A SURVEY AND PHOTOGRAPHIC INVENTORY OF METAL TRUSS BRIDGES IN VIRGINIA 1865-1932

V. The Richmond Construction District

by

Dan Grove Deibler
Research Analyst

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

Virginia Highway & Transportation Research Council
(A Cooperative Organization Sponsored Jointly by the Virginia Department of Highways & Transportation and the University of Virginia)

Charlottesville, Virginia

June 1976
VHTRC 76-R63

2962

SUMMARY

Prior to 1932, road maintenance and construction in Virginia were largely the responsibility of the individual county governments. Bridge construction projects, based on local requirements, formed a natural part of these activities. Local responsibility very often resulted in a rich variety of bridge designs built by an equally diverse group of bridge companies. The following report on the 14 counties that make up the Richmond Construction District discusses the diversity found in the most popular nineteenth century bridge type — the metal truss bridge.

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In accordance with the Virginia Highway & Transportation Research Council's study of road development and bridge building technology in Virginia, a photographic survey of the extant metal truss bridges was begun in 1973 to record and document those structures designed or built before 1932. Additional research concerned with developments in truss design during the nineteenth century has also been undertaken in order to evaluate each truss in terms of the structural technology of the period.

The Richmond Construction District is the fourth district surveyed in the project. The terrain of the 14 counties which make up the District (Figure 1) is relatively flat and largely rural. Except for the Richmond-Petersburg areas, which have suffered all the abuses of twentieth century industrial development, most of the land is still used for agricultural purposes or is devoted to timbering. Also the District is traversed, west to east, by five major rivers: the James, the Appomattox, the Nottoway, the Meherrin, and the Staunton. Despite the existence of these rivers and their obvious impediments to land transportation, there is little extant evidence of an active bridge building program by any of the counties during the late nineteenth century. Of the 24 remaining truss spans constructed before 1932, 14 were built after 1910, 2 were built before 1890, and the rest (8) have undocumented dates. (See Table 1.)

It is not clear why the number of nineteenth century truss spans in the Richmond District is so small. The economies and needs of the individual counties certainly had some effect; and since each county was responsible for the construction and maintenance of its own road system until 1932, bridge construction would have been conducted on a rather individual basis. Needs were seen as local and no statewide standards were in effect.

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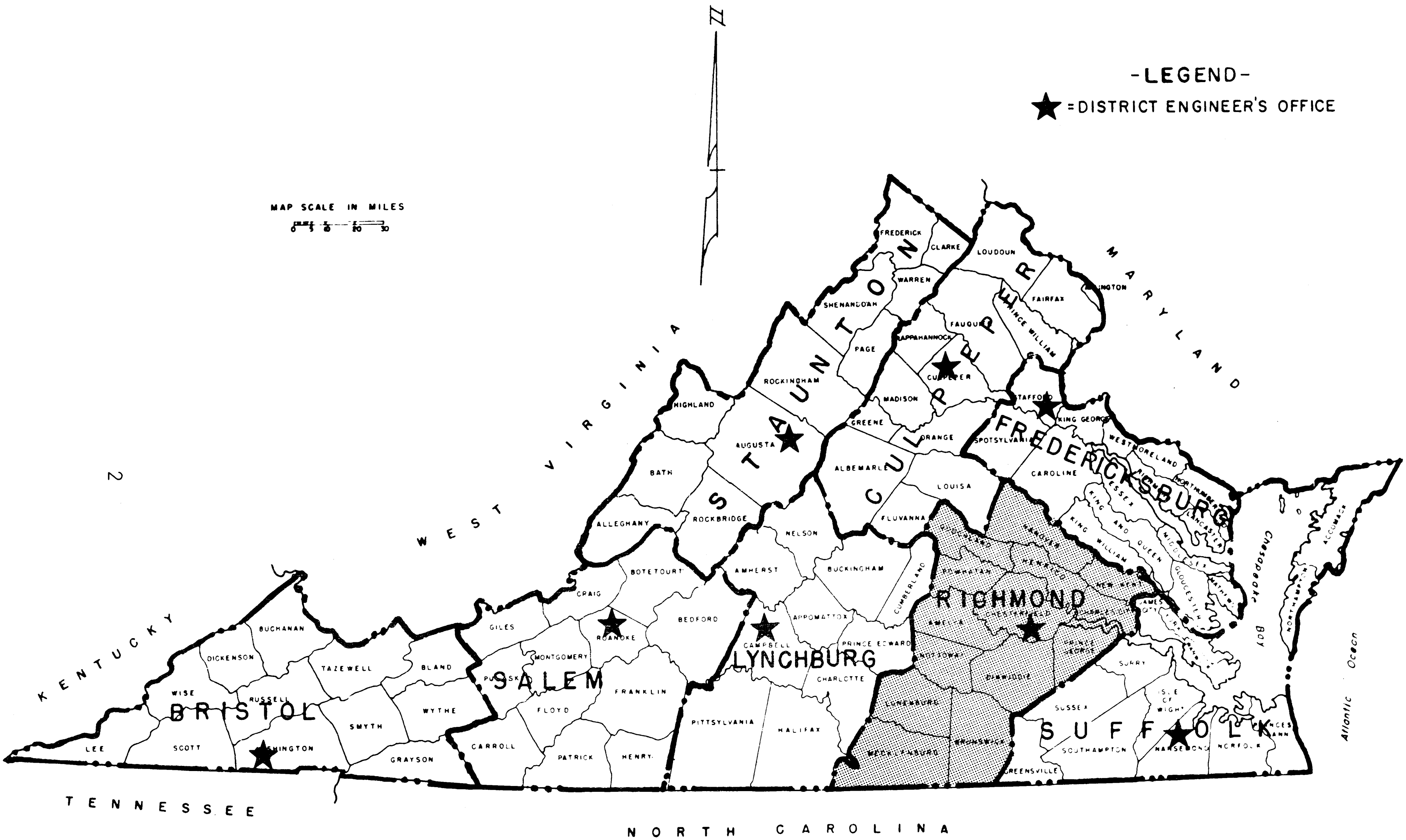

Figure 1. Richmond Construction District outline map.

County officials could determine their own requirements and pick designs and choose bridge companies as they wished. Until the industrial development of the twentieth century, the counties in the District had thinly settled agrarian populations. The transport of goods and services was limited and seasonal and railroads provided the major means of transport. Local farm products were carted over the local roads to the closest rail depots at such places as Alberta, Boydton, South Hill, Blackstone, Ashland, Columbia, Richmond, and Lawrenceville, and were stored for eventual shipment to distant markets. Demands on the local roads were not great and timber bridges of earlier years were probably quite satisfactory.

