CRITERIA FOR PRESERVATION AND ADAPTIVE USE OF HISTORIC HIGHWAY STRUCTURES

Interim Report No. 1

A Trial Rating System for Truss Bridges

by

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Associate Head

(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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ABSTRACT

Metal truss bridges are uniquely indigenous products of American engineering and construction technology, and in recent years their historic significance has been increasingly recognized along with that of other early engineering structures. Some trusses that warrant inclusion on the National Register of Historic Places require renovation or replacement to meet modern traffic demands. Conflicting requirements of federal preservation and highway safety legislation demand that standards be developed to permit, early in the replacement planning process, objective identification of those trusses that warrant retention because of historic significance.

Based upon a statewide survey of metal truss bridges in Virginia, an objective numerical rating system for historic significance has been developed that considers characteristics in three categories: documentation (age and builder), technology, and environmental factors. This system was applied to 58 bridges selected from approximately 500 surveyed statewide.

Based upon this study the following conclusions appear warranted.

1. While historic significance is in some measure subjective (no more so than the sufficiency rating), an objective numerical rating system provides a useful tool for identifying bridges of special significance and guiding decisions on preservation or adaptive use.

2. Information in three broad categories — documentation, technological significance, and environmental factors — provides necessary characteristics for establishing significance.

3. While developed from data on metal trusses in Virginia, the system is generally applicable to other types of bridges in other areas.

4. While few metal truss bridges of national significance survive in Virginia, there are several examples worthy of preservation and numerous examples reflecting the various technologies of nineteenth century bridge design and construction.

5. Virginia still possesses a sufficient diversity of truss types, materials, and geographical distribution to serve as a valuable resource for appreciation by lay persons and study by specialists.

PREFACE

When this project was initiated it was anticipated that, following a statewide survey of metal truss, stone masonry, and concrete arch bridges, criteria would be developed to permit an objective evaluation of the historic significance of highway bridges. However, because the rapid progress of the bridge replacement program in Virginia was found to threaten several bridges with obvious historic significance, it became necessary to develop guidelines as rapidly as possible, particularly in view of the long lead time between project initiation and actual construction. If there is any hope for preservation of a historically significant structure, its significance must be established prior to initiation of a replacement project. The identification of historic significance after a replacement project is under way is not only disruptive and expensive, but also often generates unnecessary conflict between the Department of Highways and Transportation and certain segments of the public.

From the large amount of data gathered in the statewide survey of metal truss bridges, sufficient information was available to formulate a trial rating system specific enough to evaluate metal trusses and general enough to be modified for other types of bridges.

Because of the immediate need, it has been decided to publish the trial rating system before completion of the entire project.

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INTRODUCTION

In the ten years since the disastrous collapse of the Silver Bridge over the Ohio River, increased attention has been directed toward upgrading and replacing many of the nation's bridges that are inadequate to meet the demands of modern traffic. A recent magazine article states that one out of every six highway bridges in the U. S. falls into this category. In 1971, Congress approved a program for replacing unsafe bridges on the federal-aid highway system. Under this program $180 million were allocated for fiscal year 1977. Despite this large expenditure it is estimated that replacement of all unsafe bridges will require more than 200 years (ENR 1977).

The article goes on to state that the Federal Highway Administration, in a recent report, lists 6,289 bridges with major structural deficiencies sufficient to require replacement, and 65,507 with minor, or repairable, deficiencies. In addition to the bridges cited for structural obsolescence, the FHWA report identified 33,015 bridges as being functionally obsolete, with problems such as insufficient width to handle traffic from connecting roads and sharply curved approaches (ENR 1977). Obviously, many of the nation's old bridges are being replaced at an increasing rate.

The year before the Silver Bridge disaster, Congress enacted the Historic Preservation Act of 1966, discussed later in this report, which extended protection to sites and structures listed in the National Register of Historic Places that might be threatened by federally-funded or licensed projects. In 1971 Executive Order 11593 extended this protection to sites and structures *eligible* for inclusion in the National Register. Obviously, some old bridges are covered by both of these federal acts — one of which requires replacement, 1546 while the other fosters preservation. Thus a substantial dilemma exists, particularly if the replacing agency is, in addition to being dedicated to the safety of its structures, also sensitive to their historic significance.

