designer." The description is used for innovative companies that had a major impact on the evolution of truss technology. Among these companies would be the Phoenix Bridge Company, Phoenixville, Pennsylvania; King Iron and Bridge Company, Cleveland, Ohio; Keystone Bridge Company, Pittsburgh, Pennsylvania; and Groton Bridge and Manufacturing Company, Groton, New York.

The major innovation of the Phoenix Bridge Company was its patented compression member called the Phoenix column, which was a series of longitudinal segments riveted together to form a cylindrical column. Additional segments could be added to increase the column size. Phoenix was internationally known, with bridges in Canada, Mexico and Brazil.

The King Iron and Bridge Company was, during the 1880s, the largest highway bridge works in the United States. Its reputation was initially based upon Zenas King's patented tubular arch truss. Ultimately the company constructed numerous through truss and swing spans throughout the eastern United States.

The Keystone Bridge Company pioneered in the use of wide, die-forged eye bars for tension members. In the 1860s it initiated the use of wrought iron for all principal truss members and, later, developed a tubular column made up of riveted circular segments.

Designation of the Groton Bridge and Manufacturing Company as an unusual and innovative designer is made largely on the basis of a structure built in Virginia in 1890 for the Goshen Land and Improvement Company. It is a multi-span, wide, and heavily skewed truss reflecting a significant design achievement for the period.

The designation "known, prolific builder" is used to describe companies such as the Champion Bridge Company, Wilmington, Ohio; Brackett Bridge Company, Cincinnati, Ohio; Wrought Iron Bridge Company, Canton, Ohio; and Roanoke Iron and Bridge Company, Roanoke, Virginia. These companies constructed large numbers of bridges but, for the most part, utilized standard elements.

The final classification is "known, contribution undetermined". As more information is developed on the activities of companies, some now designated in this category might be elevated to a higher level.

Where the builder is unknown, no points are given.

Age

Points are given for increasing age in four groupings: pre-1885 -- 4; 1886-1899 -- 3; 1900-1917 -- 2; 1918-1932 -- 1. No points are awarded for bridges built after 1932. The dates of 1885 and 1932 were taken as limits based upon the frequency of surviving metal trusses in Virginia. As noted earlier, none survive that were built prior to 1877, and after 1932 all roads and bridges came under the jurisdiction of the Department of Highways so that standardized plans became common. Application of these classifications in other areas where older trusses survive would probably warrant two additional classes; say, 1865-85 and pre-1865.

The points are awarded when the date can be definitely established from date plates, plans, newspaper accounts, or public records. Where such information is not available, the age can usually be estimated to be within one of the groupings, but only one-half of the point value is given in these cases.

TECHNOLOGICAL SIGNIFICANCE

The second broad category of characteristics recognizes the technological features of the truss without regard to whether or not it has been moved or modified. Within this category the general geometric configuration and truss type, as well as industrial details, are considered. In all cases the truss is awarded the points it it possesses the characteristic. No fractional points are given.

Patented Technology

Items of significance would include Phoenix columns, tubular arches, special connections, and other patented innovations in the evolution of truss technology.

Number of Spans

Most of the nineteenth century bridges surviving in Virginia consist of a single span. While no hard and fast rule was followed on this criterion, in general a point is given for multiple spans for truss bridges built before 1900. Although none were found, a point would probably be given for bridges of more than three spans built between 1900 and 1917.

Length of Span

Again, no hard and fast rule was used, but generally a point is given for spans in excess of 100 feet (30.5 m.) built prior to 1900. This category can be refined by considering a plot of span length versus time of construction as data are accumulated.

Materials

Most of the bridges built after 1890 used steel for the structural members and necessary parts. During the decade prior to 1890, both steel and wrought iron were used. It is not always easy to determine the difference between the two materials without extensive testing. Steel bridges built prior to 1880 and wrought iron bridges built after 1890 would receive one point. For bridges built during the period between 1880 and 1890 there would be some justification for awarding a point to wrought iron as a late or somewhat retarded practice, and to steel as an innovation. Wood trusses of this period would receive a point because of their rarity.