Not until the present century did the needs of the area change. The increases in vehicular traffic during the first three decades of the twentieth century placed greater and greater demands on the nation's roads and highways. More and more roads passed from local to state or national jurisdiction. Virginia was no exception. In 1932, the state assumed responsibility for maintaining the entire network of county roads (with some exceptions). The Richmond District is also crisscrossed by a number of state and national routes, e.g., Routes 5, 6, 40, 46, 47, 49, 1, 33, 58, 60, 301, 360, 460, which were upgraded or newly built during the 1920's and 1930's, probably as a result of the Federal Highway Act of 1921,(1) which imposed a national standard on highway design and construction. These projects involved widening and resurfacing roadways and resulted in the construction of numerous multi-span, two-lane truss bridges which could accommodate the increasing vehicular traffic. Ten such truss spans were built in the Richmond District between 1920 and 1932 (Figure 2). These massively membered structures are quite a contrast to their delicate, stick-like nineteenth century predecessors.

Because the majority of the extant trusses in the District are twentieth century designs, it is necessary to alter the evaluation method used in the Staunton and Culpeper district reports. In both cases it was possible to discuss the trusses in terms of nineteenth century technology since the majority of bridges were built then or reflected such development; however, in the Richmond District over one-half of the trusses were designed and built after 1910. Except for a two-span through/high Pratt truss bridge built in 1884 by the Wrought Iron Bridge Company, Canton, Ohio, (Appendix, form/photo number 04-12-1), the trusses reflect the standardization that had occurred in twentieth century technology. Mass production of structural steel in standardized shapes and sizes by a limited number of manufacturers assured a less than individual quality to truss designs, regardless of what particular company designed or fabricated a bridge. Trusses became more simple, using fewer but more massive members with riveted gusset-plate connections (Figure 3.)

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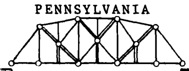
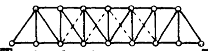
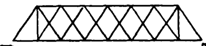
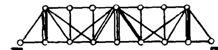
Table 1. Bridge Dates, Connection Details, and Truss Types in the Richmond District.

TRUSS TYPE	LOW (Pony)					
	PRATT half-hip	PRATT full-slope	TRIANGULAR	TRUSS LEG/BEDSTEAD	CAMELBACK Pratt	CAMELBACK Modified
TRUSS DATES						
Known: 1875-1910: 2 1911-1932: 14		1 - 1919 1 - 1930 2	1 - 1912 1 - 1913 2 - 1927 3 - 1929 1 - 1939 8			
Unknown:		3	1			
CONNECTION DETAILS						
Rigid having riveted gusset plates:		1 - 1919 1 - 1930 2 - ND	1 - 1912 1 - 1913 2 - 1927 3 - 1929 1 - 1931 1 - ND			
Pin having loop welded eyebars:		1 - ND				
Pin having die forged eyebars:						
Pin having both type eyebars:						
Other:						

THROUGH (High)

ND - no date.
* - stylistic attribution.

PENNSYLVANIA  Petit	PRATT  single-intersection	TRIANGULAR  single-intersection	TRIANGULAR  double-intersection	WHIPPLE  double-intersection	TOTAL
	2 - 1884 1 - 1911 1 - 1921 1 - 1924 5	1 - 1926 1			16
	4				8
	1 - 1924	1 - 1926			15
	2 - 1884 3 - ND				6
	1 - 1911 1 - 1921				2
	1 - ND				1
					0

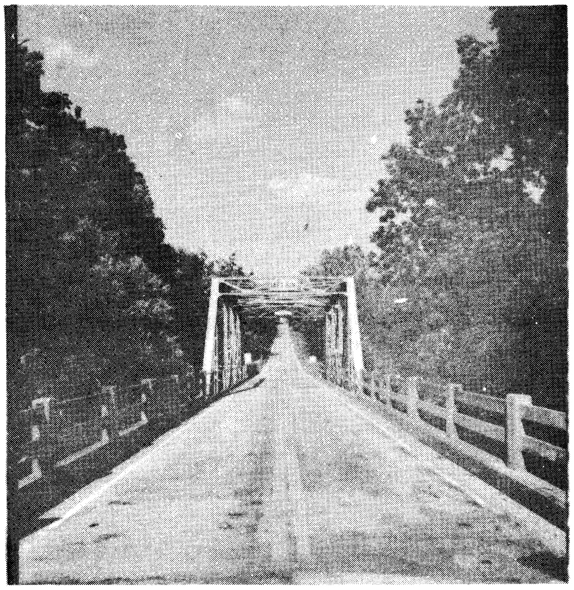


Figure 2. Five-span, two-lane bridge with an 85-foot through/high Pratt-type truss built according to plans and specifications prepared by the Virginia State Highway Commission in 1924. (Lunenburg County; photo/form number 04-55-1.)

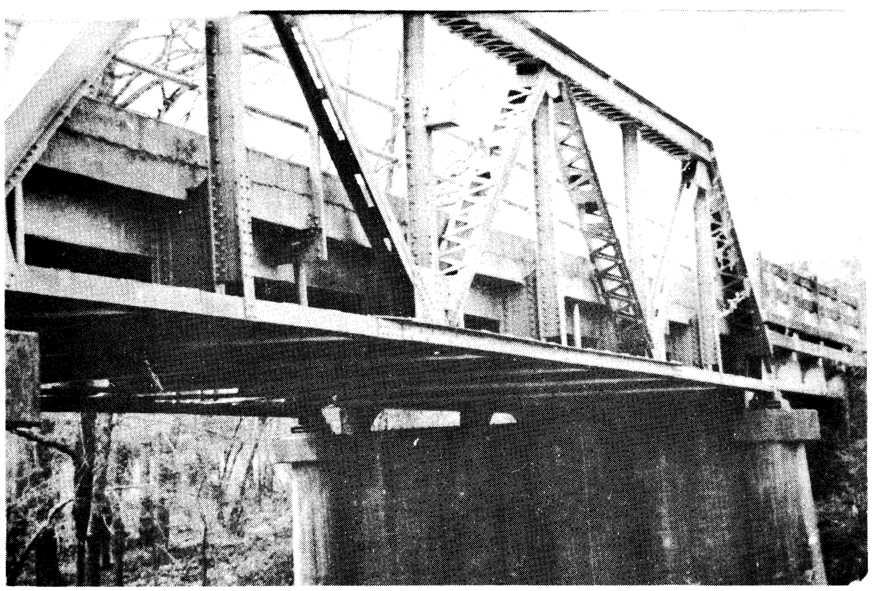


Figure 3. Riveted gusset-plate connection used on a low/pony triangular truss built in 1927. (Hanover County; see form/photo number 04-42-4.)