Because of its singular role in America's history, the Commonwealth of Virginia has a long tradition of preserving properties and artifacts associated with its early social and political development. The attraction of homes such as Monticello and Mount Vernon, the numerous Civil War battlegrounds, and the pioneering reconstruction at Colonial Williamsburg increases with each passing year. During the bicentennial year millions of tourists visited these and other historic sites as well as the state's many natural features such as caverns and the Natural Bridge.

To a large extent the abundance of historic sites in Virginia associated with the early social and political history of the United States has caused later developments, particularly those related to technology, to be ignored. This situation is not peculiar to Virginia, and recognition of the potential loss of the sites and artifacts representing the nation's technical and industrial growth has led in recent years to an increasing awareness of the importance of identifying and preserving, where possible, the fabric of these developments.

RELEVANT LEGISLATION

For many years the National Register of Historic Places contained almost exclusively buildings and prehistoric sites. To a large extent this situation evolved because of the inventory, begun in the 1930's, by the Historic American Building Survey (HABS) that sought to document the nation's architectural heritage. The increased awareness of the need for similar recognition of technical and engineering contributions, particularly by the American Society of Civil Engineers, led in 1969 to the formation of the Historic American Engineering Record (HAER) with responsibilities to the areas of engineering and industrial development similar to those of HABS in the field of architecture. Other technical organizations, notably the American Concrete Institute and the American Society of Mechanical Engineers, have more recently initiated programs to recognize the heritage of their disciplines. These efforts, along with those of lay groups interested in canals, covered bridges, railroads, and other transportation developments, have resulted in a number of engineering structures being listed in the National Register of Historic Places.

Paralleling the increased general interest in the nation's technical heritage were two landmark legislative developments in the area of preservation that have had a significant impact upon the planning and construction of transportation facilities proposed to replace facilities of historic significance (Fowler 1976).

The first of these actions was passage of the National Historic Preservation Act of 1966 (NHPA). This legislation, which evolved from earlier efforts beginning in 1935, significantly strengthened the federal commitment to preservation. The 1966 Act removed national significance as a controlling criterion by broadening the scope to include resources of state and local significance. The substance of the Act's protective provisions is found in Section 106, which states:

> The head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking in any State and the head of any Federal department of an independent agency having authority to license any undertaking shall, prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, building, structure or object that is included in the National Register. The head of any such Federal agency shall afford the Advisory Council on Historic Preservation...a reasonable opportunity to comment with regard to such undertaking.

(Note: The Council was composed of twenty members: the Secretary of Agriculture, the Attorney General, the Secretary of Commerce, the Secretary of Housing and Urban Development, the Secretary of Transportation, the Secretary of the Interior, the Secretary of the Treasury, the Administrator of the General Services Administration, the Secretary of the Smithsonian Institution, the Chairman of the National Trust for Historic Preservation, and ten nonfederal members selected by the President on the basis of their interest and service in the field of historic preservation.)

The Act also directed the Secretary of the Interior to "expand and maintain a national register of districts, sites, buildings, structures and objects significant in American history, architecture, archeology and culture". One response to the passage of the Act has been a substantial increase in Register nominations. As of February 1, 1976, the National Register comprised over 12,000 listings and was growing at the rate of about

250 additions per month (Greenburg 1976). Of the 12,000 entries, over 500 are located within the Commonwealth of Virginia. Of these, 21 are associated with transportation and include 8 bridges, 7 taverns and ordinaries, 4 canals and ferries, and 2 railroad stations. Approximately 1,000 of the National Register listings are what would be called "engineering" structures, and the vast majority of these have been designated within the past five years.

While Section 106 of the NHPA represented a major step forward in the preservation program, it contained certain shortcomings which were addressed in Executive Order 11593 issued by President Nixon on May 13, 1971. The order, titled "Protection and Enhancement of the Cultural Enivronment", contained two major new directions: One extended the Advisory Council's review process to properties *eligible for*, but not yet formally entered in, the National Register. The second feature was the extension of the administrative interpretation to nonfederally owned properties as well as those owned by the federal government

In 1976 the National Historic Preservation Act of 1966 was amended to incorporate the important features of Executive Order 11593. At that time the membership of the Advisory Council was increased from twenty to twenty-nine. Advisory Council comments mandated by the NHPA for undertakings affecting properties or sites eligible for the Register, as well as measures to mitigate any adverse impact of the proposed undertaking, are provided by the Advisory Council staff. Only projects for which acceptable mitigation cannot be agreed upon are brought before the full Council.