Integrity of Truss

A point is awarded if the truss has not been modified, even though it might have been moved from its original location. Modifications usually can be readily detected by inspection.

Special Features

Most trusses surviving in Virginia are relatively free of ornamentation. A few have unusual or attractive portal bracing, finials, or other details. Where these occur, a point is given.

Geometric Configuration

The 1840s and 1850s were the decades of experimentation in search of the ideal truss. After the Civil War the Pratt and Whipple configurations became the most common. The inventory in Virginia confirmed that the Pratt configuration was overwhelmingly the most common. Other types were found, as reported in the various reports. In judging significance, common types were awarded no points: Characterization as unique, unusual, or novel, *when compared with Virginia's surviving trusses*, was used to award 3, 2 or 1 point. Application of these classifications in other areas or to a broader sample of bridges (nationwide for example) would require slight modification.

ENVIRONMENTAL AND HISTORICAL FACTORS

In addition to the technical or engineering aspects of bridges that are evaluated by the factors included under "documentation" and "technological significance", nontechnical characteristics such as aesthetics and historical factors are important. Environmental and historical factors are irreplaceable. Once destroyed, the site is lost. The sense of place is important. It is probable that, in the absence of quantitative criteria, these factors have been the major influence on Register nominations of structures. For both reasons a significant portion of the total points is warranted in this category. The evaluation of environmental factors also provides information important for the type of preservation effort to be pursued. For example, if a truss receives high marks in the first two categories (documentation and technological significance) but low marks in the environmental category, then relocation of the structure would be warranted. If, on the other hand, the environmental characteristics are significant, then special efforts to preserve or adaptively use the structure at its current location would be indicated.

Environmental factors are judged in three areas: aesthetics, history, and integrity. Bridges judged to possess these characteristics are awarded the indicated number of points. No fractional points for varying degrees of significance are given.

Aesthetics

Aesthetics are judged on the basis that the bridge is an integral part of its setting to the point that its removal or relocation would be detrimental to the bridge and the ambiance of the setting. While aesthetics is a subjective matter, experience has indicated that people

with marked differences in background and training can usually agree on the detrimental impact of the removal.

History

The term "history" embraces a variety of characteristics. The crossing may be significant, having evolved from a ford through a series of bridges. Thus, the bridge might be one of a series that has served the site. It may demonstrate the reuse of previous features; e.g. piers or abutments. It may, on the other hand, be the first (original) span at a particular site.

The crossing or bridge may be associated with a historical property or area, or it may have fostered residential, commercial, or industrial development in an area.

The historic significance of the bridge might derive from the fact that it was associated with significant events or circumstances. Normally the fact that the bridge was named for an individual would not, in itself, impart historical significance in the absence of the characteristics already described.

Bridges in communities or settlements would generally be assumed to have contributed significantly to local development and to thereby possess significance.

Integrity

Points for integrity are given if the bridge is at its original site. When trusses were initially promoted during the nineteenth century, it was the speed with which they could be assembled that made them so important and popular. Subsequent generations recognized and capitalized on their reusability so that many removed during subsequent road improvements were reerected at different sites. There are numerous examples of reuse in Virginia, and for many years when a truss was replaced, it was standard policy to matchmark and store it for subsequent reerection. There are examples where individual spans from multi-span bridges were used as single span bridges at different locations, and where single spans were combined with other trusses to form multi-span crossings. Because of this capability for reuse, which during the twentieth century became a selling point of metal trusses, an early truss at its original location is quite rare and merits recognition.

