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

VIII. The Suffolk Construction District

by

Paula A. C. Spero
Graduate Research Assistant

(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. Survey reports for the Staunton, Culpeper, Richmond, Fredericksburg, Lynchburg, and Salem construction districts have been published.

As the work in Virginia proceeded, interest in 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 was approved to develop criteria for the preservation or adaptive use of bridges, and this work included surveys of metal truss bridges in the Lynchburg and Bristol districts and a statewide survey of concrete and masonry bridges. The surveys of metal truss bridges for the remaining two districts, Salem and Suffolk, were funded with state research funds.

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 survey of the metal trusses in the Suffolk District. The issuance of this report and that for the remaining district has been delayed because of the resignation of the research analyst originally assigned to the project.

ACKNOWLEDGEMENTS

The author expresses appreciation to Robert M. Vogel of the Smithsonian Institution for the use of the resources made available to her, and to Allen Baker, draftsman at the Virginia Highway & Transportation Research Council, for his help in laying out the tables in this series of reports.

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INTRODUCTION

It is a notorious fact that there is no country of the world which is more in need of good and permanent Bridges than the United States of America....Public spirit alone is wanting to make us the greatest nation on earth; and there is nothing more essential to the establishment of that greatness than the building of Bridges, the digging of canals, and the making of sound turnpike roads. Necessity has already produced some handsome and extensive specimens of bridge building in the United States.

Thomas Pope, as quoted above in his Treatise on Bridge Architecture of 1811, was pointing ahead to the importance of transportation development in our nation's history.(1)

The truss bridge was developed in direct response to the evolution and growth of America's transportation network. Its significance was recognized early. In 1916, prominent bridge engineer James Waddell wrote that the last form of bridge construction to be evolved but the one destined to promote the highest development of the art of bridge building was the truss.(2) Developments in technology are mirrored in its changing form. As materials changed from wood to combined wood and iron, to cast and wrought iron, and finally to steel, the truss bridge form reflected responses to needs for greater load and span capacity, mingled with manufacturing improvements in first irons, then steel. As current needs escalate load and traffic volume requirements, and highway safety standards are foremost in importance, the metal truss bridge is rapidly disappearing.

This report is a continuation of the Virginia Highway and Transportation Research Council's documentation of Virginia's remaining metal truss bridges,(3) a part of a research project delving into the technology of Virginia's historic transportation network. In particular the results of the truss survey for the Suffolk Construction District (Figure 1) are presented. In keeping with the previous reports of this series, the results are considered in light of historical trends.

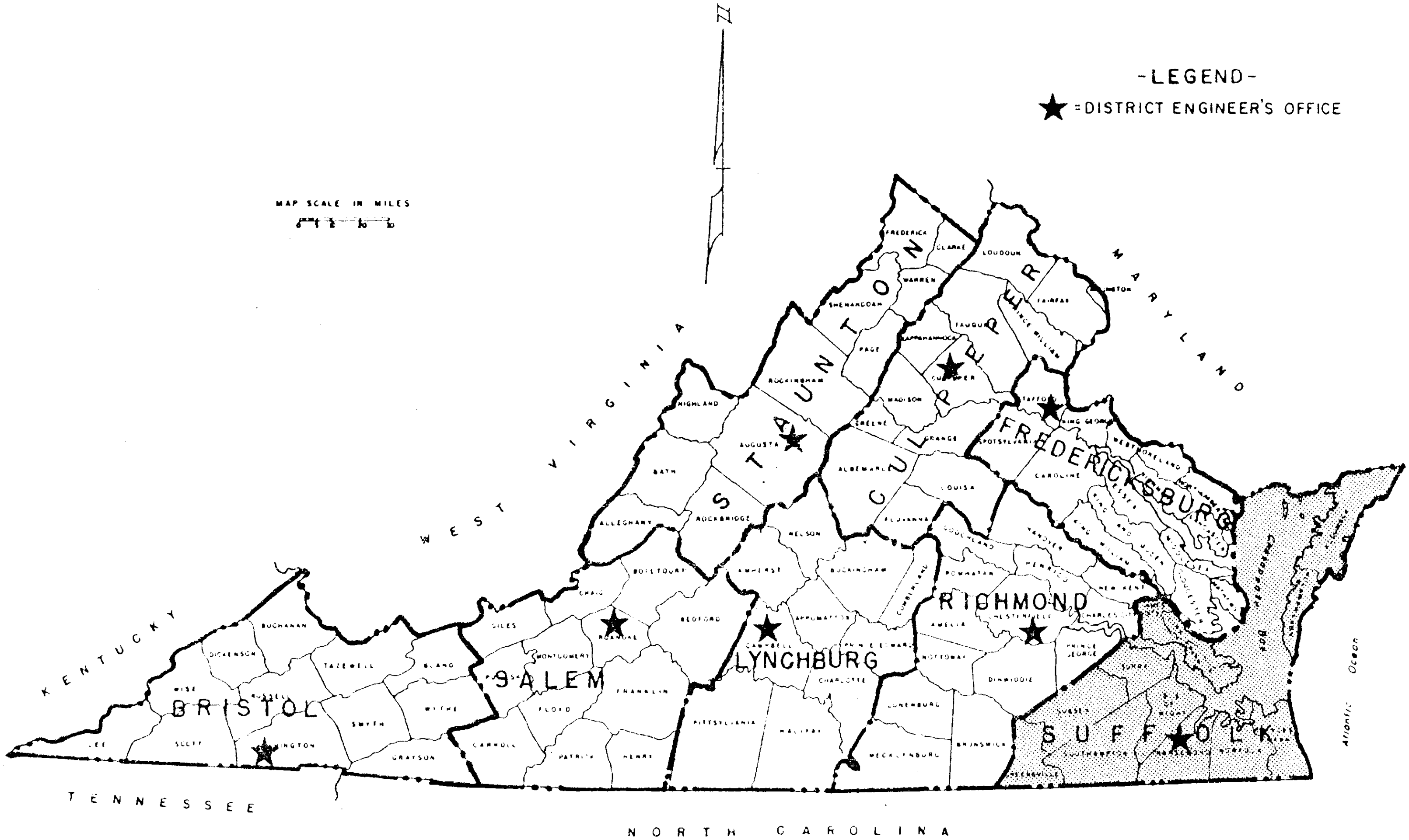


Figure 1. The Suffolk Construction District.

The study was confined to pre-1932 bridges because after this time Virginia's bridge design for its secondary road system was no longer on a county-by-county basis and centralization meant a loss of regional diversity and an increased tendency to standardization.

THE SUFFOLK CONSTRUCTION DISTRICT

Virginia's tidewater Suffolk District is the most sparsely represented construction district in the statewide metal truss bridge inventory. It was the last district to be surveyed in this Virginia Highway and Transportation Research Council project to inventory Virginia's metal truss bridges. The district has been oddly divided into two distinctly characterized areas by the rapid urbanization of the easternmost counties; the Eastern Shore and the five counties west of Suffolk are largely rural, while the conglomerate metropolitan area around Norfolk continues to expand quickly. The district is traversed by numerous rivers and several major highways, many recently constructed. Among the latter are I-95, I-64, Rtes. 460, 58, 13, 17, 32, and 168.

There are only ten pre-1932 metal truss bridges remaining in the Suffolk District, one of which is being dismantled. Of the nine in service, none date to the nineteenth century. Indeed, all of the dated extant truss spans were constructed during the active period immediately prior to the 1932 consolidation of Virginia road and bridge construction. At the time of the survey there were two truss bridges dating from the first decade of the twentieth century, one pony truss, and one through truss bridge with pinned connections, but they have since been removed.

Although in number the Suffolk District's metal trusses are insignificant, a total of 23 spans, the remaining truss bridges warrant examination as examples of the versatility of the metal truss as a bridge form. Because of the number of navigable rivers which must be bridged to accommodate both marine and highway traffic in the area, the metal truss bridges found there are the standard pony trusses and through trusses, but primarily a variety of movable bridges spanning navigable rivers.

MOVABLE BRIDGES

The engineering solution to crossing a navigable river is to build either a high bridge with adequate clearance to permit vessels to pass beneath it or a low bridge that can be moved to allow marine vessels to pass through. These bridges, then, fall broadly into the categories of fixed and movable bridges. Movable bridges are those which turn, move to the side, lift up and down, or in any other way change position to allow traffic to pass in the waters they span.

Descriptive terminology for the various types of movable bridges is not consistent in historical texts and periodicals, particularly those published during the nineteenth century. As with the truss bridge type in general, there were numerous patents for a variety of movable bridges and their moving mechanisms by the 1870's. The need for an interchange among movable bridge designers which would result in increased construction standards was addressed in the early twentieth century. In a 1907 paper intended to open discussion and establish specifications for movable bridges, past president C. C. Schneider of the American Society of Civil Engineers classified movable spans in the following categories:(4)

1. Swing bridges, which turn about a vertical axis.

2. Bascule bridges, which turn about a horizontal axis or roll back on a circular segment.

3. Lift bridges, which lift vertically.

4. Traversing or retractile bridges, which move horizontally.

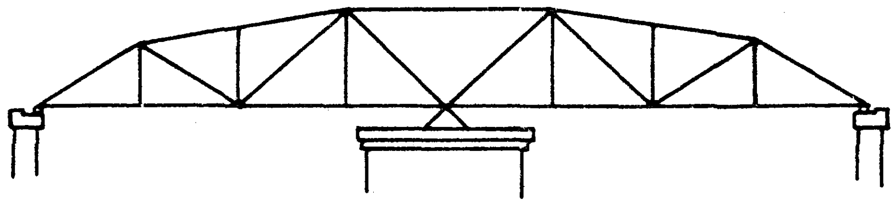
5. Transporter or ferry bridges, which consist of a fixed span with a suspended traveler.

6. Pontoon or floating swing bridges.

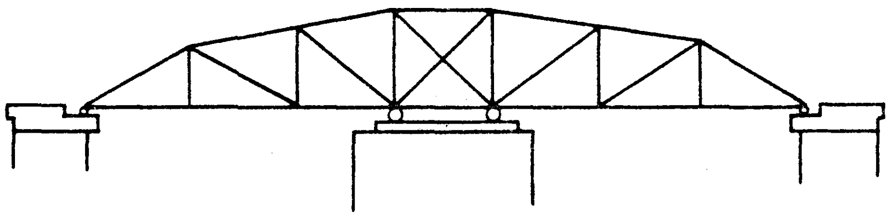
The latter three types were seldom used, so for the purposes of this report, movable bridges can be classified as being of the bascule, lift, or swing type. Each of these types is found in the Suffolk District.

Once the decision to use a movable span was made, the selection of type depended on site conditions. The criteria were the type and amount of bridge and channel traffic, character of subsoil and depth, type of foundation, and value of property on the shores.