Thus Section 106 of the NHPA and Executive Order 11593 combined with the provisions of the National Environmental Protection Act (NEPA), which requires comments from the Advisory Council or its designated representatives in environmental impact statements, dictate consideration at the earliest possible stages of planning any potential impact of projects upon properties or structures on or eligible for the National Register of Historic Places, if these projects involve, either directly or indirectly, use of any federal funds. There are no corresponding restrictions on projects funded from other sources at this time.

THE NHPA and Executive Order 11593 placed upon the funding federal agency the responsibility for resolution of conflicts subject to review by the Advisory Council, which has final responsibility to regulate the impact of federal agency actions on National Register properties.

In response to the requirements placed upon federal agencies by the National Historic Preservation Act of 1966, the Federal Aid Highway Act of 1968 amended the Federal Highway Act of 1966. Section 4(f) of the Department of Transportation Act of 1968 reads in part:

> It is hereby declared to be the national policy that special effort should be made to preserve the natural beauty of the countryside and public park and recreation lands, wildlife and waterfowl refuges, and historic sites...after the effective date of the Federal Aid Highway Act of 1968, the Secretary shall not approve any program or project which requires the use of any publicly owned land from a public park...or from any land from a historic site of national, state, or local significance as so determined by such officials unless (1) there is no feasible and prudent alternative to the use of such land, and (2) such program includes all possible planning to minimize harm to such...historic site resulting from such use.

All federal "undertakings" require application of Section 106, which involves obtaining comments from the Advisory Council. In addition, any project funding by any part of the Department of Transportation requires consideration of the provisions of Section 4(f).

Use of federal funds is not a requirement for qualifying a project as a federally assisted undertaking. Application for a permit (from the Coast Guard or Corps of Engineers, for example) invokes the requirements of Section 106 as a "licensing" activity.

The requirements of Section 4(f) of the DOT Act are subject to broader and more restrictive interpretation than are those of Section 106 of NHPA. The latter permits mitigation of the adverse effect through a memorandum of agreement that usually reflects a compromise among preservation and transportation goals, with a consideration of social and economic factors. In many cases the historic site is demolished with proper recording where any other action would be prohibitively expensive. Under Section 4(f) "reasonable and prudent" alternatives may be identified that are possible but only at extraordinary expense.

As a result of these pieces of legislation, transportation structures assumed a historical role not foreseen in the earlier legislation relating to replacement or construction. Of special importance to the replacement of functionally or structurally obsolete transportation facilities, particularly bridges, is the obvious conflict between the federal requirements for preservation of historically significant structures on the one hand and those requiring replacement under the provisions of the Emergency Bridge Replacement Act of 1971 on the other. Priorities are usually determined by which legislation is best funded, so that replacement usually results. The legitimate concerns for preservation and those for safety, in many cases, would clearly be diametrically opposed.

BRIDGE REPLACEMENT POLICY

One direct outgrowth of the Emergency Bridge Replacement Act of 1971 (U. S. Code 1971) was a nationwide inventory of bridges to identify those that did not meet specific safety criteria. This legislation provided for the hiring and training of personnel to evaluate the structures. As part of this nationwide survey, procedures were established to develop for each structure a numerical "sufficiency rating" to aid in setting replacement priorities. Detailed information was to be obtained for 84 items (FHWA 1972). Subsequently, a computerized system was developed for weighting the various factors. The details of this system are unpublished, but its general features are reflected in the following equation, which is the basis for the computer analysis.

$$\text{Sufficiency Rating} = S_1 + S_2 + S_3 - S_4,$$

where

S_1 = structural adequacy and safety (55% maximum) (this factor evaluates the load carrying capacity of the superstructure and substructure),

S_2 = serviceability and functional obsolescence — 30% maximum (this factor evaluates the geometric and traffic capacity features),

S_3 = essentially for public use — 15% maximum (this factor evaluates the importance of the structure as a defense highway and with regard to frequency of use), and

S_4 = special reductions (these reductions apply to special situations and only when $S_1 + S_2 + S_3 \geq 50$).