APPENDIX C

RESULTS OF APPLICATION OF THE RATING SYSTEM TO ARCH BRIDGES

The following tables present the rating results of the panel consensus for concrete and masonry arches. Table C-1 lists all masonry arch bridges by construction district, county, route number, and structure number. Table C-2 lists all concrete arch bridges by construction district, county, route number, and structure number. The construction districts are listed by the order of their administrative numbers 1-8: Bristol, Salem, Lynchburg, Richmond, Suffolk, Fredericksburg, Culpeper, Staunton.

TABLE C-1

APPLICATION OF RATING SYSTEM TO
MASONRY ARCH BRIDGES

BRIDGE			DOCUMENTATION	SIGNIFICANCE											ENVIRONMENT			TOTAL
				Technology							Configuration							
No.	County	Route	Designer/ Builder Date	PAT	MTL	INT	LTH	SPN	ND	SC	UQ	SV	TP		Aes.	Hist.	Integ.	
				BRISTOL DISTRICT														
6043	Russell	628	0	0	0	0	0	0	0	1	3	0	0		3	3	3	13
6055	Russell	637	2	1	0	3	3	0	0	1	1	3	0	0	3	3	3	23
6065	Russell	646	2	1	0	3	3	2	0	1	1	0	1	0	3	3	3	23
6068	Russell	647	2	1	0	3	3	0	0	1	1	0	0	0	3	3	3	20
6055	Scott	636	2	3	0	0	3	0	0	0	1	0	0	0	0	3	3	15
6069	Scott	650	1	2	0	0	3	0	0	0	0	0	0	0	0	0	3	9
6089	Scott	665	2	2	0	3	3	0	0	0	0	0	0	0	3	0	3	16
6050	Smyth	645	2	1	0	3	0	0	0	1	1	3	0	0	3	3	3	20
6006	Washington	612	0	2.5*	0	3	3	0	0	0	1	3	0	0	3	3	3	21.5
6283	Washington	726	0	0	0	0	3	0	0	1	0	0	0	0	3	0	3	10
6088	Washington	740	2	1	0	0	0	0	0	0	0	0	0	0	0	3	3	9
				SALEM DISTRICT														
6177	Botetourt	1308	2	2	0	3	3	0	0	1	1	0	1	0	3	3	3	22
6080	Giles	649	2	2	0	3	0	0	0	0	1	0	1	0	0	3	3	15
6145	Pulaski	755	2	2	0	3	0	0	0	1	1	0	1	0	3	3	3	19
				LYNCHBURG DISTRICT														
6013	Campbell	609	2	2	0	3	3	0	0	1	0	3	0	0	3	3	3	23

TABLE C-1 (CONT.)

APPLICATION OF RATING SYSTEM TO
MASONRY ARCH BRIDGES

BRIDGE			DOCUMENTATION	SIGNIFICANCE												ENVIRONMENT			TOTAL
				Technology									Configuration						
No.	County	Route	Designer/ Builder	Date	PAT	MTL	INT	LTH	SPN	ND	SC	UQ	SV	TP		Aes.	Hist.	Integ.	
6070	Nelson	606	2	2	0	3	3	0	0	1	0	0	0	0		3	3	3	20
				RICHMOND DISTRICT															
Out of Service	Chesterfield	--	2	3	0	3	3	0	2	0	1	0	0	0		3	3	3	24
				SUFFOLK DISTRICT															
				FREDERICKSBURG DISTRICT															
				CULPEPER DISTRICT															
--	Fairfax	193	2	1	0	0	3	0	0	0	1	0	1	0		3	3	0	14
6008	Fairfax	611	0	1	0	0	3	0	0	0	1	3	0	0		3	3	3	17
6233	Fauquier	628	0	0	0	0	3	3	0	0	0	0	0	0		3	0	3	12
1003	Loudoun	7	2	2	0	0	3	0	0	0	0	0	1	0		3	3	3	17
1025	Loudoun	50	2	3	0	3	3	2	2	0	1	0	1	0		3	3	3	26
6088	Loudoun	734	2	3	0	3	3	0	2	0	1	0	1	0		3	3	3	24
6236	Loudoun	751	0	0	0	0	3	3	0	0	0	0	0	0		3	0	3	12
Out of Service	Loudoun	Near 50	2	3	0	3	0	0	0	1	0	0	1	0		3	3	0	16
Out of Service	Loudoun	832	2	3	0	3	3	0	2	1	0	0	1	0		3	3	3	24
				STAUNTON DISTRICT															
1044	Alleghany	311	2	2	0	3	0	0	0	1	0	0	0	0		3	3	3	17
1807	Augusta	252	2	2	0	3	3	0	2	1	0	0	1	0		3	3	3	23