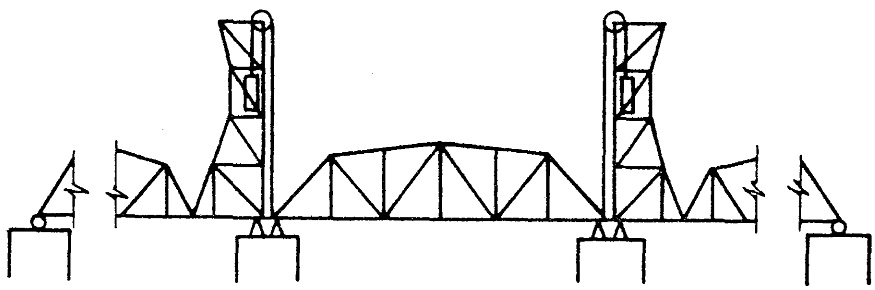
The three types of movable bridges are shown in Figure 2. Low movable bridges have several advantages over high fixed bridges; initial costs are lower and less of the surrounding land is used. Their disadvantages are considerable, however. When the span is open, there is either an inconvenience to highway traffic or marine traffic. They require additional expense for machinery, power, and operators, and they are hazardous in case of emergency needs. Each type has its own advantages and disadvantages. Shown in Figure 2 are (a) a center-bearing swing bridge, (b) a rim-bearing swing bridge, (c) a vertical-lift bridge, and (d) a bascule bridge.



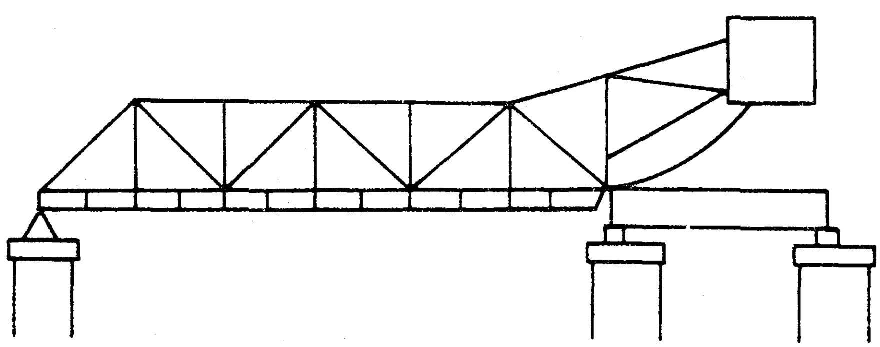
(a) Center-bearing swing bridge



(b) Rim-bearing swing bridge



(c) Vertical-lift bridge



(d) Bascule bridge

Figure 2. Swing, lift, and bascule movable bridge types.

Bascule Movable Bridges

The earliest type of movable bridge used was the bascule bridge, a shallow deck which could be raised to a vertical or inclined position. It was constructed of timber, was hand operated, and was limited to small openings; typically, it was the castle moat bridge. Its form was later translated into metal with the development of suitable materials. A bascule bridge was desirable when one large clear channel was necessary or when growing traffic demands required an additional bridge parallel to the existing one. The disadvantages of the bascule type were difficulty of maintenance and the power necessary for operation when the span was opened and exposed to wind pressure.

Two types of bascule bridge were described by J. A. L. Waddell in his 1898 book De Pontibus; namely, the counterweighted bascule and the rolling bascule.(5) A counterweighted bascule bridge contemporary with his description is illustrated in Figure 3. Waddell revised the list of bascule types in his 1916 book Bridge Engineering to trunnion, rolling-lift, and roller-bearing bascule bridges.(6) The differences among them are in the detailing of the moving mechanism. The trunnion bascule bridge moves about a fixed center of rotation located at the center of gravity of the rotating part. The roller-bearing bascule bridge also moves about a fixed center of rotation that coincides with the center of gravity, but the trunnion is eliminated and the load is carried by a segmental circular bearing on rollers in a circular track. The rolling-lift bascule bridge continually changes its center of rotation and shifts its load application point as its center of gravity moves in a horizontal line.

To overcome features which were unsatisfactory, various subtypes were developed. In the trunnion category were the Strauss, Brown, Page, Chicago City, and Waddell and Harrington types. In the roller-bearing category were the Montgomery, Waddell, and Cowing types; and in the rolling-lift category were the Scherzer and Rall types.

The Suffolk District's bascule bridge representative is a Scherzer rolling-lift bridge. It is located in Portsmouth over the west branch of the Elizabeth River, and is locally designated the Hodge's Ferry Bridge. The entire bridge is 525 ft long and consists of 15 steel girders and a single-leaf bascule span, as illustrated in Figure 4. A line drawing of the 56-ft bascule span shows a combination steel girder and steel truss construction. The steel girder supporting the deck is a built-up section; the lifting truss, counterweight truss, and lateral bracing trusses are all riveted.

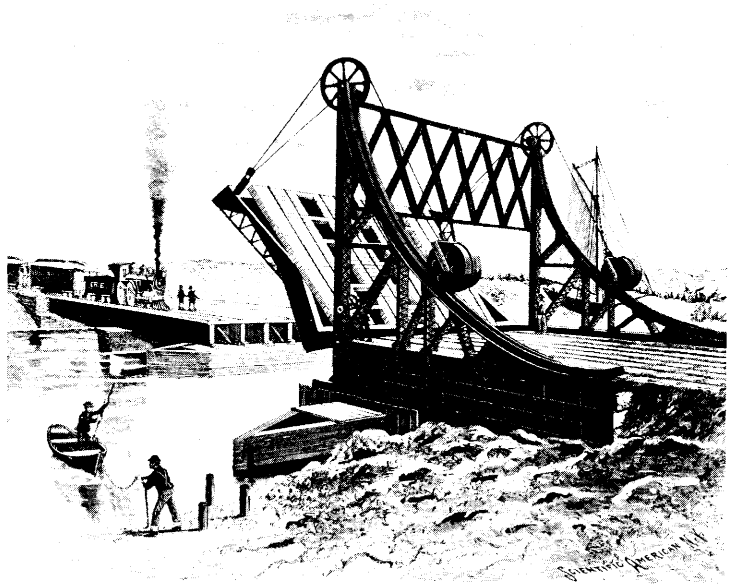


Figure 3. An example of an early counterweighted bascule bridge.

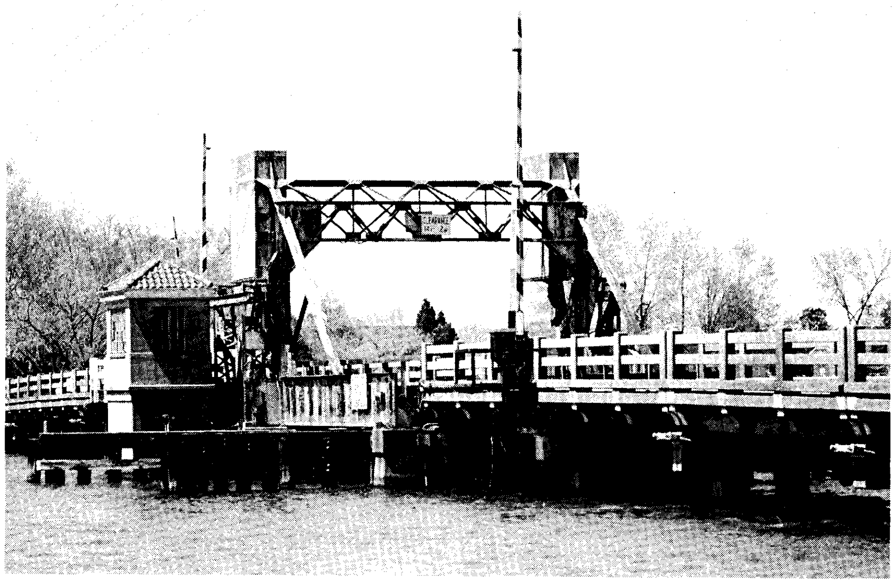


Figure 4. The Hodge's Ferry bascule bridge in Portsmouth, Virginia, is the only known Scherzer rolling-lift highway bridge in Virginia.

A Scherzer rolling-lift bascule bridge is characterized by its large concrete counterweight and segmental circular moving girder. The bridge's movement occurs as it rotates on a short circular segment along a horizontal track girder. The rectangular counterweight is attached to this short shoreward section of the moving leaf. In the main pier, below the counterweight, is a pit that receives the counterweight when the bridge is open. For a simple, single-leaf, Scherzer rolling-lift bridge three piers are necessary: the main pit pier, the rest pier for the free end of the leaf, and a shoreward pier for the approach span. The Hodge's Ferry Bridge illustrated in a line drawing in Figure 5 is illustrated in elevation in Figure 6, where the Portsmouth bascule span is flanked by 15 steel girder approach spans.

Waddell's analysis of which type of bascule bridge was preferable reflected his sense of aesthetics. All were "inherently ugly" and "for all but comparatively short spans are uneconomic in comparison to the vertical lift."(7) From an engineering perspective, he claimed, "they are scientific, and they represent, probably, the best and most profound thought that has ever been devoted to bridge engineering."(8) In 1916, he pronounced the Scherzer rolling-lift bascule the most popular of all types. At that time, the longest single-leaf Scherzer bascule spanned 200 ft on the Baltimore and Ohio Railroad in Cleveland, Ohio.

The Hodge's Ferry bascule bridge is the only known remaining Scherzer rolling-lift bridge in Virginia.

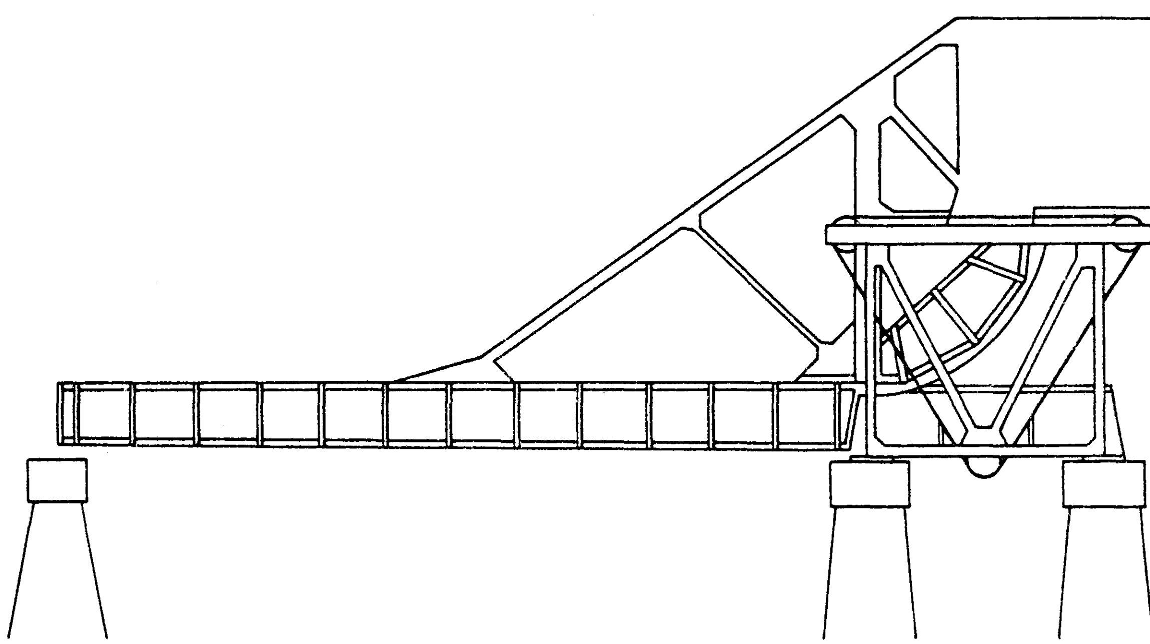


Figure 5. The Scherzer rolling-lift span of the Hodge's Ferry Bridge illustrated in a simple line drawing.