The resulting sufficiency rating is reported as a numerical value between 1 and 100. Currently, structures with a sufficiency rating below 50 are eligible for replacement with federal funds.

In Virginia the decision to replace a particular bridge results from a combination of factors, including the need for road relocation and upgrading as well as obsolescence of the structure. Candidates for bridge replacements usually are recommended annually from the Department's district offices but may be recommended at any time. Because the number recommended always exceeds the available resources, the candidates undergo various reviews and balancing of needs, priorities, and funds available in the various areas and for the several road categories.

For each bridge recommended as a candidate for replacement, the sufficiency rating is obtained. At present, the rating is used in Virginia primarily to determine eligibility for federal assistance. There is currently no systematic program to replace the bridges in the order of sufficiency ratings. A program is under way to determine the sufficiency rating of all bridges in Virginia, rather than just those recommended for replacement. Under the current approach it is common for a bridge with a sufficiency rating above 50 to be replaced before one with a lower value.

The time required from the initiation of a project until it is advertised for construction is typically three years. This time is required for the acquisition of right-of-way, surveys, securing of various permits, preparation of plans and contract documents, and the holding of public hearings when necessary. Regardless of whether the project is financed with federal or local funds, the Department publicly announces its willingness to hold a public hearing and prepares documents evaluating the environmental impact of the project. When the project is federally funded the procedures differ only in the degree of documentation necessary, rather than in any fundamental way,from those applied to locally funded projects.

WHY PRESERVE METAL TRUSSES?

Why should old metal truss bridges be preserved? The answer to this question cannot be stated in terms of cost-benefit ratios or other quantitative measures. In like manner, it is difficult at best to quantify safety improvements because dollar values cannot be placed upon loss of life or crippling injury. Increasing speed and capacity is likewise a two-sided coin as recent concerns with energy and environmental pollution have identified. Rather than argue the preservation rationale, for the purposes of this project it is assumed that preservation of historically significant structures is a goal to be positively pursued. Recent constraints evolving from the need for energy conservation have made preservation of older buildings and neighborhoods economically attractive when compared with replacement by new structures. In a few cases similar economical justification might be made for upgrading a historic bridge, but the major reason for such preservation is largely subjective. Perhaps the case for preserving metal trusses is best stated in a recent article by Delony (1977), which says in part:

> They [trusses] represent some of the finest achievements of American engineering and construction technology. The metal truss bridge is uniquely indigenous to America; no other country experimented with the truss concept as we did during the 19th century. With unlimited supplies of wood, coupled with the need to construct railroads and highways as quickly and as cheaply as possible, the timber truss was a national solution. Once the trunklines opened up the frontier, the people who moved westward built a network of primary and secondary roads to connect their farms with market towns and on to larger commercial centers. The solution to crossing thousands of streams and rivers was the prefabricated metal truss which evolved in the country from the wooden truss about the middle of the 19th century....
>
> Presently, a significant number of these trusses remain. The more modest spans maintain a sense of scale with the rural landscape not duplicated in the concrete girders that replace them. Those located near towns and cities serve to slow traffic, and thus contribute to preserving the human scale and 19th century character of many historic towns and urban neighbourhoods.
>
> Thus, we have both a historical and an environmental argument to preserve metal truss bridges.

INVENTORY OF VIRGINIA'S METAL TRUSS BRIDGES

In 1973 the Research Council initiated a statewide survey of metal truss bridges, recognizing that this type of bridge, because of its age and design features, would be immediately affected by the provisions of the bridge replacement program. The inventory was restricted to trusses constructed prior to 1932, the date at which the state assumed jurisdiction over all roads and structures formerly maintained by the counties. The inventory has been completed for all of the state's eight construction districts and reports for four of these, along with a general introductory report, have been issued (Deibler 1975a, 1975b, 1975c, 1976a, 1976b). Reports for the remaining districts are in preparation. The number of surviving trusses were found to vary among the districts as follows:

District	Number of Trusses
Bristol	118
*Culpeper	75
*Fredericksburg	7
Lynchburg	44
*Richmond	24
Salem	95
*Staunton	144
Suffolk	6
TOTAL	513

*Report published

In 1976 a project, funded from Federal Highway Planning and Research Funds and entitled "Criteria for the Preservation or Adaptive Uses for Historic Highway Structures", was initiated (Newlon and Deibler 1976). The purpose of this project was to establish criteria by which the historic significance of highway bridges could be determined in a manner generally like that used for establishing the "sufficiency rating" used to judge obsolescence. Included in this project were field surveys of the metal trusses in the Bristol and Lynchburg Districts, a statewide survey of stone masonry and concrete arch bridges, and the development of the rating system.