APPLICATION OF RATING SYSTEM TO
MASONRY ARCH BRIDGES

BRIDGE			DOCUMENTATION		SIGNIFICANCE											ENVIRONMENT			TOTAL
					Technology								Configuration						
No.	County	Route	Designer/ Builder	Date	PAT	MTL	INT	LTH	SPN	ND	SC	UO	SV	TP		Aes.	Hist.	Integ.	
1808	Augusta	252	2	2	0	3	3	0	2	1	1	0	1	0		3	3	3	24
1803	Augusta	250	2	2	0	0	0	2	0	0	1	0	1	0		3	3	0	14
Out of Service	Augusta	Near 81	2	2	0	3	3	0	2	1	0	0	1	0		3	3	0	20
6044	Page	683	2	2	0	3	0	0	0	0	0	0	0	0		0	3	3	13
6124	Rockbridge	773	2	2	0	3	3	0	0	1	0	0	0	0		3	3	3	20
1006	Rockbridge	11	3	5	0	3	3	2	0	0	1	3	0	0		3	3	3	29

TABLE C-2

APPLICATION OF RATING SYSTEM TO
CONCRETE ARCH BRIDGES

BRIDGE			DOCUMENTATION	SIGNIFICANCE												ENVIRONMENT			TOTAL
				Technology										Configuration					
No.	County	Route	Designer/ Builder Date	PAT	MTL	INT	LTH	SPN	ND	SC	UQ	SV	TP	Aes.	Hist.	Integ.	
			BRISTOL DISTRICT														
1021	Bland City	98	2 2	3	3	3	0	0	1	1	0	1	0	3	3	3	25
6280	Grayson	805	0 1*	0	0	3	0	0	0	0	0	0	0	0	0	3	7
1041	Scott	65	1 2	0	0	3	2	0	0	1	0	0	0	0	0	3	12
6474	Scott	796	1* 1*	0	3	3	0	0	0	0	0	0	0	3	0	3	14
6029	Smyth	622	0 2	0	0	3	0	0	0	0	0	0	0	0	3	0	5
6400	Smyth	634	1* 1*	0	0	0	0	0	0	0	0	0	0	0	3	0	5
6088	Smyth	689	2 2	0	3	3	0	0	0	1	0	0	0	3	0	3	17
1802	Tazewell	16	2 2	0	3	3	0	0	1	0	0	0	0	3	3	3	20
1054	Tazewell	91	2 2	0	0	3	0	2	0	0	0	0	0	0	0	3	12
1804	Tazewell	102	2 2	0	0	3	0	0	0	1	0	0	0	0	3	0	11
6400	Tazewell	634	2 2	0	0	3	0	2	0	0	0	0	0	0	0	3	12
6269	Tazewell	637	0 2	0	3	3	0	0	1	0	0	0	0	3	0	3	15
6233	Tazewell	770	0 1*	0	0	3	0	0	0	0	0	0	0	0	0	3	7
6063	Washington	689	1* 2	0	3	3	0	0	0	0	0	0	0	0	0	3	12
6242	Washington	689	2 2	0	3	3	0	0	0	0	0	0	0	0	0	3	13
6243	Washington	689	2 2	0	3	3	0	0	0	0	0	0	0	0	0	3	13

TABLE C-2 (CONT.)