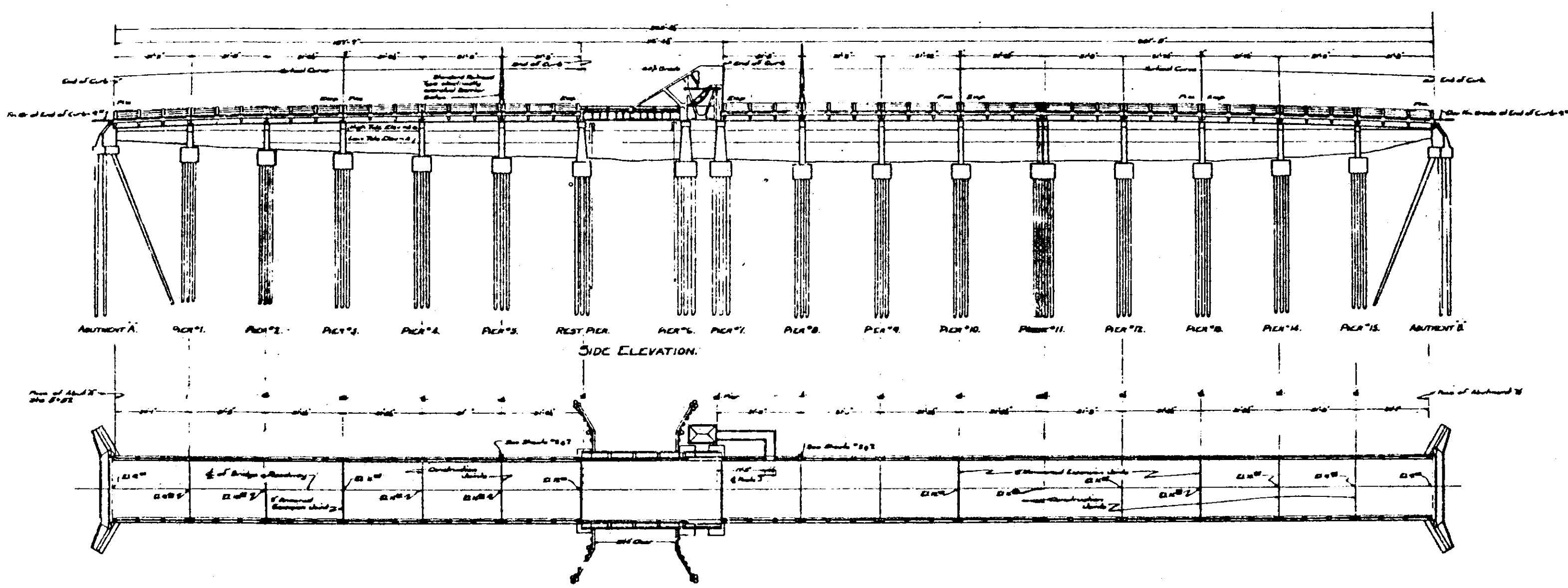


Figure 6. Elevation and plan drawings of the Hodge's Ferry Bridge show the bascule span in its central position flanked by 15 girder spans.

Lifting Movable Bridges

The second movable bridge category listed is the lift bridge. Like the bascule bridge, the vertical-lift bridge leaves one large, clear channel open for vessels to pass through. It is counterweighted, but it has the advantages of acting as a simple span on supports when it is closed and not being limited in span length.

The vertical-lift bridge made its appearance in the mid-1800's according to both J. A. L. Waddell and H. G. Tyrrell. Tyrrell claimed that the completion of the Erie Canal in 1825 led to experimentation with elevated fixed bridges and center-pier swing bridges. By 1872, Squire Whipple was investigating alternative solutions and he patented a vertical-lift bridge. Another patent was awarded to A. J. Post of Jersey City, New Jersey. These lift bridges were composed of fixed overhead trusses or girders with a suspended, counterweighted, movable platform. The supports for the movable section could be towers or columns with trusses between them acting as bracing.

In 1916, Waddell described three types of vertical-lift bridges: one in which the entire span was raised, one in which a deck was raised to an overhead fixed span, and one in which a deck was raised to an overhead movable span that could also be raised.(9) The counterweights on these vertical-lift bridges were first cast iron blocks and later concrete. In some cases, water tanks were used as ballast to balance any unbalanced load due to ice or water on the deck and to allow for raising or lowering the span if the machinery malfunctioned.

The small lift bridges used on canals could be raised only high enough to allow canal boats to pass through. Waddell claimed the South Halsted Street Bridge that he designed in 1893 to be the first large-scale lift bridge ever built;(10) it was a 130 ft Pratt through truss with a maximum clearance of 155 ft. The operating machinery for these large lift bridges could be housed either on the movable span itself or on top of the stationary towers at both ends of the bridge. The Suffolk District lift spans illustrate the variation in control housing.

There are two vertical-lift bridges in the Suffolk District. One is in service and is located on Rte. 337 over the Elizabeth River; the other is on Rte. 17 over the James River and currently stands next to its modern replacement. The Elizabeth River lift bridge, locally known as the Jordan Bridge, is illustrated in Figure 7. The bridge's main spans are five camelback Pratt through trusses; the lift span is 284 ft long and the other trusses are each 197 ft long. All truss joints are riveted. The lift span houses the control room. The maximum clearance for the raised truss is 145 ft.

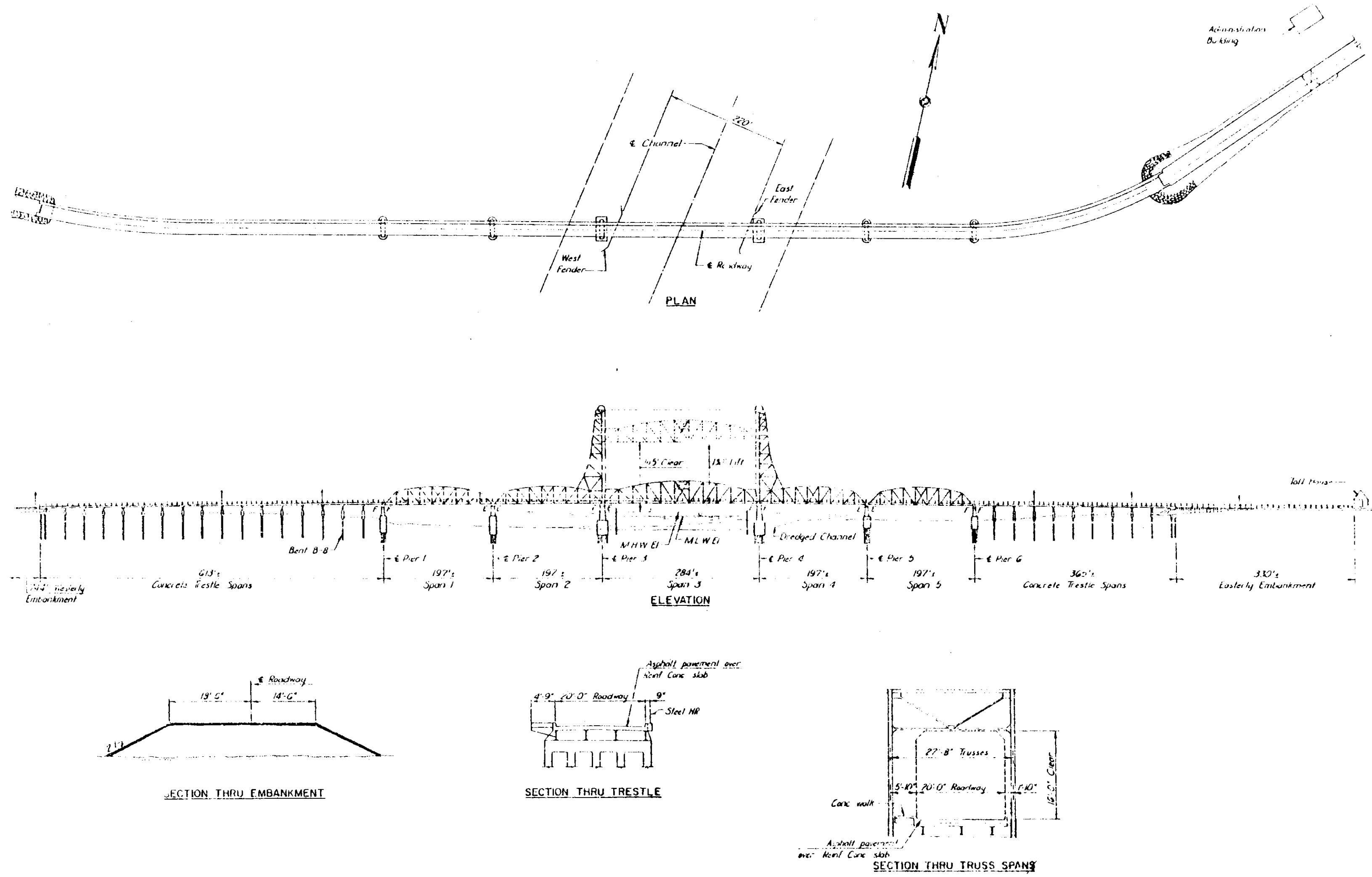


Figure 7. Elevation and plan drawings of the Jordan Bridge, a vertical lift bridge in Chesapeake, Virginia, which is still in operation.

The old lift bridge over the James River on Rte. 17 is locked into its raised position (see Figure 8). It is a 300-ft triangular-with-verticals truss with an inclined upper chord, as are the eight 210 ft secondary trusses on either end of the lift span. All joints are riveted.

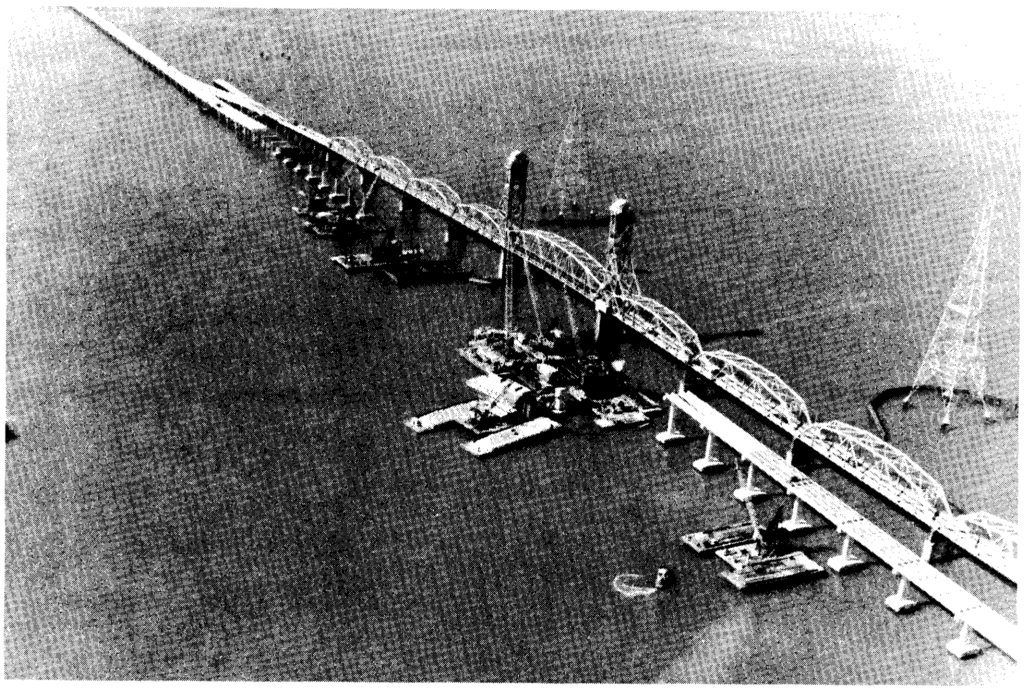


Figure 8. The old James River Bridge lift span is presently standing next to the modern Rte. 17 bridge.