While the field work for the project has not been completed, the historic significance of certain specific structures vis-a-vis the need for their replacement or upgrading has become necessary

1554 because of their inclusion in the Department's bridge replacement program. Therefore, a tentative system has been developed with the view of immediately applying it as needed and refining it as the project proceeds.

CRITERIA

In developing the criteria a number of approaches and factors were considered. Despite the fact that the quantification of "historical significance", a subjective quality, is difficult, it was deemed desirable to develop the rating in some numerical way. After consideration of the various factors that enter into such a subjective evaluation, the characteristics of the bridges were identified into three broad categories as follows:

1) Documentation (age and builder) — 7 points (26%) maximum

2) Technological significance (technology and geometrics) — 9 points (33%) maximum

3) Environmental (aesthetics, history, and integrity) — 11 points (41%) maximum

While the largest single category relates to environmental factors, the remaining two categories together reflect largely technological factors, and viewed together the three appear to give a fair balance between the significance as viewed by those whose primary interest is technology and those whose primary concern is more general.

Each of the broad categories includes specific features as will be discussed later. Among these features are age, technological innovation, length and number of spans, and uniqueness, as well as history, and the evolution of the crossing along with the aesthetics and integrity of the bridge. Establishment of the factors to be included and the numerical weights to be applied to each is complicated by the lack of an adequate data base for determining the ultimate standard for significance. For example, should the criteria recognize uniqueness on a national, regional, or local level? And, within what geographical limits, state or local, should the last truss of a given configuration be recognized? These and similar questions require criteria that can be applied at various levels. The tentative rating system proposed here attempts to incorporate these features, as will be discussed.

A broad perspective of historic significance was attempted by considering data and suggestions from other national sources, especially published reports of Historic American Engineering Record and the National Register of Historic Places (Sackheim 1976, Greenberg 1976). However, because the largest body of data available was that from Virginia's inventory of metal truss bridges, it was decided to use the state of Virginia as the geographical limit.

Unfortunately, Virginia possesses comparatively few nationally significant bridges because of the vast destruction wrought by the Civil War and two disastrous floods in 1870 and 1877. The war probably had minimal impact on metal bridges. In fact, the wooden bridges destroyed during the conflict were often replaced by metal trusses. Natural destruction and "progress" have replaced most of the rest. The oldest surviving metal truss was built in 1877-8 when truss technology was well developed. In other states, such as New York, examples of Squire Whipple's original patent survive from the 1840's. Despite these limitations, the criteria and weighting provide a basis for quantitative and objective assessments, and the essential format is capable of being extended to include older or more technically significant structures.

The factors considered and the weight given to each are shown in Table 1, and the rationale for the factors and relative weighting are then discussed.

Table 1

Factors Comprising the Criteria For Historic Significance of Virginia's Metal Truss Bridges*

FACTOR	POINTS ASSIGNED
A. Documentation	Maximum possible — 7
1. Builder	
a. Unknown	0
b. Known, contribution to truss technology undetermined	1
c. Known, prolific builder	2
d. Known, unusual designer	3
2. Date**	
a. Post-1932	0
b. 1918-1932	1
c. 1900-1917	2
d. 1886-1899	3
e. Pre-1885	4
B. Technological Significance	Maximum possible — 9
1. Technology	
a. Patented technology	1
b. Number of spans	1
c. Individual span lengths	1
d. Materials	1
e. Integrity	1
f. Special features	1
2. Geometry/configuration	
a. Unique	3
b. Unusual	2
c. Novel	1
C. Environmental	Maximum possible — 11
1. Aesthetics	4
2. History	3
3. Integrity	4

*This rating system initially was developed by Dan G. Deibler, with minor modifications by the History Research Advisory Committee.