Instead of there being a rich variety in truss configurations such as were patented and marketed during the nineteenth century, e.g., the Bollman, Fink, Howe, Parker, Pratt, Town, Post, Petit, and lenticular, two basic truss types — the Pratt and Warren/triangular — came to dominate the field. This is quite clearly demonstrated in the Richmond District, where all of the truss spans are either Pratt or triangular configurations. (See Table 2.)

Developments in truss standardization and simplification were as much the result of practical considerations as they were theoretical ones. Since cost has always been an important consideration in any construction project, speed and ease of erection were recognized very early in bridge technology as variables which could be improved. This fact accounts for the development and exploitation of the pin-connected truss form (Figure 4) during the nineteenth century. Because hand-driven field rivets were regarded as structurally inferior and far more expensive to apply, the American engineering profession was slow to adopt them for general use.(2) Once a bridge site had been prepared, the pin-connected truss could be erected rather quickly and, the extensive falsework required during construction could thus be removed within a short time. This reduced the probability of its being washed away by the unpredictable flooding that plagues the rivers of North America. Such a disaster could unnecessarily delay on-site construction time, and thereby add to the cost. The pin connection was also preferred by the nineteenth century engineer because of the structural clarity resulting from its unambiguous distribution of stresses. This condition was not available with the riveted (rigid) connection. The pin connection, however, was not without its drawbacks. It resulted in a less rigid structure as well as a less heavy one than was possible with riveted connections. To compensate for these deficiencies, more complex webbing systems were developed, e.g., Whipple, Petit configurations, which required a greater number of parts and pieces; however, there was an optimum size which the pin, itself, could achieve. The load-carrying capacity of a pin-connected truss was thus limited by the very device which made the truss so desirable. It became apparent that the technology was not able to meet the demands of the continuing increases in vehicular loads.

The problem was to combine the advantages of the two structural systems: rigidity and strength and expeditious construction. The development of portable pneumatic riveters resolved the dilemma. Field riveting could now compete with shop/machine riveting for strength and reliability and with pin connections with respect to speed of erection. This innovation certainly occurred at a specific time but its implementation was more gradual. The years between 1890 and 1915 were something of a transitional period for connection features. Older trusses continued in service while the older technology persisted among the small bridge companies. Innovations

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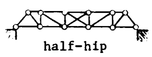
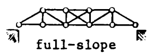
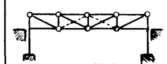
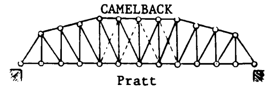
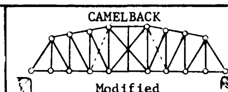
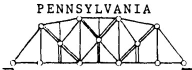
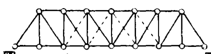
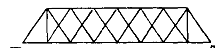
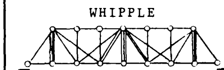
Table 2. Truss Types in the Richmond District.

TRUSS TYPE / COUNTY	LOW (Pony)					
	PRATT  half-hip	PRATT  full-slope	TRIANGULAR 	TRUSS LEG/BEDSTEAD 	CAMELBACK  Pratt	CAMELBACK  Modified
AMELIA COUNTY			1 - 1929			
BRUNSWICK COUNTY		1 - 1919	1 - 1927 1 - 1929 1 - 1931			
DINWIDDIE COUNTY						
HANOVER COUNTY		2 - ND	1 - 1927			
LUNENBURG COUNTY		1 - 1930 *1 - ND	1 - 1929			
MECKLENBURG COUNTY		1 - 1912	1 - 1913 1 - ND			
NOTTOWAY COUNTY						
TOTAL		6	8			

THROUGH (High)

ND - no date.
* - stylistic attribution.

PENNSYLVANIA  Petit	PRATT  single-intersection	TRIANGULAR  single-intersection	TRIANGULAR  double-intersection	WHIPPLE  double-intersection	TOTAL
	1 - ND				2
	2 - 1884				6
	1 - ND				1
	1 - 1911 1 - 1921	1 - 1926			6
	1 - 1924				4
	1 - ND				4
	1 - ND				1
	9	1			24

would have first appeared in the very long bridges that required individual solutions and where the advantages to be gained from recent innovations would have been the greatest. Small bridges were commonplace and routinely designed. In the Richmond District, only 2 of the 14 trusses built after 1910 have pin connections.

Prior to the 1890's it was also common to find truss bridges that included a variety of structural material, e.g., wood, cast iron, wrought iron or steel; however, as steel became economically competitive and more readily available, it became the exclusive material used in structural design. Continued improvements in the strength and quality of alloy steels enabled longer spans to be achieved with a more efficient use of material. Nickel steel was found to be as durable as carbon steel and over 50% stronger.[3] It was first used in bridge design in 1903 for the eyebars in the Blackwell's Island (Queensboro) Bridge in New York City. This development, in conjunction with the use of riveted connections, permitted a threefold increase (from 100 feet to 350 feet) in the maximum recommended length for riveted truss spans.[4] No crossing in the Richmond District at the time would have required any structure as formidable as the Queensboro Bridge. In 1884, James A. L. Waddell, the prominent nineteenth century bridge engineer, formulated the following scale which correlated span length to truss type and connection detail:[5]

Span Length	Recommended Truss Type; Connection
> 65 feet < 90 feet	Low/pory; pin
> 90 feet <200 feet	Through/high; pin
>200 feet	Through/high with polygonal top chords; —

As the quality of steel increased and connection techniques improved, Waddell's scale values no longer applied; however, the basic concept remained valid — the longer the span the deeper the truss and the greater the probability of its having a polygonal top chord. Low/pony trusses continued to be used for the shorter spans and through/high trusses for the longer ones. Generally, this statement is true for the Richmond District. The average length of all through/high trusses is 107 feet, while for low/pony trusses it is 72 feet. For those low/pony trusses built between 1920 and 1932, the average length is 80 feet; for those that appear to have been built earlier, the average length is 64 feet. The longest through/high truss measures 140 feet and was built in 1926. It has horizontal top chords. (See Figure 5.) Two years prior to that time, a through/high truss of similar character was built in

Lunenburg County, but it spanned only 85 feet. (See Figure 2.) A similar contrast occurs with the low/pony trusses; one built in 1929 (Figure 6) spans 105 feet, while another, built in 1913, spans only 46 feet. (See Figure 7.) The latter is the shortest span in the District. There are no trusses with polygonal top chords dating prior to 1932, a fact probably best explained by the relatively short crossings which were then encountered.