Swinging Movable Bridges

The third movable bridge category listed is the swing bridge. There is far more descriptive literature available on historical swing bridges than on lift and bascule bridges. Swing bridges were the most common movable spans in use prior to 1916, according to Waddell. The earliest swing bridges were constructed of wood and were put into motion by the approaching vehicle, as illustrated in Figure 9. As the rotating wooden bridge gave way to the metal swing span, its form varied. The main span could be made of plate girders; open-webbed, riveted girders; riveted trusses; or pin-connected trusses. Deck, pony, and through trusses were all

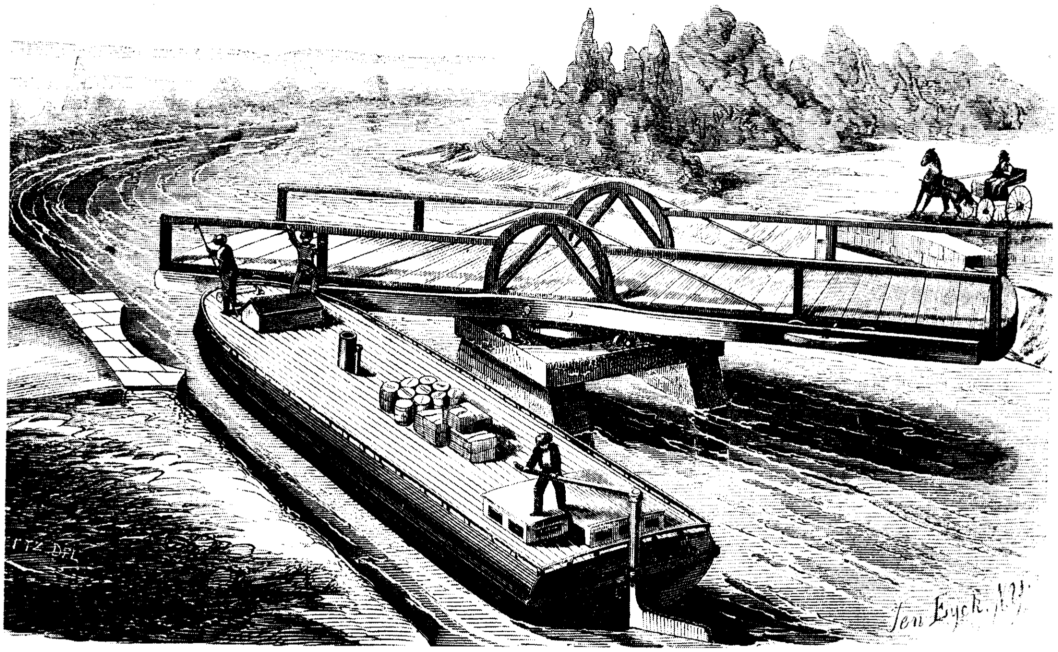


Figure 9. A wooden swing bridge patented by John Selser in 1861.

considered appropriate forms by Waddell. As cited in De Pontibus,[11] his specifications in 1989 were:

Spans up to 140 ft	Plate girders
Spans 140 - 225 ft	Pin-connected Pratt trusses with parallel top chords and stiff diagonals in panels where stress reversal occurs
Spans 225 - 300 ft	Pin-connected Pratt trusses with broken top chords
Spans greater than 350 ft	Pin-connected trusses with sub-divided panels

In general, the 1898 design requirements complied with those for fixed spans. But by the early twentieth century, the need for simplicity and rigidity in the design of truss swing spans was emphasized. All members subject to stress reversals needed to be stiff and have riveted connections. This was particularly noticed in the end posts and lower chord connections, because the continued stress reversal due to lifting and lowering the ends of the bridge when initiating and terminating rotation caused serious wear on the pins and pinholes. Riveted connections alleviated the problem as no play in the joints was possible.

A swing-span bridge rotates on its central pier and rests in a position perpendicular with the roadway, thus opening two channels for passing marine traffic. Disadvantages of the swing-bridge type, in general, included the time required for opening and closing the bridge, the obstruction the pivot pier created in the waterway, and the uselessness of dock-front property adjacent to the opening span.

In addition to classifying swing spans by structural type, they can be differentiated by the mode in which they rotate and are attached to the central pier. The span's weight is either supported at the center pivot (center bearing) or on small roller bearings or wheels that run on a steel track (rim bearing) a small distance from the center. Both these types were in common use, each with its own advantages. Since the pivot bearing wears with use and is expensive and difficult to replace, parts which should serve only to steady the span, not carry loads, were frequently overloaded. Often a bridge designed to be center bearing would function in a rim-bearing capacity. For this reason, it was recommended that center-bearing swing spans be used only for short, light spans. Long, heavy spans were designed as either rim-bearing swing bridges or combination center bearing and rim bearing. Solely rim-bearing swing spans had strong disadvantages and were not hastily recommended. The rollers and tracks necessary in rim-bearing spans required great care in construction and delicate adjustments in their erection. Repair work was expensive, and unequal settlement of the bridge disrupted the entire turning apparatus.

Span length and site conditions thus controlled the choice of swing bridge form and mechanical design. Among the widely varying types of swing-span bridges available, one of the most curious was the bobtailed swing span. This was a through truss that was not symmetrical about the centerline. One of the arms was shortened and counterweighted to balance the structure about the principal planes containing the axis of rotation. It was not a common type of construction; unbalanced wind loads raised machinery costs and the counterweight added to the bridge's initial cost. The bobtailed swing bridge was used only when the pivot pier had to be on or near one of the banks and a shore arm of the usual length would interfere with the use of valuable property or buildings.

There are three pre-1932 swing-span truss bridges in the Suffolk District and these are good illustrations of the variety in swing bridges. All are center-bearing swing bridges but they vary in form. One is a pony truss, one is a triangular-with-verticals through truss, and one is a bobtailed swing span. Only two of these bridges continue to function as swing bridges. The Reid's Ferry Bridge, located on Rtes. 10 and 32 over the west branch of the Nansemond River in Suffolk, was a triangular-with-verticals pony truss swing bridge until it recently was strengthened with steel beams. The steel beams undergird the riveted truss in its present permanently closed position. Plan and elevation drawings for this bridge are illustrated in Figure 10. This is the only pony swing-span truss observed in Virginia's survey.

An equally unique bridge is the Pungo Ferry Bridge in Virginia Beach. This swing span is a bobtailed swing bridge 194 ft long. It is a triangular-with-verticals truss with two extra panels added to one arm, making it asymmetrical and requiring a concrete counterweight to balance it (see Figure 11). The center-bearing pier is very near the shore and one navigable clear channel of 80 ft is thus opened, as illustrated in Figure 12. Controls for operating this swing bridge are housed on the span itself. The Pungo Ferry Bridge was previously the Churchland Bridge in Portsmouth and was relocated here in 1952. It is extremely well maintained and is opened approximately forty times per day, according to the present operator.

The third Suffolk District swing-span truss bridge is located on Rte. 125 in Suffolk over the Nansemond River. It was built by the Atlantic Bridge Company in 1928 and is a standard triangular-with-verticals through truss. The upper chord is inclined and the joints are all riveted. Controls for revolving the bridge are located on the truss near the upper chords. The span length is 200 ft.

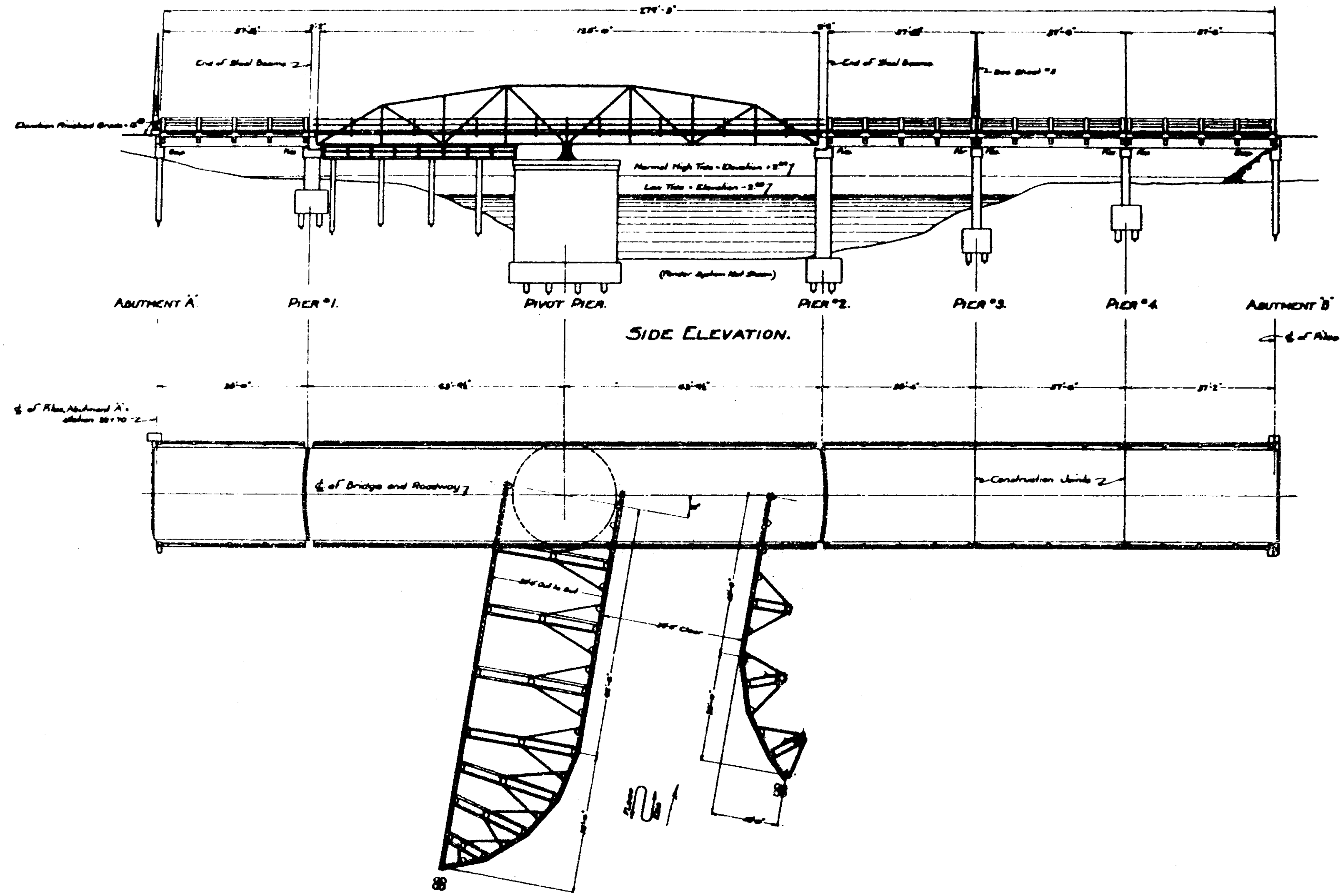


Figure 10. Elevation and plan drawings of the Reid's Ferry Bridge, a pony truss swing bridge which no longer functions as a movable span.