APPLICATION OF RATING SYSTEM TO
CONCRETE ARCH BRIDGES

BRIDGE			DOCUMENTATION		SIGNIFICANCE										ENVIRONMENT			TOTAL
					Technology							Configuration						
No.	County	Route	Designer/ Builder	Date	PAT	MTL	INT	LTH	SPN	ND	SC	UQ	SV	TP	Aes.	Hist.	Integ.	
6244	Washington	689	2	2	0	3	3	0	0	0	0	0	0	0	0	0	3	13
1009	Wise	23	2	2	3	3	3	0	0	1	1	3	0	0	3	3	3	27
6097	Wise	1308	2	2	3	3	3	0	0	1	1	3	0	0	3	3	3	27
1042	Wise	83	2	2	0	3	3	0	0	1	1	0	0	0	3	0	3	18
6089	Wise	603	1*	0	0	0	0	0	0	0	0	0	0	0	0	0	3	4
6099	Wise	621	0	3	0	0	3	0	0	0	0	0	0	0	0	3	3	12
6059	Wise	652	1*	2	0	3	3	0	0	0	1	0	0	0	0	0	0	10
6062	Wise	657	1*	2	0	0	3	0	0	0	1	0	0	0	0	0	3	10
6063	Wise	657	1*	2	0	3	3	0	0	0	0	0	0	0	0	0	3	12
6095	Wise	1321	2	2	0	3	3	2	0	1	1	0	0	0	3	0	3	20
6046	Wythe	671	2	2	0	3	3	0	0	0	0	0	0	0	0	0	3	13
6050	Wythe	680	2	2	0	3	3	0	0	0	0	0	0	0	3	0	3	16
				SALEM DISTRICT														
1800	Bedford (Bridge St.)	43/ 122/221	2	3	0	3	3	2	0	1	1	0	1	0	3	3	3	25
6097	Bedford	680	2	3	0	0	3	0	0	0	1	0	1	0	0	3	3	16
6140	Bedford	741	2	3	0	0	3	0	0	0	0	0	1	0	0	3	3	15
1900	Franklin	220	2	2	0	3	3	0	0	0	1	0	0	0	3	3	3	20

TABLE C-2 (CONT.)

APPLICATION OF RATING SYSTEM TO
CONCRETE ARCH BRIDGES

BRIDGE			DOCUMENTATION		SIGNIFICANCE										ENVIRONMENT			TOTAL
					Technology								Config-uration					
No.	County	Route	Designer/ Builder	Date	PAT	MTL	INT	LTH	SPN	ND	SC	UO	SV	TP	Aes.	Hist.	Integ.	
6109	Franklin	724	0	1*	0	0	3	0	0	0	0	0	0	0	0	0	3	7
6014	Giles	622	2	1.5*	0	3	0	0	0	0	1	0	0	0	0	3	3	13.5
6035	Giles	648	0	1*	0	0	3	0	0	0	0	0	0	0	0	0	3	7
6066	Giles	724	1*	1*	0	3	3	0	0	0	0	0	0	0	0	0	3	11
6065	Giles	724	1*	1*	0	3	3	0	0	0	1	0	0	0	0	0	3	12
6004	Montgomery	601	0	1.5	0	0	3	0	0	0	0	0	0	0	0	0	0	4.5
6030	Montgomery	617	0	1.5	0	0	3	0	0	0	0	0	0	0	0	0	0	4.5
6076	Montgomery	660	2	2	0	3	0	0	0	0	1	3	0	0	0	3	3	17
6086	Montgomery	685	2	3	0	3	3	0	0	0	0	0	0	0	0	3	3	17
Out of Service	Montgomery	Aband.	2	3	0	0	3	0	0	0	1	3	0	0	0	3	3	18
6073	Montgomery	705	2	3	0	0	3	0	0	0	0	3	0	0	0	3	3	17
6104	Montgomery	723	2	3	0	3	3	0	0	0	1	3	0	0	0	3	3	21
6001	Pulaski	600	2	2	0	3	3	0	0	0	1	0	0	0	3	0	3	17
6020	Pulaski	627	2	2	0	3	3	0	0	1	0	3	0	0	3	0	3	20
6005	Pulaski	693	2	2	0	3	3	0	0	0	0	0	0	0	3	0	3	16
6012	Pulaski	789	2	2	0	3	3	0	0	0	0	0	0	0	3	0	3	16

TABLE C-2 (CONT.)