Generally speaking, the truss spans in the Richmond District are routinely designed bridges for casual crossings and reflect the technological characteristics of the twentieth century. Inclined end posts/batter braces (Figure 8) are used exclusively; Waddell had espoused their superiority over vertical end posts as early at 1884.[6] The same can be said for lacing bars (Figure 9); no latticing is used on structural members on any truss. And as already discussed, riveted gusset plates became the preferred connection device. (See Figure 4.) The general lack of variety among the 24 extant trusses is as much the result of the very limited number of bridge companies or agencies which designed and built these structures (see Table 3) as it is the standardization that occurred in truss technology. Six spans were built by the Roanoke Iron & Bridge Works, Roanoke, Virginia; 5 trusses were built by the Virginia Bridge and Iron Company, also of Roanoke; 6 truss spans are by undetermined builders; and the remaining 7 are distributed among five other companies or designers. (See Table 3.)

There are really only 3 truss spans in the Richmond District of special interest. Two through/high Pratt-type trusses are incorporated in a bridge designed and built in 1884 by the Wrought Iron Bridge Company, Canton, Ohio. (See Appendix, Form 04-12-1.) It is the oldest extant bridge in the District and may be the oldest multi-span metal truss bridge in the state. It is especially significant because it appears to be at its original location. The third truss is a single-span low/pony triangular truss built in 1913 by the York Bridge Company, York, Pennsylvania. (See Appendix, Form 04-58-4.) It is the District's shortest truss span at 46 feet, though that is hardly a significant feature. It is one of the two known examples built by this company in the state and is an unusually light configuration.

No county record search has been undertaken to determine the specific procedure followed for getting the company designed bridges built; however, a general understanding of the practice is apparent from some other sources.[7] The county officials, having decided where a truss was needed, either as a replacement structure or as new construction, would draw up a notice of a "bridge-letting" and post it publicly, mail it to potential bidders, or publish it in newspapers or engineering journals.[8] (See Figure 10.)

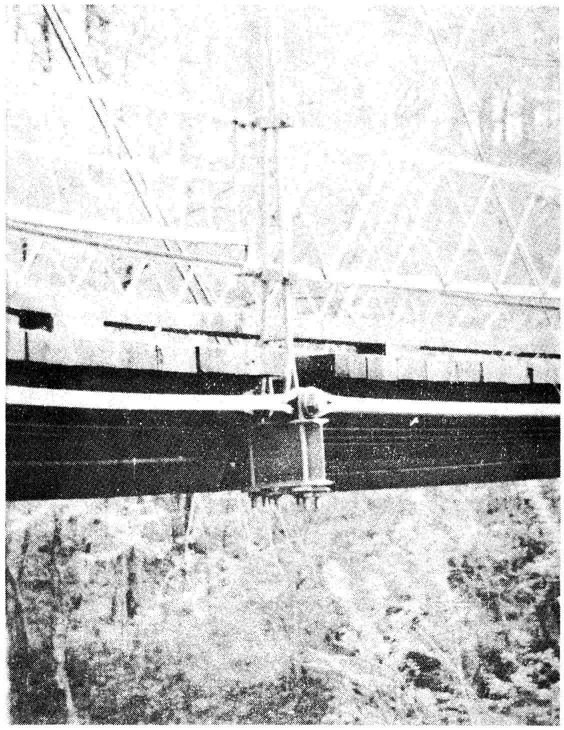


Figure 4. Pin connection used on a through/high Pratt-type truss; builder and date unknown. (Mecklenburg/Halifax County line; see form/photo number 04-58-1.)

Figure 5. Five-span,two-lane bridge with a 140-foot span through/high triangular truss with horizontal top chords; built in 1926 by the Roanoke Iron & Bridge Works, Inc., Roanoke, Virginia. (Hanover/Caroline County line; see form/photo number 04-42-1.)

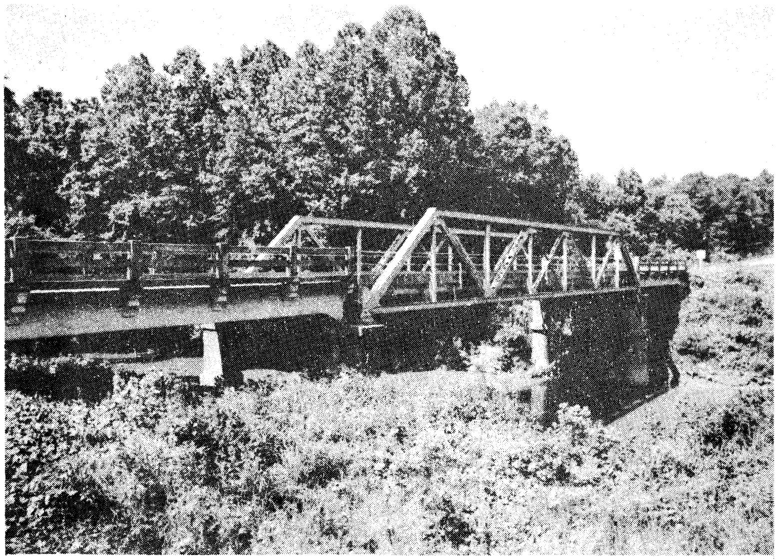


Figure 6. Three-span, two-lane bridge with a 105-foot low/pony triangular truss center span designed in 1929 by the Virginia State Highway Commission, Richmond, Virginia. (Brunswick County; see form/photo number 04-12-4.)

Figure 7. Single-span low/pony triangular truss with a 46-foot span built in 1913 by the York Bridge Company, York, Pennsylvania. (Mecklenburg County; form/photo number 04-58-4.)

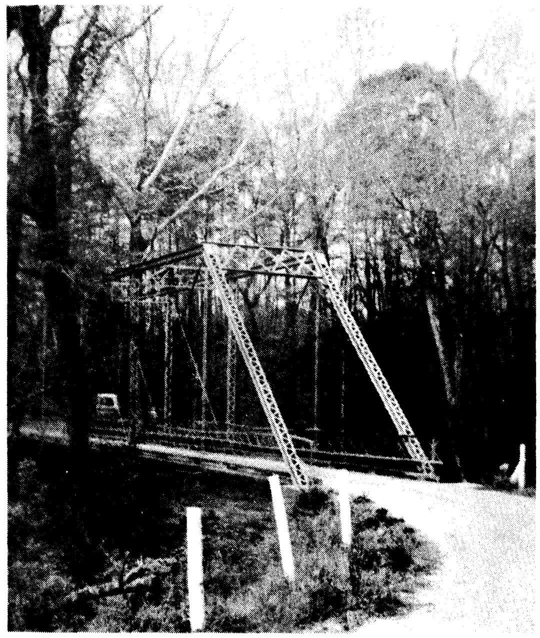


Figure 8. Inclined end posts/batter braces used on a through/high Pratt-type truss; date and builder unknown. (Mecklenburg/ Halifax County line; form/photo number 04-58-1.)