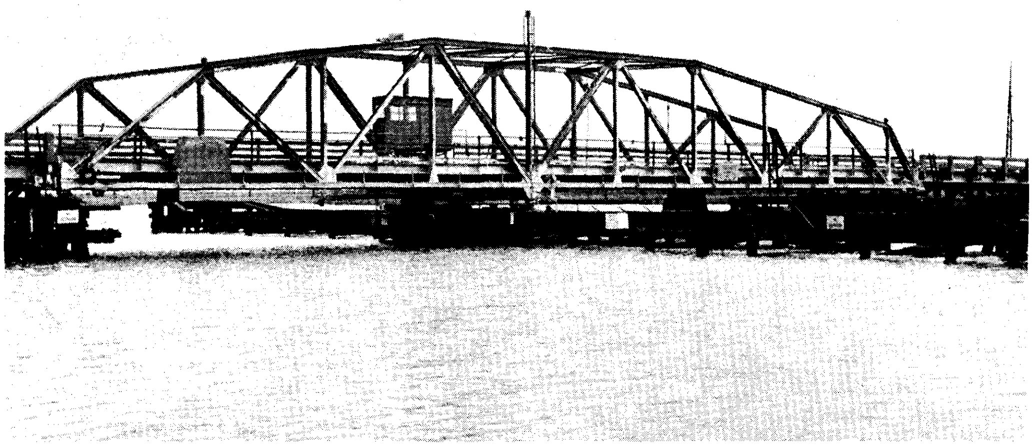


Figure 11. The Pungo Ferry Bridge in Virginia Beach is a bobtailed swing span.

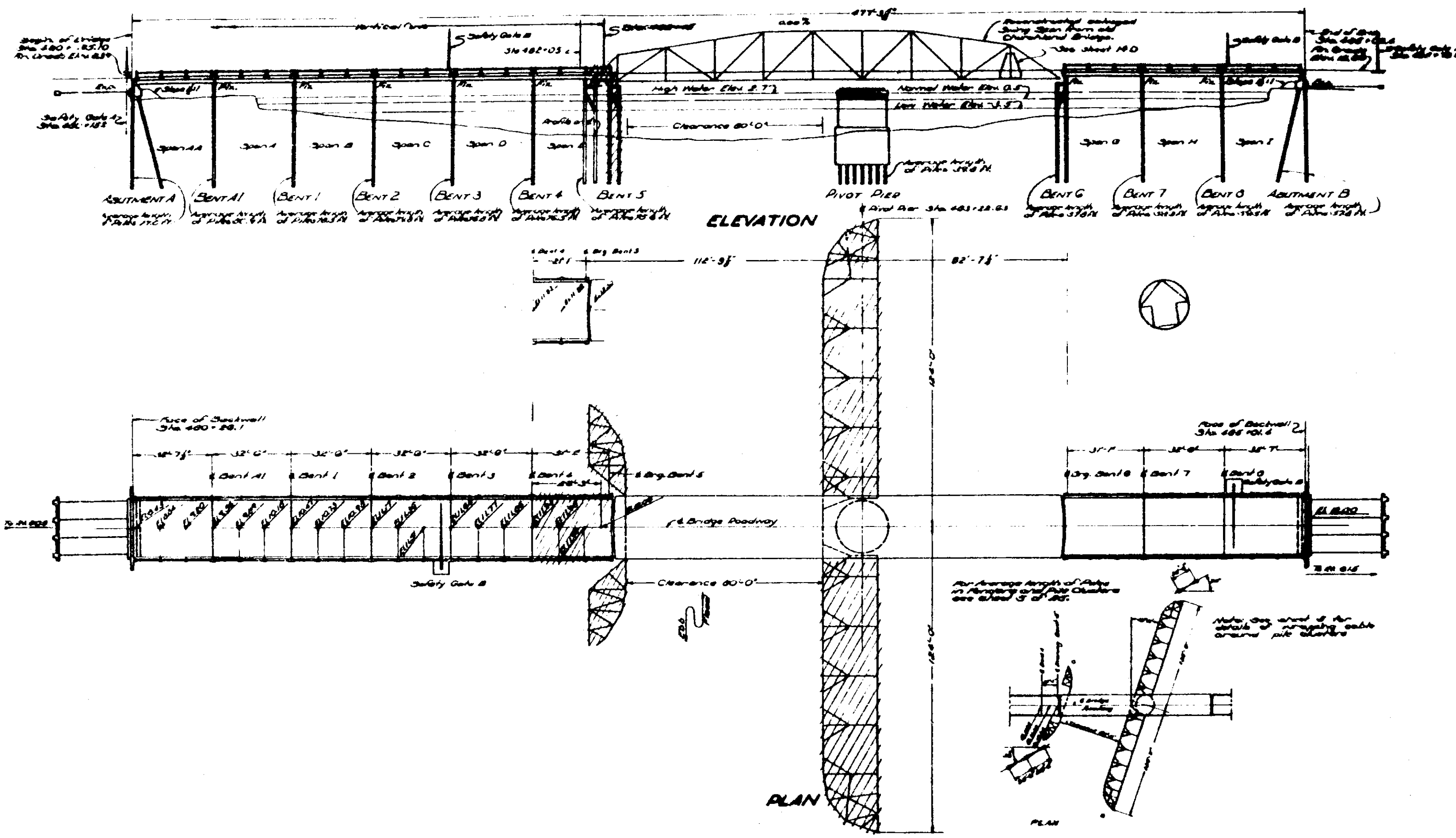


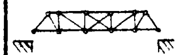
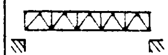
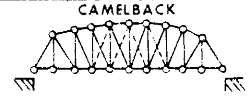
Figure 12. Elevation and plan drawings of the Pungo Ferry Bridge show the assymetrical nature of the bobtailed swing bridge type.

Traditional Trusses in the Suffolk District

The remaining four pre-1932 truss bridges in the Suffolk District are located in Sussex, Southampton, and Greensville counties. They are heavily structured, riveted triangular trusses; three are pony truss bridges and one is a through truss bridge. The two-span through bridge in Southampton County and one pony truss in Sussex County are modified triangular truss bridges.

Additional information and photographs on the Suffolk District truss bridges can be found in the following tables and in the survey information sheets in the Appendix.

Table 1. Truss types in the Suffolk District.

TRUSS TYPE / COUNTY/CITY	DECK	LOW (PONY)				
	FINK 	PRATT  half-hip	PRATT  full-slope	TRIANGULAR 	TRIANGULAR  vertical endpost	CAMELBACK  Pratt
ACCOMACK						
CHESAPEAKE						1-1928 Movable lift 4-1928
GREENSVILLE				1-1927		
ISLE OF WIGHT						
JAMES CITY						
NEWPORT NEWS						
NORTHAMPTON						
PORTSMOUTH						
SOUTHAMPTON						
SUFFOLK				1-1931 (including chords) Movable-swing		
SURRY						
SUSSEX				1-1928 (modified) 1-1928		
VIRGINIA BEACH						
YORK						
TOTAL				4		5

*Only spans of bridge remaining, not functional.

THROUGH (HIGH)

ND - no date

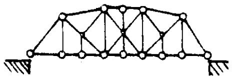
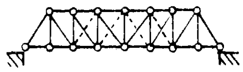
PENNSYLVANIA  Petit	PRATT  single-intersection	TRIANGULAR  single-intersection	TRIANGULAR  inclined upper chord	OTHER	TOTAL
					5
					1
			*1-1927 Lift *8-1927		9
				1-1928 Bascule lift	1
		2-1928 (modified)			2
			1-1928 (modified) Movable-swing		2
					2
			1-ND(modified) Movable-swing		1
		2	11	1	23

Table 2. Truss dates and connection types in the Suffolk District.

TRUSS TYPE	DECK	LOW (PONY)				
	FINK	PRATT half-hip	PRATT full-slope	TRIANGULAR	TRIANGULAR vertical endpost	CAMELBACK Pratt
TRUSS DATES KNOWN 1870-1910:0 1911-1932:13				1-1927 1-1928 1-1929 1-1931 (incl. chords) -swing		1-1928 Lift 4-1928
UNKNOWN: 1						
CONNECTION DETAILS AND SPAN LENGTHS						
PIN WITH LOOP-WELDED EYEBARS						
PIN WITH DIE-FORGED EYEBARS						
PIN WITH COMBINATION EYEBARS						
RIGID CONNECTED				1-1927 1-1928 1-1928 (Mod.) 1-1931 (Mod.-Swing)		1-1928 Lift 4-1928

THROUGH (HIGH) — ND - no date

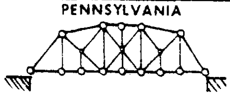
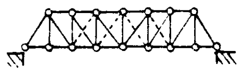
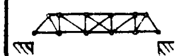
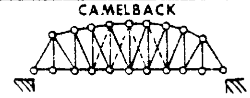
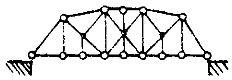
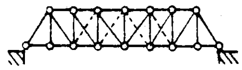
PENNSYLVANIA	PRATT	TRIANGULAR	TRIANGULAR	OTHER	TOTAL
 Petit	 single-intersection	 single-intersection	 inclined upper chord		
		2-1928 (Modified)	1-1927 Lift 8-1927 1-1928 (Mod.swing)	1-1928 Bascule lift	22
			1-(Mod. swing)		1
		2-1928 (Mod.)	1-1927 Lift 8-1927 1-1928 (Mod. swing) 1-ND (Mod. swing)	1-1928 - Bascule lift	23

Table 3. Bridge companies and truss types in the Suffolk District.

TRUSS TYPE / BRIDGE COMPANY	DECK	LOW (PONY)				
	FINK 	PRATT  half-hip	PRATT  full-slope	TRIANGULAR 	TRIANGULAR  vertical endpost	CAMELBACK  Pratt
ATLANTIC BRIDGE CO. ROANOKE, VA.						1-1928 Lift 4-1928
ROANOKE IRON & BRIDGE WORKS ROANOKE, VA.				1-1931 (Incl. chords) Movable-swing		
VIRGINIA BRIDGE & IRON CO. ROANOKE, VA.						
VIRGINIA STATE HIGHWAY COMMISSION RICHMOND, VA.				1-1927 1-1928 (Modified) 1-1928		
UNKNOWN						
TOTAL				4		5

THROUGH (HIGH) ND - no date

PENNSYLVANIA  Petit	PRATT  single-intersection	TRIANGULAR  single-intersection	TRIANGULAR  inclined upper chord	OTHER	TOTAL
			1-1928 (Modified) Swing		6
					1
			1-1927 8-1927		9
		2-1928 (Modified)		1-1928 Bascule lift	6
			1-ND (Modified) - Swing		1
TOTAL		2	11	1	23

REFERENCES

1. Pope, Thomas, A Treatise on Bridge Architecture, New York, printed for the author, by A. Niven, 1811.

2. Waddell, J. A. L., Bridge Engineering, New York, John Wiley & Sons, Inc., 1916, p. 11.

3. Deibler, Dan Grove, "Metal Truss Bridges in Virginia: 1865-1932: The Staunton Construction District", VHTRC 75-R53, Virginia Highway & Transportation Research Council, May 1975.