APPLICATION OF RATING SYSTEM TO
CONCRETE ARCH BRIDGES

BRIDGE			DOCUMENTATION		SIGNIFICANCE											ENVIRONMENT			TOTAL
					Technology							Configuration							
No.	County	Route	Designer/ Builder	Date	PAT	MTL	INT	LTH	SPN	ND	SC	UQ	SV	TP		Aes.	Hist.	Integ.	
1815	Roanoke City	116	2	2	0	3	3	2	2	1	0	0	0	0		3	3	3	24
1826	Roanoke City	Memorial Avenue	2	2	0	3	3	2	2	1	0	0	0	0		3	3	3	24
8003	Roanoke City	Jefferson Street	2	2	0	0	3	2	2	1	0	0	0	0		3	3	3	21
				LYNCHBURG DISTRICT															
6129	Amherst	610	0	2	0	0	3	0	0	0	1	0	0	0		0	0	3	9
1028	Amherst	130	0	2	0	3	3	0	0	0	0	0	0	0		0	0	3	11
1024	Buckingham	60	2	1	0	3	3	0	0	0	1	0	0	0		3	0	3	16
6027	Campbell	624	0	1*	0	0	0	0	0	0	0	3	0	0		0	0	0	4
6039	Campbell	623	0.5*	2	0	0	3	0	0	0	1	0	0	0		0	3	3	12.5
6083	Campbell	694	2	1.5*	0	0	0	0	0	0	0	0	0	0		0	3	3	9.5
6098	Campbell	704	2	2	0	3	3	0	0	0	0	0	0	0		3	0	3	16
6099	Campbell	704	2	2	0	3	3	0	0	0	0	0	0	0		3	0	3	16
6106	Campbell	712	2	1.5*	0	3	3	0	0	0	0	0	0	0		0	3	3	15.5
6059	Cumberland	690	0	1*	0	0	3	0	0	0	0	0	0	0		0	0	3	7
6154	Halifax	663	0	2	0	3	3	0	0	1	1	0	1	0		3	3	3	20
6061	Halifax	663	0	2	0	3	3	0	0	1	1	0	1	0		3	3	3	20

TABLE C-2 (CONT.)