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

Documentation

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

Company

Companies and builders are characterized at three levels of significance. The most significant category is "known, unusual designer". The description is used for innovative companies that had a major impact on the evolution of truss technology. Among these companies would be the Phoenix Bridge Company, Phoenixville, Pennsylvania; King Iron and Bridge Company, Cleveland, Ohio; Keystone Bridge Company, Pittsburgh, Pennsylvania; and Groton Bridge and Manufacturing Company, Groton, New York.

The major innovation of the Phoenix Bridge Company was its patented compression member called the Phoenix column, which was a series of longitudinal segments riveted together to form a cylindrical column. Additional segments could be added to increase the column size. Phoenix was internationally known, with bridges in Canada, Mexico and Brazil.

The King Iron Bridge and Manufacturing Company was, during the 1880's, the largest highway bridge works in the United States. Its reputation was initially based upon Zenas King's patented tubular arch truss. Ultimately the company constructed numerous through truss and swing spans throughout the Eastern United States.

The Keystone Bridge Company pioneered in the use of wide, die-forged eye bars for tension members. In the 1860's it initiated the use of wrought iron for all principal truss members and, later, developed a tubular column made up of riveted circular segments.

Designation of the Groton Bridge and Manufacturing Company as an unusual and innovative designer is made largely on the basis of a structure built in Virginia in 1890 for the Goshen Land and Improvement Company and discussed later in this report. It is a multispan, wide, and heavily skewed truss reflecting a significant design achievement for the period.

The designation "known, prolific builder" is used to describe companies such as the Champion Bridge Company, Wilmington, Ohio; Brackett Bridge Company, Cincinnati, Ohio; Wrought Iron Bridge Company, Canton, Ohio; and Roanoke Iron and Bridge Company, 1558 Roanoke, Virginia. These companies constructed large numbers of bridges but, for the most part, utilized standard elements.

The final classification is "known, contribution undetermined". As more information is developed on the activities of companies, some now designated in this category might be elevated to a higher level.

Where the builder is unknown, no points are given.

Age

Points are given for increasing age in four groupings: pre-1885 — 4; 1886-1899 — 3; 1900-1917 — 2; 1918-1932 — 1. No points are awarded for bridges built after 1932. The dates of 1885 and 1932 were taken as limits based upon the frequency of surviving metal trusses in Virginia. As noted earlier, none survive that were built prior to 1877, and after 1932 all roads and bridges came under the jurisdiction of the Department of Highways so that standardized plans became common. Application of these classifications in other areas where older trusses survive would probably warrant two additional classes; say 1865-85 and pre-1865.

The points are awarded when the date can be definitely established from date plates, plans, newspaper accounts, or public records. Where such information is not available, the age can usually be estimated to be within one of the groupings, but only one-half of the point value is given in these cases.

Technological Significance

The second broad category of characteristics recognizes the technological features of the truss without regard to whether or not it has been moved or modified. Within this category the general geometric configuration and truss type, as well as industrial details, are considered. In all cases the truss is awarded the points if it possesses the characteristic. No fractional points are given.

Patented Technology

Items of significance would include Phoenix columns, tubular arches, special connections, and other patented innovations in the evolution of truss technology.

Number of Spans

Most of the nineteenth century bridges surviving in Virginia consist of a single span. While no hard and fast rule was followed on this criterion, in general a point is given for multiple spans for truss bridges built before 1900. Although none were found, a point would probably be given for bridges of more than three spans built between 1900 and 1917.

Length of Span

Again, no hard and fast rule was used, but generally a point is given for spans in excess of 100 feet (30.5 m) built prior to 1900. This category can be refined by considering a plot of span length versus time of construction as data are accumulated.

Materials

Most of the bridges built after 1890 used steel for the structural members and necessary parts. During the decade prior to 1890, both steel and wrought iron were used. It is not always easy to determine the difference between the two materials without extensive testing. Steel bridges built prior to 1880 and wrought iron bridges built after 1890 would receive one point. For bridges built during the period between 1880-1890 there would be some justification for awarding a point to wrought iron as a late or somewhat retarded practice, and to steel as an innovation. Wood trusses of this period would receive a point because of their rarity.