4. Schneider, C. C., "Movable Bridges", Transactions of the ASCE, Vol. LX, June 1908, pp. 258-259.

5. Waddell, J. A. L., De Pontibus, New York: John Wiley & Sons, 1898, p. 105.

6. Waddell, Bridge Engineering, p. 701.

7. Ibid., p. 713.

8. Ibid.

9. Ibid., p. 744.

10. Waddell, J. A. L., "The Halsted Street Lift-Bridge", Transactions of the ASCE, Vol. XXXIII, January 1895, pp. 1-58.

11. Waddell, De Pontibus, p. 238.

Photo Numbers:

Color 3:20-24
4:1-15

TRUSS BRIDGE SURVEY AND INVENTORY FORM

Geographic Information

State: Virginia
Va. Dept. of Highways District: Suffolk ; No. 5 .
County: ; No. 131 .
City/~~Town~~: Chesapeake .
Street/Road: Rt. 337 .
River/Stream/Railroad (crossing): S.Br.Elizabeth River .
UTM/KGS Coordinates: .

Historical Information

Formal designation: #1801 .
Local designation: Jordan Bridge .
Designer: C.M. & W.P. Jordan Associates .
Builder: Atlantic Bridge Co. .
Date: 1928 ; basis for: Bridge Plate .
Original owner: Norfolk-Portsmouth Bridge Corp. ; use: Vehicular .
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: .

___ Other Remarks/Explanation: .

Nature/Degree of any destructive threats: .

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

Recorder: Paula A. C. Spero .
Date: August 25, 1978 .
Affiliation: Research Council .

Design Information

Compass orientation of axis: _______.

Architectural or decorative features:

No. of spans: _______; length; overall: 2036'.

Main Span types:

(1) *Steel truss*; length: *197'*.
(2) *Steel truss*; length: *197'*.
(3) *Steel truss lift*; length: *284'*.
(4) *Steel truss*; length: *197'*.
(5) *Steel truss*; length: *197'*.
(6) _______; length: _______.
\+ *Steel beams of varying lengths*

No. of lanes: *2*; width: *30.0* c to c.

Structural Information

Substructure:

Material: *Concrete and timber*.
Foundations: *Timber piles*.
Piers: *Concrete*.
Abutments: *Concrete*.
Wings: _______.
Seats: _______.

Superstructure:

Material: *Steel* sources _______.

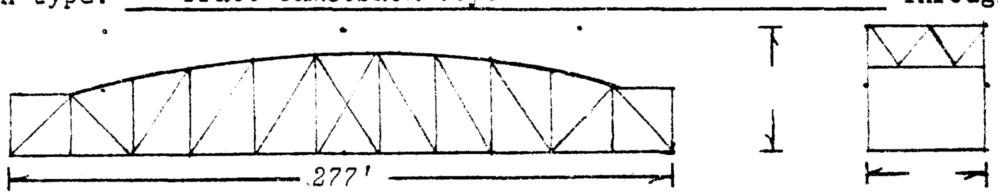
Characteristics, details and members:

Connections: _______ pin.
X rigid.

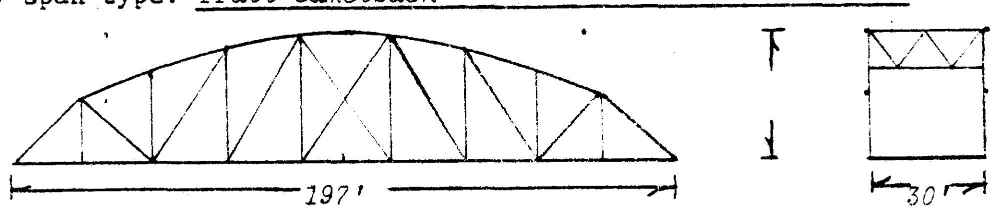
Top Chords *2 channels with cover plate and latticing*.
End Posts: *2 channels with cover plate and latticing*.
Bottom chords: *4 angles back to back with continuous stay plate*.
Posts: *4 angles back to back with lacing bars*.
Diagonals: *4 angles back to back with lacing bars and 2 channels with lacing bars*.
Counters: _______.

Truss Configuration

Main span type: *Pratt camelback lift* Through



Secondary span type: *Pratt camelback* Through



R-358

A-3

Photo Numbers:

Color 5:1-3

TRUSS BRIDGE SURVEY AND INVENTORY FORM

Geographic Information

State: Virginia
Va. Dept. of Highways District: ______; No. ______.
County: ______; No. ______.
City/Town: Portsmouth.
Street/Road: West Norfolk Road.
River/Stream/~~Railroad (crossing)~~: West branch, Elizabeth River.
UTM/KGS Coordinates: ______.

Historical Information

Formal designation: ______.
Local designation: Hodges Ferry Bridge.
Designer: Keller and Harrington, Consulting Engineers, Chicago, Illinois.
Builder: Virginia State Highway Commission.
Date: 1928; basis for: Plans.
Original owner: ______; use: ______.
Present owner: ______; use: ______.

Historical or Technological Significance

___ Unique/Unusual in its time: ______.

X Rare survivor though of standard design: Only Scherzer Rolling Lift Bridge in Virginia.

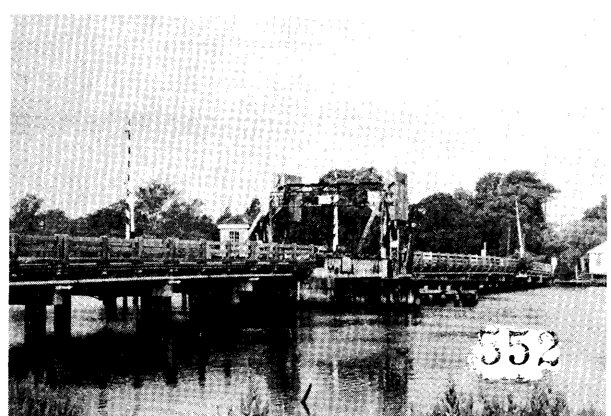
___ Typical example of its time and a common survivor: ______.

___ Other Remarks/Explanation: ______.

Nature/Degree of any destructive threats: Corrosive action throughout bottom chord. Missing sections rusted out.

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

Recorder: Paula A. C. Speró.
Date: August 24, 1978.
Affiliation: Research Council.



Design Information

Compass orientation of axis: ______.

Architectural or decorative features:

No. of spans: 16; length; overall: 525'.

Span types:

(1) 1-6, Steel beam; length: 31'.
(2) 7, Bascule; length: 56'.
(3) 8-16, Steel beam; length: 31'.
(4) ______; length: ______.
(5) ______; length: ______.
(6) ______; length: ______.

No. of lanes: 2; width: 24' c to c.

Structural Information

Substructure:

Material: Concrete and wood.
Foundations: Wood piles.
Piers: Concrete.
Abutments: Concrete.
Wings: ______.
Seats: ______.

Superstructure:

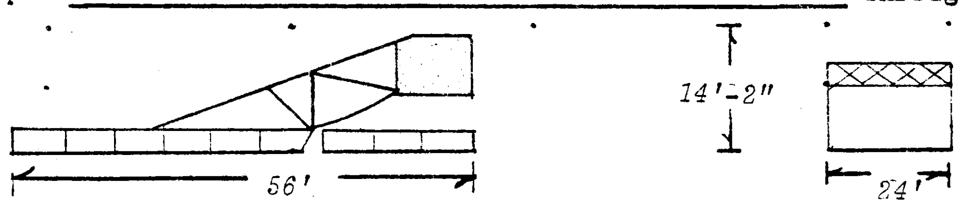
Material: Steel sources ______.

Characteristics, details and members:

Connections: ______ pin.
X rigid.
Top Chords 2 angles back to back.
End Posts: ______.
Bottom chords: Built up section - angles and plates.
Posts: 2 angles back to back.
Diagonals: ______.
Counters: ______.

Truss Configuration

Main span type: Scherzer Single Leaf Bascule Through



Secondary span type: ______ Through/Pony/Deck, Skew

Photo Numbers:

Color 2: 5-12

Black/white: 13036: 2-10

TRUSS BRIDGE SURVEY AND INVENTORY FORM

Geographic Information

State: Virginia
Va. Dept. of Highways District: Suffolk ; No. 5 .
County: ; No. 133 .
City/Town: Suffolk .
Street/Road: Rts.10 and 32 .
River/~~Stream/Railroad (crossing)~~: West branch, Nansemond River .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: Reid's Ferry Bridge .
Designer: .
Builder: Roanoke Iron and Bridge Works .
Date: 1931 ; basis for: Date plate .
Original owner: Virginia State Highway Commission ; use: Vehicular .
Present owner: Virginia Dept. of Highways & Trans; use: Vehicular .

Historical or Technological Significance

___ Unique/Unusual in its time: .

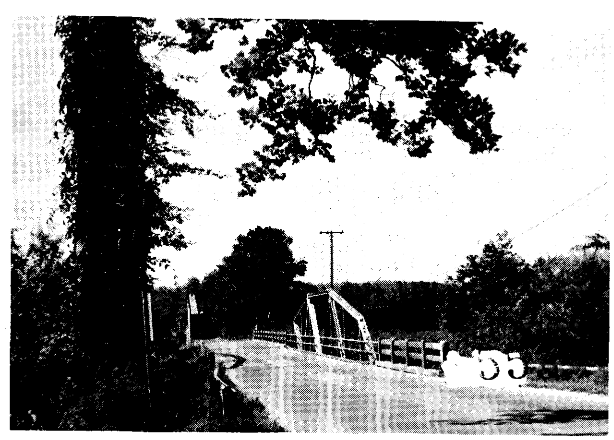
X Rare survivor though of standard design: Only pony truss swing span observed in Virginia survey. .

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

X Other Remarks/Explanation:
Strengthened with steel beams, no longer movable span. .

Nature/Degree of any destructive threats: .

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



Recorder: Paula A. C. Spero .
Date: August 23, 1978 .
Affiliation: Research Council .

Design Information

Compass orientation of axis: ______.

Architectural or decorative features:

No. of spans: 5 ; length; overall: 277'.

Span types:

(1) 1-3, Steel beam ; length: 37'.
(2) 4, Pony truss ; length: 129'.
(3) 5, Steel beam ; length: 37'.
(4) ______ ; length: ______.
(5) ______ ; length: ______.
(6) ______ ; length: ______.

No. of lanes: 2 ; width: 23' c to c.

Structural Information

Substructure:

Material: Concrete and timber.
Foundations: Timber piles.
Piers: 2 columns, 2 column rest piers, pivot pier.
Abutments: ______.
Wings: ______.
Seats: ______.

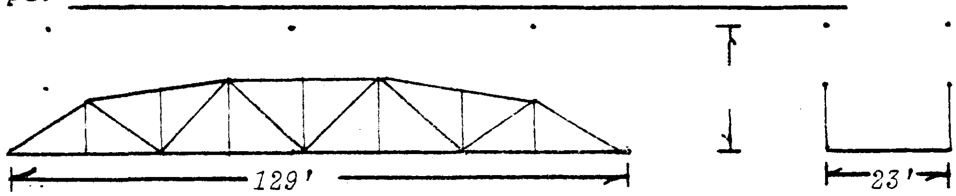
Superstructure:

Material: Steel sources ______.
Characteristics, details and members:
Connections: ______ pin.
X rigid.
Top Chords 2 channels with lacing, top and bottom.
End Posts: 2 channels with lacing, both sides.
Bottom chords: 2 channels with lacing, top and bottom.
Posts: 4 angles back to back, with solid piece riveted.
Diagonals: ______.
Counters: ______.