APPLICATION OF RATING SYSTEM TO
CONCRETE ARCH BRIDGES

BRIDGE			DOCUMENTATION		SIGNIFICANCE										ENVIRONMENT			TOTAL
					Technology							Configuration						
No.	County	Route	Designer/ Builder	Date	PAT	MTL	INT	LTH	SPN	ND	SC	UQ	SV	TP	Aes.	Hist.	Integ.	
6079	Halifax	684	0	2	0	3	3	0	0	1	1	0	1	0	3	3	3	20
6243	Pittsylvania	924	2	1.5*	0	3	3	0	0	0	0	0	0	0	0	3	3	15.5
1811	Pittsylvania	29	2	2	0	3	3	0	2	1	0	0	1	0	3	3	3	23
8006	Pittsylvania	Worsham Street	2	2	0	3	3	0	2	1	1	0	1	0	3	3	3	24
--	Pittsylvania	Colquhoun	2	2	0	3	3	0	0	0	0	0	1	0	3	3	3	20
1902	City of Lynchburg	29	2	2	0	3	3	2	2	1	1	3	0	0	3	3	3	28
1829	City of Lynchburg	Carrol Avenue	2	2	0	0	3	0	0	0	0	0	0	0	0	3	0	10
				RICHMOND DISTRICT														
1001	Brunswick	1	2	2	0	3	0	0	0	1	0	0	0	0	3	3	3	17
1008	Brunswick	46	0	1*	0	0	0	0	0	0	0	0	0	0	0	3	3	7
6003	Brunswick	606	2	2	0	3	3	0	0	0	0	0	0	0	3	0	3	16
6087	Brunswick	673	2	2	0	3	3	0	0	0	0	0	0	0	3	3	3	19
1801	Chesterfield	1 & 301	0	1*	0	0	0	0	0	0	0	0	0	0	0	3	0	4
1005	Dinwiddie	1	2	2	0	3	3	0	0	1	0	3	0	0	3	3	0	20
1915	Dinwiddie	1	2	2	0	3	3	0	0	1	0	3	0	0	3	3	0	20
1003	Hanover	1		2	2	0	3	0	0	0	1	0	0	0	3	3	3	17
5020	Henrico	Osborne Turnpike	0	1*	0	0	0	0	0	0	0	0	0	0	0	3	3	7

TABLE C-2 (CONT.)

APPLICATION OF RATING SYSTEM TO
CONCRETE ARCH BRIDGES

BRIDGE			DOCUMENTATION	SIGNIFICANCE											ENVIRONMENT			TOTAL
				Technology								Config-uration						
No.	County	Route	Designer/ Builder	Date	PAT	MTL	INT	LTH	SPN	ND	SC	UQ	SV	TP	Aes.	Hist.	Integ.	
1849	City of Richmond	360	3	3	3	3	3	2	2	1	1	0	1	0	3	3	3	31
6160	Nottoway	634	2	2	0	0	0	0	0	0	0	0	1	0	0	3	3	11
				SUFFOLK DISTRICT														
6002	James City Co.	601	2	1*	0	0	3	0	0	0	0			0	0	3	3	12
				FREDERICKSBURG DISTRICT														
1006	Stafford	3	2	1*	0	3	3	0	0	1	0	0	0	0	3	3	3	19
6075	Stafford	607	2	3	0	3	0	0	2	0	1	0	1	0	3	3	3	21
				CULPEPER DISTRICT														
6016	Fairfax	612	2	1*	0	0	3	0	0	0	0	0	0	0	0	3	3	12
6017	Fairfax	613	2	2	0	3	3	0	0	0	1	3	0	0	0	3	3	20
6013	Fauquier	605	0	1	0	3	3	0	0	1	1	0	0	0	3	3	3	18
6033	Fauquier	624	2	2	0	3	3	0	0	1	0	0	0	0	3	3	3	20
6034	Fauquier	624	2	2	0	0	3	0	0	1	0	0	0	0	3	3	3	17
6060	Fluvanna	601	0	2	0	3	3	0	0	0	1	3	0	0	0	3	3	18
6008	Loudoun	611	2	2	0	0	3	0	0	0	0	0	0	0	0	0	3	10
6031	Loudoun	626	1*	1*	0	0	3	0	0	0	0	0	0	0	0	0	3	8
6039	Loudoun	643	1*	1*	0	0	3	0	0	0	0	0	0	0	0	0	3	8
6038	Loudoun	643	0	1*	0	0	0	0	0	0	0	0	0	0	0	0	3	4
6045	Loudoun	661	2	1*	0	3	3	0	0	0	1	0	0	0	0	0	3	13

TABLE C-2 (CONT.)