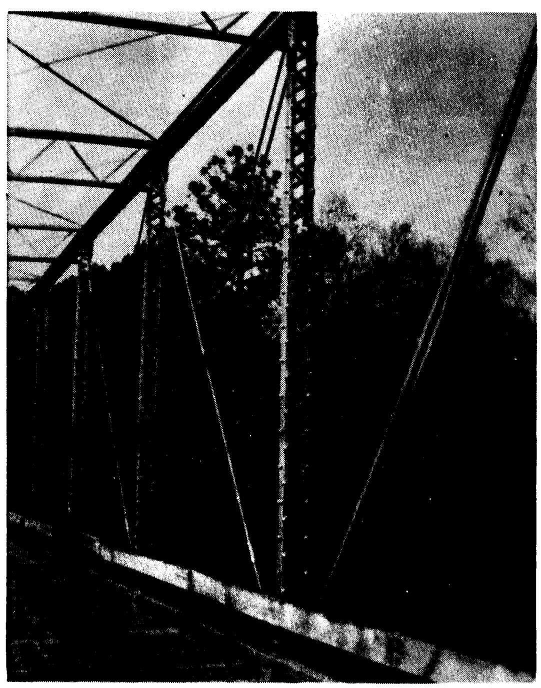


Figure 9. Lacing bars used on posts and lateral struts of a through/high Pratt-type truss built by Virginia Bridge and Iron Company, Roanoke, Virginia; date unknown. (Dinwiddie/Brunswick County line; form/photo number 04-26-1.)

The extent of the published specifications could vary significantly: one might be a highly detailed listing of dimensions, materials, loads, flooring and abutment requirements, while another might be a relatively simple notice whose purpose was more a search for and discussion of what type bridge would be the best for the crossing.(9) Certainly, the experience and background of the local officials, along with their access to professional advice, would have determined the nature of a particular "bridge-letting". Waddell placed little faith in the ability of the typical local official to select the best bridge design from among those submitted by the competitive bidders.(10) Even the most elementary comprehension of the variables in truss technology, e.g., number of panels vs. truss depth vs. span length vs. dead load vs. pin size vs. floor beam depth, should indicate the formidable technological knowledge required in truss design. Most county officials were really at the mercy of the bridge companies and their representatives on whose integrity they were forced to rely. The bridge companies would respond to the "bridge-letting" notices either by sending bids and specifications along with their designs for the commissioners to examine, or by having company representatives appear before the local officials to explain their proposals. The exact procedure would thus have depended on the preferences and policies of the individual counties.

It is not clear if all "bridge-lettings" were based on the competitive bidding system. Public policy would certainly have dictated adhering to this system; however, on a local level there may have been factors of convenience or familiarity. After a county had contracted with a particular company, the immediate task of erecting the bridge was the responsibility of the site foreman, a company employee who traveled from one bridge project to the next, hiring and training local labor for each job as well as securing building supplies, e.g., timber for falsework and masonry and mortar for abutments.(11) Some of the materials were probably available at the site — sand and gravel from the stream bed and stone and timber from the surrounding locale.(12) If everything went according to plan, this preliminary work was completed by the time the tools, equipment and truss components arrived at the nearest freight depot. The rapidity of the work depended on a number of other variables as well: the site's location and accessibility, the weather, the water depth, the span length, and the truss type itself. Pin-connected trusses were considerably easier to erect than rivet-connected ones, though, as already discussed, improvements in field riveting techniques reduced this advantage significantly. Except for those in the connecting joints, the majority of rivets were machine driven in the company's shop. Just as a truss is built up from component parts, i.e., posts, chord sections, eyebars, and tie rods, so too are these members fabricated from

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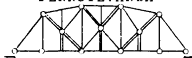
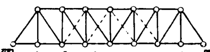
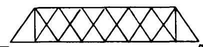
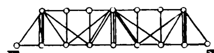
Table 3. Bridge Companies and Truss Types in the Richmond District.

TRUSS TYPE / BRIDGE COMPANIES	LOW (Pony)					
	PRATT half-hip	PRATT full-slope	TRIANGULAR	TRUSS LEG/BEDSTEAD	CAMELBACK Pratt	CAMELBACK Modified
FREDERICKSBURG BRIDGE COMPANY Fredericksburg, Virginia		1 - 1930				
GRESHAM BRIDGE COMPANY ------			1 - 1927			
ROANOKE IRON & BRIDGE WORKS Roanoke, Va.			1 - 1927 2 - 1929			
VIRGINIA BRIDGE & IRON COMPANY Roanoke, Va.		1 - 1912 *1 - ND	1 - 1931			
VIRGINIA STATE HIGHWAY COM-MISSION Richmond, Va.		1 - 1919	1 - 1929			
WROUGHT IRON BRIDGE COMPANY Canton, Ohio						
YORK BRIDGE COMPANY York, Penna.			1 - 1913			
UNKNOWN		2 - ND	1 - ND			
TOTAL		6	8			

THROUGH (High)

ND - no date.
* - stylistic attribution.

PENNSYLVANIA  Petit	PRATT  single-intersection	TRIANGULAR  single-intersection	TRIANGULAR  double-intersection	WHIPPLE  double-intersection	TOTAL
					1
					1
	1 - 1921 1 - 1924	1 - 1926			6
	1 - 1911 1 - ND				5
					2
	2 - 1884				2
					1
	3 - ND				6
	9	1			24

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NOTICE

TO BRIDGE CONTRACTORS !

PROPOSALS will be received until the 16th day of April next, by the undersigned commissioners on the part of the counties of Orange and Culpeper, in the state of Virginia, for the Masonry and Construction of a **Wrought Iron Bridge,** about 167 feet span, across the Rapidan River, at Raccoon Ford.

The masonry required consists of two abutments, first-class rubble work of 20 feet face, with wings 20 feet and 8 feet thick, and to be founded on solid hard pan, or rock, below, and raised 15 feet above level of water when running over the entire length of the mill dam, to be laid of Syenite or solid hard stone in cement to water level, and with lime mortar above, and the bridge to be of ENTIRE WROUGHT IRON, floor excepted, which is to be of White Oak Plank, two and a-half inches thick, laid diagonally across, and with roadway twelve feet wide, the whole not to cost over FIVE THOUSAND DOLLARS, as limited by orders of the court.

Bids for entire work, or separately, for masonry and bridge, will be received, said proposals to be sent to office of the Clerk of the County Court of Culpeper County, in Culpeper, and are subject to the confirmation of the courts of the counties of Orange and Culpeper, and if any be accepted, and contract made, the work to be paid for out of the levies for the year 1883.

For any further information address Culpeper Commissioners at Raccoon Ford, Culpeper county, or Orange Commissioners at Rapidan Station, Culpeper county.

J. J. HALSEY,
H. T. HOLLADAY,
JAMES S. WILLIS,
Commissioners for Orange County.

W. S. STRINGFELLOW,
JNO. Z. HOLLADAY,
J. M. SCOTT,
Commissioners for Culpeper County.

Raccoon Ford, Va., March 21, 1883.