Truss Configuration

Main span type: Triangular swing span

Pony



Secondary span type: ______ Through/Pony/Deck, Skew

TRUSS BRIDGE SURVEY AND INVENTORY FORM

Photo Numbers:

Color 2:12-13

Black/white 13036: 11-14

Geographic Information

State: Virginia
Va. Dept. of Highways District: Suffolk ; No. 5 .
County: ; No. 133 .
City/Town: Suffolk .
Street/Road: Rt. 125 .
River/S~~tream/Railroad (crossing~~): Nansemond River .
UTM/KGS Coordinates: .

Historical Information

Formal designation: .
Local designation: #1830 .
Designer: Harrington, Howard & Ash, consulting engineers .
Builder: Atlantic Bridge Company .
Date: 1928 ; basis for: Bridge plate .
Original owner: Portsmouth-Nansemond Bridge Corp. ; use: Vehicular .
Present owner: ; use: .

Historical or Technological Significance

___ Unique/Unusual in its time: .

X Rare survivor though of standard design: Swing span bridge .

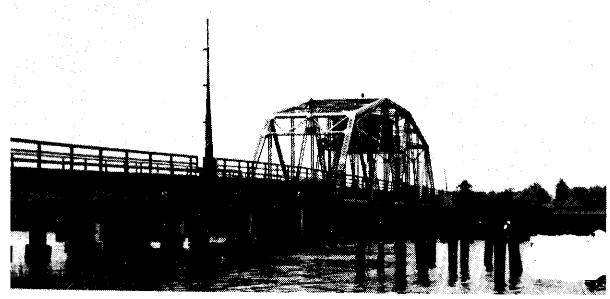
___ Typical example of its time and a common survivor: .

___ Other Remarks/Explanation: .

Nature/Degree of any destructive threats: .

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

Recorder: Paula A. C. Speró .
Date: August 23, 1978 .
Affiliation: Research Council .



Design Information

Compass orientation of axis: _______.

Architectural or decorative features:

No. of spans: *71*; length; overall: *2,538'*.

Span types:

(1) *59, Steel beams*; length: *33'*.
(2) *1, Steel beam*; length: *35'*.
(3) *1, Swing truss*; length: *200'*.
(4) *1, Steel beam*; length: *35'*.
(5) *9, Steel beams*; length: *33'*.
(6) ________; length: ________.

No. of lanes: *2*; width: *20'* c to c.

Structural Information

Substructure:

Material: *Concrete and timber*.
Foundations: *Timber piles*.
Piers: *Concrete*.
Abutments: *Concrete*.
Wings: ________.
Seats: ________.

Superstructure:

Material: *Steel* sources ________.

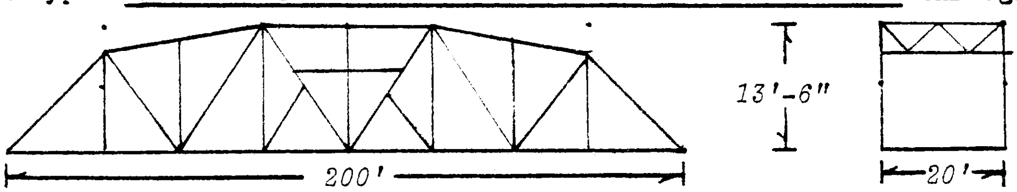
Characteristics, details and members:

Connections: ________ pin.
X rigid.

Top Chords *2 channels with latticing, top and bottom*.
End Posts: *2 channels with latticing, both sides*.
Bottom chords: *2 channels with lacing, both sides*.
Posts: *4 angles back to back, with lacing*.
Diagonals: ________.
Counters: ________.

Truss Configuration

Main span type: *Triangular (modified) swing span* Through



Secondary span type: ________ Through/Pony/Deck, Skew

R-358

TRUSS BRIDGE SURVEY AND INVENTORY FORM

Photo Numbers:

Color: 3:10-18

Black/white: 13036: 15-20A
13031-A: 1-7

Geographic Information

State: Virginia
Va. Dept. of Highways District: Suffolk ; No. 5 .
County: ______ ; No. 134 .
City/Town: Virginia Beach .
Street/Road: Pungo Ferry Road .
River/~~Stream/Railroad (crossing)~~: N. Landing River .
UTM/KGS Coordinates: ______ .

Historical Information

Formal designation: ______ .
Local designation: Pungo Ferry Bridge .
Designer: ______ .
Builder: ______ .
Date: ______ ; basis for: ______ .
Original owner: ______ ; use: ______ .
Present owner: Virginia Dept. of Highways ; use: Vehicular .

Historical or Technological Significance

X Unique/Unusual in its time: Bobtailed swing span .

___ Rare survivor though of standard design: ______ .

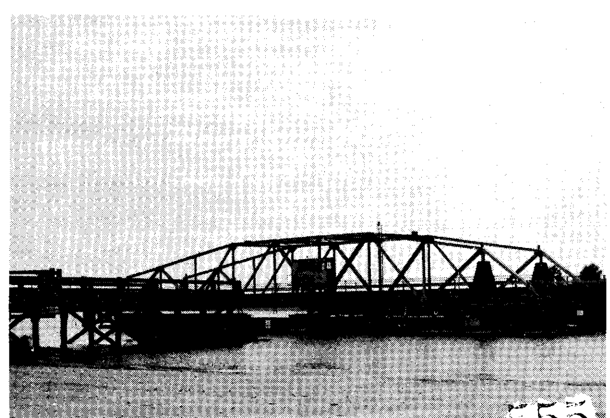
___ Typical example of its time and a common survivor: ______ .

___ Other Remarks/Explanation:
- Relocated here in 1952
- Was over Elizabeth River on Rt. 17 at Churchland, Portsmouth.

Nature/Degree of any destructive threats: ______ .

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

Recorder: Paula A. C. Spero .
Date: August 26, 1978 .
Affiliation: Research Council .



Design Information

Compass orientation of axis: ______.

Architectural or decorative features:

No. of spans: 10 ; length; overall: 475'.

Span types:

(1) 1, Steel beam ; length: 32'.
(2) 2-6, Steel beam ; length: 32'.
(3) 7, Steel beam ; length: 26'.
(4) 8, Steel beam ; length: 31'.
(5) 9, Swing span ; length: 194'.
(6) 10, Steel beam ; length: 32'.

No. of lanes: 2 ; width: 23' c to c.

Structural Information

Substructure:

Material: Concrete and timber.
Foundations: Timber piles (treated and untreated).
Piers: Bents.
Abutments: Concrete.
Wings: ______.
Seats: ______.

Superstructure:

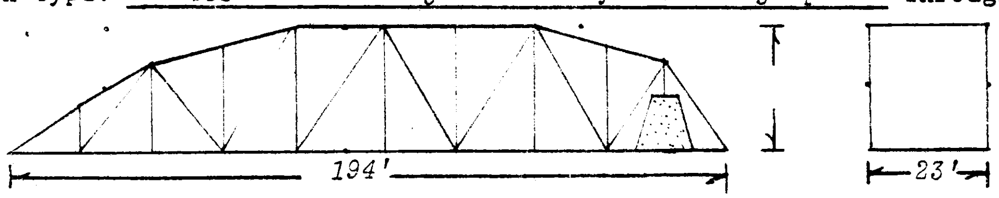
Material: Steel sources ______.

Characteristics, details and members:

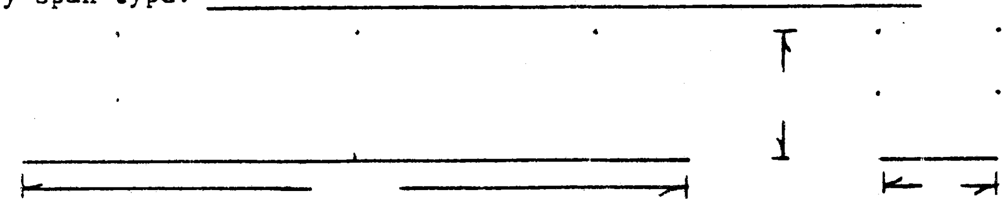
Connections: ______ pin.
X rigid.
Top Chords 2 channels with lacing, both sides.
End Posts: 2 channels with lacing, cover plate.
Bottom chords: 2 channels with lacing, both sides.
Posts: I-beams.
Diagonals: 2 channels with lacing, both sides.
Counters: I-beams.

Truss Configuration

Main span type: Bobtailed triangular (modified) swing span Through/~~Pony/Deck, Skew~~



Secondary span type: ______ Through/Pony/Deck, Skew



R-358

Photo Numbers:

Color: 1:8,9

TRUSS BRIDGE SURVEY AND INVENTORY FORM

Geographic Information

State: Virginia
Va. Dept. of Highways District: *Suffolk*; No. *5*.
County: *Greensville*; No. *40*.
City/Town: ______.
Street/Road: *Rt. 301 and I-95 service road*.
River/Stream/Railroad (crossing): *Three Creek*.
UTM/KGS Coordinates: ______.

Historical Information

Formal designation: ______.
Local designation: ______.
Designer: ______.
Builder: *Roanoke Iron & Bridge Works*.
Date: *1927*; basis for: *Date plate*.
Original owner: *Va. State Highway Commission*; use: *vehicular*.
Present owner: *Va. Dept. of Highways*; use: *vehicular*.

Historical or Technological Significance

____ Unique/Unusual in its time: ______.

____ Rare survivor though of standard design: ______.

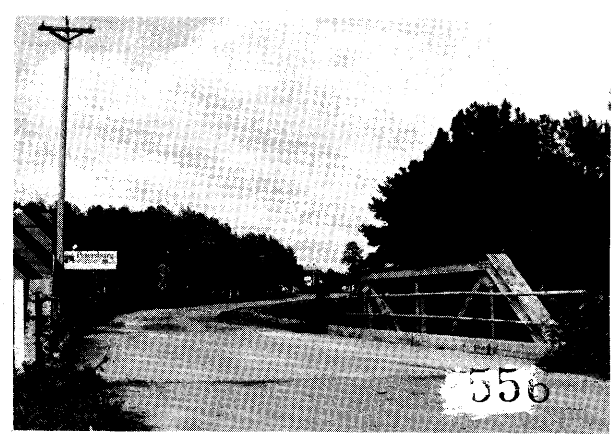
X Typical example of its time and a common survivor: ______.

____ Other Remarks/Explanation: ______.

Nature/Degree of any destructive threats: ______.

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

Recorder: *Paula A. C. Spero*.
Date: *August 22, 1978*.
Affiliation: *Research Council*



Design Information

Compass orientation of axis: N/S.

Architectural or decorative features:

No. of spans: 1; length; overall: 64'.

Span types:
(1) Steel truss; length: 64'.
(2) ______; length: ______.
(3) ______; length: ______.
(4) ______; length: ______.
(5) ______; length: ______.
(6) ______; length: ______.

No. of lanes: 2; width: 23'-0" c to c.

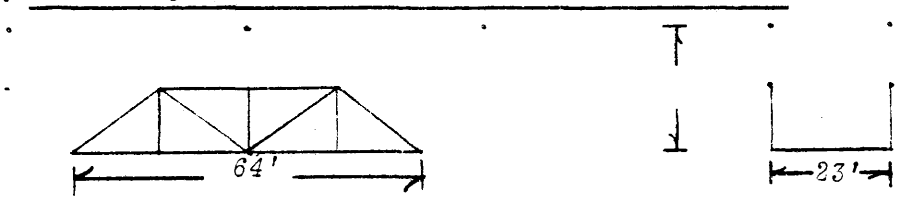
Structural Information

Substructure:
- Material: Concrete.
- Foundations: ______.
- Piers: ______.
- Abutments: Concrete.
- Wings: ______.
- Seats: ______.