APPLICATION OF RATING SYSTEM TO
CONCRETE ARCH BRIDGES

BRIDGE			DOCUMENTATION		SIGNIFICANCE										ENVIRONMENT			TOTAL
					Technology							Configuration						
No.	County	Route	Designer/ Builder	Date	PAT	MTL	INT	LTH	SPN	ND	SC	UQ	SV	TP	Aes.	Hist.	Integ.	
6048	Loudoun	674	1*	1*	0	3	3	0	0	0	0	0	0	0	0	0	3	11
6146	Loudoun	690	1*	2	0	3	3	0	0	0	1	0	0	0	0	0	3	13
6019	Loudoun	719	2	2	0	0	3	0	0	0	0	0	0	0	0	0	3	10
6079	Loudoun	725	1*	1*	0	0	3	2	0	0	0	0	0	0	0	0	3	10
6090	Loudoun	734	2	2	0	3	3	0	0	0	0	0	0	0	0	3	3	16
Out of Service	Loudoun	Near 287/683	2	1*	0	3	3	0	0	0	0	0	0	0	0	0	0	9
Out of Service	Loudoun	Near 287	2	2	0	3	3	0	0	0	0	0	0	0	0	0	3	13
Out of Service	Loudoun	Near 643	2	1*	0	3	3	0	2	0	0	0	0	0	3	0	0	14
Out of Service	Loudoun	Near 671	2	1*	0	3	3	0	0	0	0	0	0	0	3	0	0	12
6040	Orange	655	2	1*	0	0	0	0	0	0	1	0	0	0	3	3	0	10
				STAUNTON DISTRICT														
1923	Alleghany	60	2	2	0	3	3	0	2	1	0	0	0	0	3	3	0	19
1900	Alleghany	60	2	2	0	3	3	2	0	1	0	0	0	0	3	3	3	22
1035	Alleghany	159	2	3	0	3	3	0	0	0	0	0	0	0	0	3	3	17
6143	Alleghany	633	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	4
6142	Alleghany	633	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	4
6441	Alleghany	696	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3

TABLE C-2 (CONT.)

APPLICATION OF RATING SYSTEM TO
CONCRETE ARCH BRIDGES

BRIDGE			DOCUMENTATION		SIGNIFICANCE										ENVIRONMENT			TOTAL
					Technology								Config-uration					
No.	County	Route	Designer/ Builder	Date	PAT	MTL	INT	LTH	SPN	ND	SC	UO	SV	TP	Aes.	Hist.	Integ.	
8002	Alleghany	Commercial Ave.	0	1*	0	0	0	0	0	0	0	0	0	0	0	3	3	7
1046	Augusta	254	2	2	0	3	3	0	0	0	0	0	0	0	3	3	3	19
1010	Bath	39	2	2	0	0	0	0	0	0	0	0	0	0	3	3	3	13
6016	Frederick	608	2	2	0	0	3	0	0	0	0	0	0	0	3	3	3	16
6903	Frederick	672	2	2	0	0	3	2	2	0	1	0	1	0	3	3	3	22
6022	Rockbridge	631	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
6322	Rockbridge	672	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
6324	Rockbridge	676	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
6326	Rockbridge	676	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	4
6315	Rockbridge	770	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
6333	Rockbridge	770	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
6334	Rockbridge	770	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
6605	Rockingham	693	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
6398	Rockingham	747	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3
6639	Rockingham	1013	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6044	Shenandoah	667	1	1	0	0	3	0	2	0	1	3	0	0	0	0	3	14

TABLE C-2 (CONT.)

APPLICATION OF RATING SYSTEM TO
CONCRETE ARCH BRIDGES

BRIDGE			DOCUMENTATION		SIGNIFICANCE										ENVIRONMENT			TOTAL
					Technology							Configuration						
No.	County	Route	Designer/ Builder	Date	PAT	MTL	INT	LTH	SPN	ND	SC	UQ	SV	TP	Aes.	Hist.	Integ.	
6047	Shenandoah	675	1	1	0	0	3	0	2	0	1	3	0	0	0	0	0	11
6049	Shenandoah	760	1	1	0	0	3	0	2	0	1	3	0	0	0	0	3	14
6060	Shenandoah	1419	1	1	0	0	3	0	2	0	1	3	0	0	0	0	3	14