"TIMES" PRINT—CULPEPER.

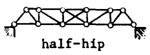
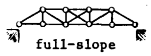
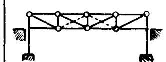
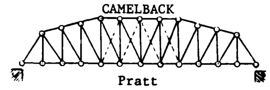
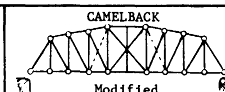
Figure 10. A "bridge letting" notice put out in 1883 by the Boards of Supervisors of Culpeper and Orange Counties.

standardized steel or wrought iron shapes such as channels, angles, bars and plates. These basic shapes were machine sized, cut, drilled, punched, and riveted in the various truss components at a company's fabrication shop, and were subsequently put together at the site simply by slipping pins in at each panel point. Field riveting was thus kept to a minimum and on-site construction time was limited.

When the job was completed, the erection crew was disbanded and the foreman moved on to the next project or returned to the company's offices. In some counties where an active bridge building program was pursued, a pool of trained laborers would develop over a period of years; however, this appears not to have been the case with the counties now in the Richmond Construction District. (See Tables 4-10.) Most of the bridge construction seems to have occurred after the State Highway Commission assumed responsibility for the primary and, later, the county road systems. As a result, the extant trusses are largely twentieth century structures designed with different needs in mind and built according to standard specifications. What used to be a company foreman became a structural engineer, while the locally recruited laborer needed to be a skilled riveter, steel erector or special equipment operator. Local participation became minimal from the decision making process to the construction process.

2984

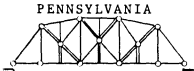
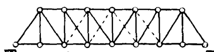
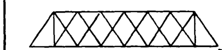
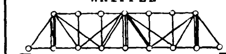
Table 4. Bridge Companies and Truss Types in Amelia County.

TRUSS TYPE / AMELIA COUNTY	LOW (Pony)					
	PRATT  half-hip	PRATT  full-slope	TRIANGULAR 	TRUSS LEG/BEDSTEAD 	CAMELBACK  Pratt	CAMELBACK  Modified
ROANOKE IRON & BRIDGE WORKS Roanoke, Va.			1 - 1929			
UNKNOWN						
TOTAL			1			

2985

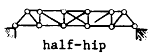
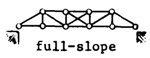
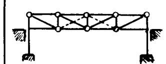
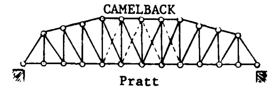
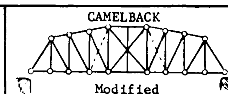
THROUGH (High)

ND - no date.
* - stylistic attribution.

PENNSYLVANIA  Petit	PRATT  single-intersection	TRIANGULAR  single-intersection	TRIANGULAR  double-intersection	WHIPPLE  double-intersection	TOTAL
					1
	1 - ND				1
	1				2

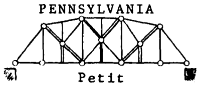
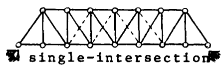
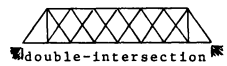
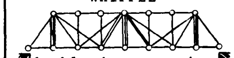
2986

Table 5. Bridge Companies and Truss Types in Brunswick County.

TRUSS TYPE / BRUNSWICK COUNTY	LOW (Pony)					
	PRATT  half-hip	PRATT  full-slope	TRIANGULAR 	TRUSS LEG/BEDSTEAD 	CAMELBACK  Pratt	CAMELBACK  Modified
WROUGHT IRON BRIDGE COMPANY Canton, Ohio						
ROANOKE IRON & BRIDGE WORKS Roanoke, Va.			1 - 1927			
VIRGINIA BRIDGE & IRON COMPANY Roanoke, Va.			1 - 1931			
VIRGINIA STATE HIGHWAY COMMISSION Richmond, Va.		1 - 1919	1 - 1929			
TOTAL		1	3			

THROUGH (High)

ND - no date.
* - stylistic attribution.

PENNSYLVANIA  Petit	PRATT  single-intersection	TRIANGULAR  single-intersection	TRIANGULAR  double-intersection	WHIPPLE  double-intersection	TOTAL
	2 - 1884				2
					1
					1
					2
	2				6

2988

Table 6. Bridge Companies and **Truss Types** in Dinwiddie County.

TRUSS TYPE / DINWIDDIE COUNTY	LOW (Pony)					
	PRATT half-hip	PRATT full-slope	TRIANGULAR	TRUSS LEG/BEDSTEAD	CAMELBACK Pratt	CAMELBACK Modified
VIRGINIA BRIDGE & IRON COMPANY Roanoke, Va.						
TOTAL						

ND - no date.
* - stylistic attribution.

THROUGH (High)

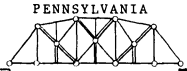
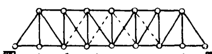
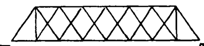
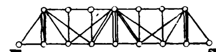
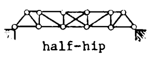
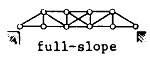
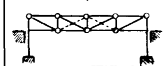
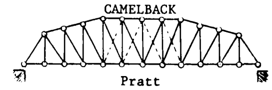
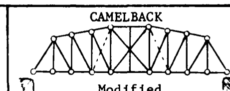
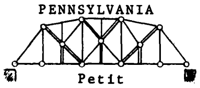
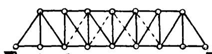
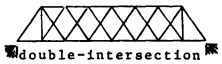
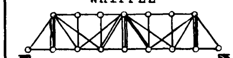
PENNSYLVANIA  Petit	PRATT  single-intersection	TRIANGULAR  single-intersection	TRIANGULAR  double-intersection	WHIPPLE  double-intersection	TOTAL
	1 - ND				1
	1				1

Table 7. Bridge Companies and Truss Types in Hanover County.

TRUSS TYPE / HANOVER COUNTY	LOW (Pony)					
	PRATT  half-hip	PRATT  full-slope	TRIANGULAR 	TRUSS LEG/BEDSTEAD 	CAMELBACK  Pratt	CAMELBACK  Modified
VIRGINIA BRIDGE & IRON COMPANY Roanoke, Va.						
ROANOKE IRON & BRIDGE WORKS Roanoke, Va.						
GRESHAM BRIDGE COMPANY ------			1 - 1927			
UNKNOWN		1 - ND 1 - ND				
TOTAL		2	1			

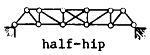
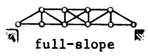
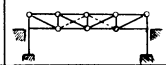
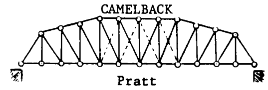
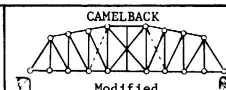
THROUGH (High)

ND - no date.
* - stylistic attribution.