Superstructure:
- Material: Steel sources Bethlehem.
- Characteristics, details and members:
  - Connections: ______ pin.
    X rigid.
  - Top Chords 2 channels with cover plate and lacing bars.
  - End Posts: 2 channels with cover plate and lacing bars.
  - Bottom chords: 2 channels with stay plates.
  - Posts: 4 angles back to back with continuous stay plate.
  - Diagonals: 4 angles back to back with stay plates.
  - Counters: ______.

Truss Configuration

Main span type: Triangular Pony



Secondary span type: ______ Through/Pony/Deck, Skew

R-358

Photo Numbers:

Color 1:10-18

TRUSS BRIDGE SURVEY AND INVENTORY FORM

Geographic Information

State: Virginia
Va. Dept. of Highways District: Suffolk ; No. 5 .
County: Southampton ; No. 87 .
City/Town: ______.
Street/Road: Rt. 35 .
River/Stream/Railroad (crossing): Nottoway River .
UTM/KGS Coordinates: ______.

Historical Information

Formal designation: ______.
Local designation: ______.
Designer: ______.
Builder: ______.
Date: 1928 ; basis for: Date plate on concrete post .
Original owner: Va. State Highway Commission ; use: Vehicular .
Present owner: Va.Dept. of Highways ; use: Vehicular .

Historical or Technological Significance

____ Unique/Unusual in its time: ______.

____ Rare survivor though of standard design: ______.

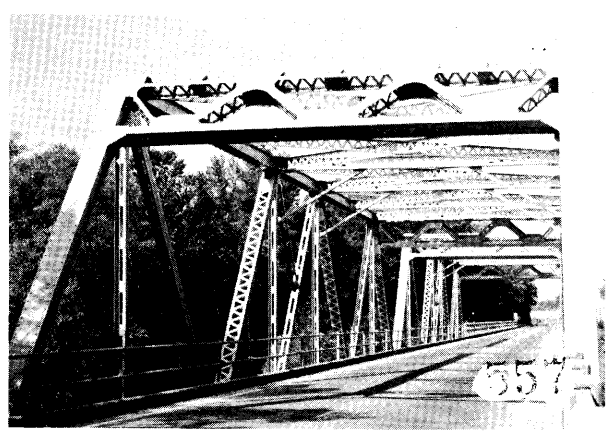
X Typical example of its time and a common survivor: ______.

____ Other Remarks/Explanation: ______.

Nature/Degree of any destructive threats: ______.

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

Recorder: Paula A. C. Spero .
Date: August 22, 1978 .
Affiliation: Research Council



Design Information

Compass orientation of axis: *E/W*.

Architectural or decorative features:

No. of spans: *26*; length; overall: *905'*.

Span types:

(1) *1-11, Concrete beam*; length: *27'-6"*.
(2) *12-13, Steel truss*; length: *122'*.
(3) *14-26 Concrete beam*; length: *27'-6"*.
(4) ______; length: ______.
(5) ______; length: ______.
(6) ______; length: ______.

No. of lanes: *2*; width: *23'-0"* c to c.

Structural Information

Substructure:

Material: *Concrete and timber*.
Foundations: *Precast concrete piles and a few timber piles*.
Piers: *Concrete*.
Abutments: *Concrete*.
Wings: ______.
Seats: ______.

Superstructure:

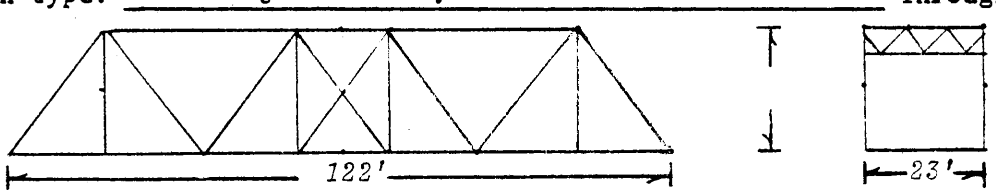
Material: *Steel* sources ______.

Characteristics, details and members:

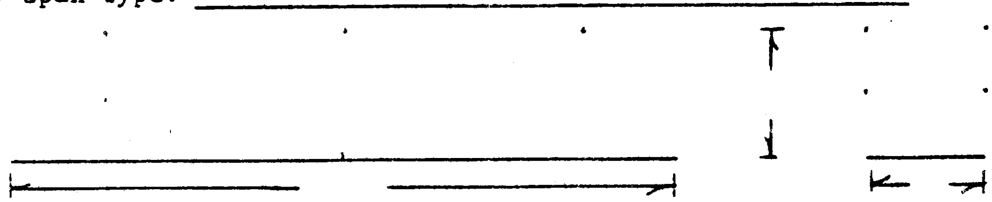
Connections: ______ pin.
X rigid.
Top Chords *2 channels with cover plates and lacing bars*.
End Posts: *2 channels with cover plates and lacing bars*.
Bottom chords: *2 channels with stay plates*.
Posts: *4 angles back to back with stay plates*.
Diagonals: ______.
Counters: ______.

Truss Configuration

Main span type: *Triangular (modified)* Through



Secondary span type: ______ Through/Pony/Deck, Skew



R-358

Photo Numbers:

Color 1:1-3

TRUSS BRIDGE SURVEY AND INVENTORY FORM

Geographic Information

State: Virginia
Va. Dept. of Highways District: *Suffolk* ; No. *5* .
County: *Sussex* ; No. *91* .
City/Town: ______ .
Street/Road: *Rt. 301* .
River/Stream/Railroad (crossing): *Nottoway River* .
UTM/KGS Coordinates: ______ .

Historical Information

Formal designation: ______ .
Local designation: ______ .
Designer: ______ .
Builder: ______ .
Date: *1928* ; basis for: *date plate on concrete post* .
Original owner: *Virginia State Highway Comm.* ; use: *Vehicular* .
Present owner: *Virginia Department of Highways* ; 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: ______ .

___ Other Remarks/Explanation: ______ .

Nature/Degree of any destructive threats: ______ .

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

Recorder: *Paula A. C. Spero* .
Date: *August 21, 1978* .
Affiliation: *Research Council*

Design Information

Compass orientation of axis: *N/S*.

Architectural or decorative features:

No. of spans: *4*; length; overall: *258'*.

Span types:
(1) *Concrete beam*; length: *38'*.
(2) *Steel truss*; length: *107'*.
(3) *Concrete beam*; length: *38'*.
(4) *Concrete beam*; length: *38'*.
(5) ______; length: ______.
(6) ______; length: ______.

No. of lanes: *2*; width: *23'-0"* c to c.

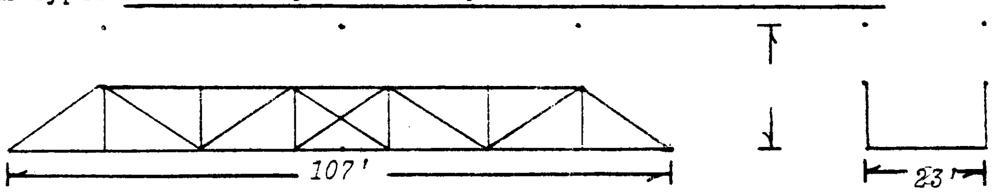
Structural Information

Substructure:
- Material: *Concrete and timber*.
- Foundations: *Timber piles*.
- Piers: *Concrete*.
- Abutments: *Concrete*.
- Wings: ______.
- Seats: ______.

Superstructure:
- Material: *Steel* sources ______.
- Characteristics, details and members:
  - Connections: ______ pin.
    X rigid.
  - Top Chords *2 channels with cover plates and lacing bars*.
  - End Posts: *2 channels with cover plates and lacing bars*.
  - Bottom chords: *2 channels with stay plates*.
  - Posts: *4 angles back to back with continuous stay plate*.
  - Diagonals: ______.
  - Counters: ______.

Truss Configuration

Main span type: *Triangular (modified)* Pony



Secondary span type: ______ Through/Pony/Deck, Skew

Photo Numbers:

Color 1:1-3

TRUSS BRIDGE SURVEY AND INVENTORY FORM

Geographic Information

State: Virginia
Va. Dept. of Highways District: Suffolk; No. 5.
County: Sussex; No. 91.
City/Town: ______.
Street/Road: Rt. 301.
River/Stream/Railroad (crossing): Stony River.
UTM/KGS Coordinates: ______.

Historical Information

Formal designation: ______.
Local designation: ______.
Designer: ______.
Builder: ______.
Date: 1928; basis for: Date plate on concrete span.
Original owner: Va. State Highway Commission; use: Vehicular.
Present owner: Va. Dept. of Highways; use: Vehicular.

Historical or Technological Significance

___ Unique/Unusual in its time: ______.

___ Rare survivor though of standard design: ______.

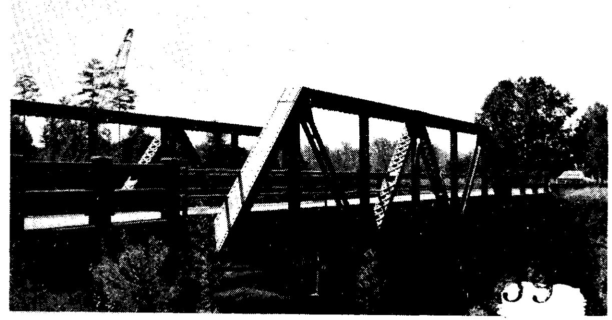
X Typical example of its time and a common survivor: ______.

___ Other Remarks/Explanation: ______.

Nature/Degree of any destructive threats: ______.

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

Recorder: Paula A. C. Spero.
Date: August 21, 1978.
Affiliation: Research Council.



Design Information

Compass orientation of axis: *N/S*.

Architectural or decorative features:

No. of spans: *3*; length; overall: *146'*.

Span types:

(1) *Concrete beam*; length: *22'*.

(2) *Steel truss*; length: *92'*.

(3) *Concrete beam*; length: *32'*.

(4) ________; length: ________.

(5) ________; length: ________.

(6) ________; length: ________.

No. of lanes: *2*; width: *23'-0"* c to c.

Structural Information

Substructure:

Material: *Concrete and timber*.

Foundations: *Timber piles*.

Piers: *Concrete*.

Abutments: *Concrete*.

Wings: ________.

Seats: ________.

Superstructure:

Material: *Steel* **sources** ________.

Characteristics, details and members:

Connections: ________ **pin.**

X **rigid.**

Top Chords *2 channels with cover plate and lacing bars*.

End Posts: *2 channels with cover plate and lacing bars*.

Bottom chords: *2 channels with stay plates*.

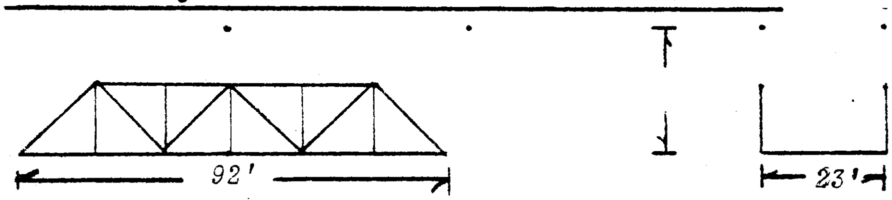
Posts: *Angles and continuous stay plate*.

Diagonals: *2 angles with stay plates or channels with stay plates and latticing*.

Counters: ________.

Truss Configuration

Main span type: *Triangular* **Pony**



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