PENNSYLVANIA  Petit	PRATT  single-intersection	TRIANGULAR  single-intersection	TRIANGULAR  double-intersection	WHIPPLE  double-intersection	TOTAL
	1 - 1911				1
	1 - 1921	1 - 1926			2
					1
					2
	2	1			6

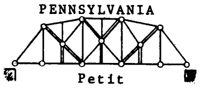
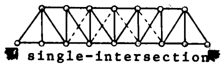
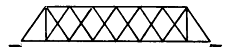
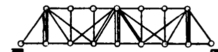
2992

Table 8. Bridge Companies and Truss Types in Lunenburg County.

TRUSS TYPE / LUNENBURG COUNTY	LOW (Pony)					
	PRATT  half-hip	PRATT  full-slope	TRIANGULAR 	TRUSS LEG/BEDSTEAD 	CAMELBACK  Pratt	CAMELBACK  Modified
ROANOKE IRON & BRIDGE WORKS Roanoke, Va.			1 - 1929			
FREDERICKSBURG BRIDGE COMPANY Fredericksburg, Va.		1 - 1930				
VIRGINIA BRIDGE & IRON COMPANY Roanoke, Va.		* 1 - ND				
TOTAL		2	1			

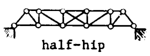
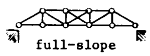
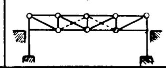
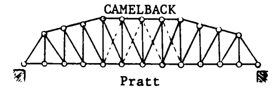
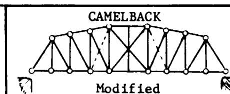
THROUGH (High)

ND - no date.
* - stylistic attribution.

	PENNSYLVANIA  Petit	PRATT  single-intersection	TRIANGULAR  single-intersection	TRIANGULAR  double-intersection	WHIPPLE  double-intersection	TOTAL
		1 - 1924				2
						1
						1
						4

2994

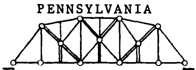
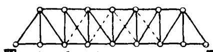
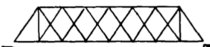
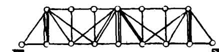
Table 9. Bridge Companies and Truss Types in Mecklenberg County.

TRUSS TYPE / MECKLENBURG COUNTY	LOW (Pony)					
	PRATT  half-hip	PRATT  full-slope	TRIANGULAR 	TRUSS LEG/BEDSTEAD 	CAMELBACK  Pratt	CAMELBACK  Modified
VIRGINIA BRIDGE & IRON COMPANY Roanoke, Va.		1 - 1912				
YORK BRIDGE COMPANY York, Pa.			1 - 1913			
UNKNOWN			1 - ND			
TOTAL		1	2			

2995

THROUGH (High)

ND - no date.
* - stylistic attribution.

PENNSYLVANIA  Petit	PRATT  single-intersection	TRIANGULAR  single-intersection	TRIANGULAR  double-intersection	WHIPPLE  double-intersection	TOTAL
					1
					1
	1 - ND				2
	1				4

2996

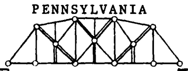
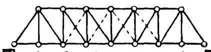
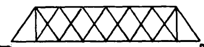
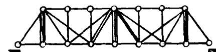
Table 10. Bridge Companies and Truss Types in Nottoway County.

TRUSS TYPE / NOTTOWAY COUNTY	LOW (Pony)					
	PRATT half-hip	PRATT full-slope	TRIANGULAR	TRUSS LEG/BEDSTEAD	CAMELBACK Pratt	CAMELBACK Modified
UNKNOWN						
TOTAL						

2997

THROUGH (High)

ND - no date.
* - stylistic attribution.

PENNSYLVANIA  Petit	PRATT  single-intersection	TRIANGULAR  single-intersection	TRIANGULAR  double-intersection	WHIPPLE  double-intersection	TOTAL
	1 - ND				1
	1				1

NOTES

1. Carl W. Condit, American Building Art, New York, Oxford University Press, 1961, p. 276.

2. J. A. L. Waddell, Bridge Engineering, New York, John Wiley & Sons, 1916, 1:747.

3. Ibid., pp. 58-9.

4. Ibid., p. 747.

5. J. A. L. Waddell, The Designing of Ordinary Iron Highway Bridges, New York, John Wiley & Sons, Inc., 1891 (fifth edition), pp. ix-x.

6. Ibid.

7. See David H. Miars, A Century of Bridges, Wilmington (Ohio), 1972, pp. 23-25; and Waddell, The Designing of ... Bridges, pp. 157-171.

8. Waddell, The Designing of ... Bridges, p. 157.

9. Ibid.

10. Ibid., pp. 157-171.

11. Miars, op. cit., p. 24.

12. Ibid.

APPENDIX

METAL TRUSS BRIDGES OF SPECIAL INTEREST IN THE RICHMOND DISTRICT

R-358

3003

Photo Numbers:

04-12-1

__A
__B
__C
__D

12455-3: 4-21

TRUSS BRIDGE SURVEY AND INVENTORY FORM

Geographic Information

State: Virginia
Va. Dept. of Highways District: *Richmond* ; No. *04* .
County: *Brunswick* ; No. *12* .
City/Town: ______ .
[redacted]/Road: *State Route 715* .
River/[redacted] (crossing): *Meherrin River* .
UTM/KGS Coordinates: ______ .

Historical Information

Formal designation: *0761 (Structure Tabulation No.)* .
Local designation: *6104 (District Structure No.), Ghetson's Bridge.*
Designer: *Wrought Iron Bridge Company, Canton, Ohio* .
Builder: *Wrought Iron Bridge Company, Canton, Ohio* .
Date: *1884* ; basis for: *Bridge/date plate* .
Original owner: *Brunswick County* ; use: *Vehicular bridge* .
Present owner: *Va. Dept. of Highways & Transp.* ; use: *Vehicular bridge* .

Historical or Technological Significance

____ Unique/Unusual in its time: ______ .

X Rare survivor though of standard design: *This is the oldest multi-span metal truss inventoried to date; cf. to 6128 (08-82-34) Rockingham County* .

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

____ Other Remarks/Explanation: *Because of the nature (masonry) and position (unequal spans) of the abutments and pier, it is most likely that this is the original location; however, there are bolts at the panel points on the top chords which suggest a relocation.*

Nature/Degree of any destructive threats: *This bridge appears to be under consideration for replacement.*

Reference materials and contemporary photos/illustrations with their respective locations:
BRIDGE SAFETY INSPECTION FILE, District Bridge Office.

Bridge Commissioner plate: *F. E. Buford,* *JUDGE*
I. E. Britt
J. R. Jones *COMMISSIONERS*
H. H. Heartwell

Recorder: *DAN DEIBLER* .
Date: *23 April 1975* .
Affiliation: *Research Council, Concrete Section* .

A-1

Design Information

Compass orientation of axis: *N/S*.

No. of spans: *2*; length; overall: *192'*.
Span types:
(1) *Through truss*; length: *86'*.
(2) *Through truss*; length: *100'4"*.
(3) ; length: .
(4) ; length: .
(5) ; length: .
(6) ; length: .

No. of lanes: *1*; width: *13'* c to c.

Architectural or decorative features:
New single channel railings.
End posts have decorative cast metal caps with date. Portal strut has pedimented bridge plaque.
NW end post has been replaced.

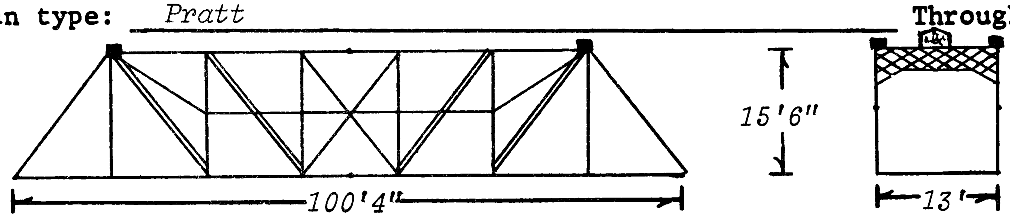
Structural Information

Substructure:
Material: *Sandstone*.
Foundations: .
Piers: *Random coursed ashlar masonry*.
Abutments: *Random coursed ashlar masonry*.
Wings: *Random coursed ashlar masonry*.
Seats: *Sandstone masonry*.

Superstructure:
Material: *Wrought iron (poss.)* sources .
Characteristics, details and members:
Connections: *X* pin.
rigid.
Top Chords *2 upright channels connected with cover plates and stay plates*.
End Posts: *2 upright channels connected with cover plates and stay plates*.
Bottom chords: *Double rectilinear eyebars, loop welded*.
Posts: *Simple small "I" beams; end panel posts are built-up eye beams*.
Diagonals: *Double rectilinear eyebars and tie rods, loop welded*.
Counters: *Single cylindrical or rectilinear tie rods, loop welded*.

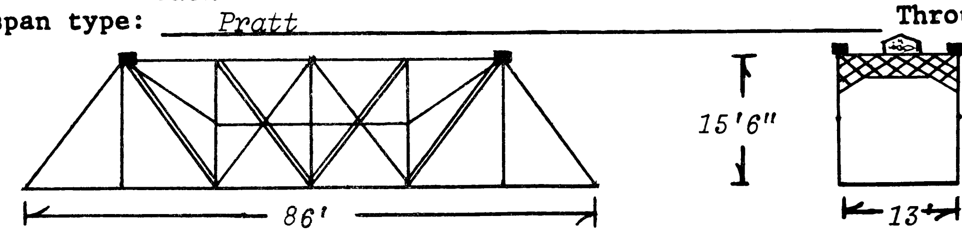
Truss Configuration

Main span type: *Pratt* Through/[redacted]



7 panels @ 14'4" each

Secondary span type: *Pratt* Through/[redacted]



R-358

TRUSS BRIDGE SURVEY AND INVENTORY FORM

Photo Numbers:

04-58-4

__A
__B
__C

12455-4: 7-12

Geographic Information

State: Virginia
Va. Dept. of Highways District: Richmond ; No. 04 .
County: Mecklenburg ; No. ____ .
[redacted]/Town: Muck Cross .
[redacted]/Road: State Route 677 .
[redacted]/Stream/[redacted] (crossing): Allens Creek .
UTM/KGS Coordinates: ____ .

Historical Information

Formal designation: 1984 (Structure Tabulation No.) .
Local designation: 6061 (District Structure No.) .
Designer: York Bridge Company, York, Pennsylvania .
Builder: York Bridge Company, York, Pennsylvania .
Date: 1913 ; basis for: Bridge/date plate .
Original owner: ____ ; use: Vehicular bridge .
Present owner: Va. Dept. of Highways & Transp. ; use: Vehicular bridge .

Historical or Technological Significance

____ Unique/Unusual in its time: ____ .

X Rare survivor though of standard design: Only truss span by this company in the District.

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

____ Other Remarks/Explanation: Bolts at top chord panel points indicate that this truss has been relocated to this site. It is very similar to a truss in Loudoun County, Route 729. See Form 07-53-4, Structure #6083.

Nature/Degree of any destructive threats: ____ .

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

BRIDGE SAFETY INSPECTION FILE, District Bridge Office

Recorder: DAN DEIBLER .
Date: 24 April 1975 .
Affiliation: Research Council, Concrete Section .

Design Information

Compass orientation of axis: *E/W*.

No. of spans: *1*; **length; overall:** *49'*.
Span types:
(1) *Pony truss*; **length:** *46'*.
(2) ____; **length:** ____.
(3) ____; **length:** ____.
(4) ____; **length:** ____.
(5) ____; **length:** ____.
(6) ____; **length:** ____.

No. of lanes: *1*; **width:** *12'11"* **c to c.**

Architectural or decorative features:

Latticed side railings.
Very thin, light members.
SE end post has been reinforced with "I" beam.

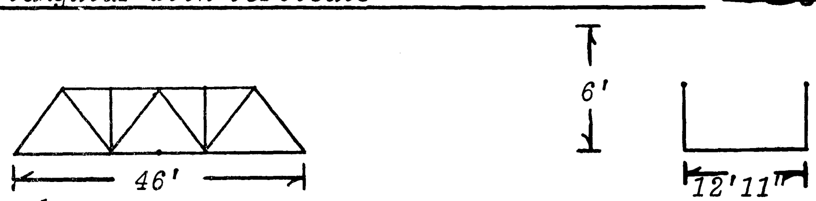
Structural Information

Substructure:
Material: *Concrete*.
Foundations: ____.
Piers: ____.
Abutments: *Concrete applied over rubble stonework*.
Wings: ____.
Seats: *Concrete*.

Superstructure:
Material: *Steel* **sources** ____.
Characteristics, details and members:
Connections: ____ **pin.**
X **rigid.**
Top Chords *2 angles connected with cover plates*.
End Posts: *2 angles connected with cover plates*.
Bottom chords: *2 angles connected with stay plates*.
Posts: *2 angles connected with lacing bars*.
Diagonals: *2 angles connected with lacing bars*.
Counters: *2 angles connected with lacing bars*.

Truss Configuration

Main span type: *Triangular with verticals* **[redacted]/Pony/[redacted]**



3 panels @ 15'4" each

Secondary span type: ____ **Through/Pony/Deck, Skew**