Integrity of Truss

A point is awarded if the truss has not been modified, even though it might have been moved from its original location. Modifications are usually evident during field inspections.

Special Features

Most trusses surviving in Virginia are relatively free of ornamentation. A few have unusual or attractive portal bracing, finials, or other details. Where these occur, a point is given.

Geometric Configuration

The 1840's and 1850's were the decades of experimentation in search of the ideal truss. After the Civil War the Pratt and Whipple configurations became the most common. In 1884 Waddell stated that "at least ninety per cent of all American iron highway bridges are built on these systems" (Waddell 1891). The inventory in Virginia confirmed that the Pratt configuration was overwhelmingly the most common. Other types were found, as reported in the various reports (Deibler 1975b, 1975c, 1976a and 1976b). In judging significance, common types were awarded no points. Characterization as unique, unusual, or novel, *when compared with Virginia's surviving trusses*, was used to award 3,2 or 1 point. Application of these classifications in other areas or to a broader sample of bridges (nationwide for example) would require slight modification.

Environment

In addition to the technical or engineering aspects of bridges that are evaluated by the factors included under "documentation" and "technological significance", nontechnical characteristics such as aesthetics and historical factors are important. Environmental and historical factors are irreplaceable. Once destroyed, the site is lost. The sense of place is important. It is probable that, in the absence of quantitative criteria, these factors have been the major influence on Register nominations of structures. For both reasons a significant portion of the total points is warranted in this category. The evaluation of environmental factors also provides information important for the type of preservation effort to be pursued. For example, if a truss receives high marks in the first two categories (documentation and technological significance) but low marks in the environmental category, then relocation of the structure would be warranted. If, on the other hand, the environmental characteristics are significant, then special efforts to preserve or adaptively use the structure at its current location would be indicated.

Environmental factors are judged in three areas: aesthetics, history and integrity. Bridges judged to possess these characteristics are awarded the indicated number of points. No fractional points for varying degrees of significance are given.

Aesthetics

Aesthetics are judged on the basis that the bridge is an integral part of its setting to the point that its removal or relocation would be detrimental to the bridge and the ambiance of the setting. While aesthetics is a subjective matter, experience has indicated that people with marked differences in background and training can usually agree on the detrimental impact of the removal.

History

The term "history" embraces a variety of characteristics. The crossing may be significant, having evolved from a ford through a series of bridges. Thus, the bridge might be one of a series that has served the site. It may demonstrate the re-use of previous features; e.g. piers or abutments. It may, on the other hand, be the first (original) span at a particular site.

The crossing or bridge may be associated with a historical property or area, or it may have fostered residential, commercial, or industrial development in an area.

The historic significance of the bridge might derive from the fact that it was associated with significant events or circumstances. Normally the fact that the bridge was named for an individual would not, in itself, impart historical significance in the absence of the characteristics already described.

Bridges in communities or settlements would generally be assumed to have contributed significantly to local development and to thereby possess significance.

Integrity

Points for integrity are given if the bridge is at its original site. When trusses were initially promoted during the nineteenth century, it was the speed with which they could be assembled that made them so important and popular. Subsequent generations recognized and capitalized on their reusability so that many removed during subsequent road improvements were re-erected at different sites. There are numerous examples of reuse in Virginia, and for many years when a truss was replaced, it was standard policy to matchmark and store it for subsequent reerection. There are examples where individual spans from multi-span bridges were used as single span bridges at different locations, and where single spans were combined with other trusses to form multi-span crossings. Because of this capability for reuse, which during the twentieth century became a selling point of metal trusses, an early truss at its original location is, therefore, quite rare and merits recognition.

INITIAL APPLICATION OF RATING SYSTEM

Because some potentially significant trusses were included in the Department's replacement program, it was important to identify these at the earliest possible time. From the approximately 500 metal trusses inventoried in the state, 58 were selected as the most likely to be historically significant, and the rating system was applied to them by a six-man task group of the Council's History Research Advisory Committee. The 58 were selected by the person who saw them all in their settings during the survey. This continuity of initial evaluation represents an ideal situation. The six-man task group included people from the Department's Location and Design and Bridge Divisions and the Research Council. A consensus was reached on the points to be awarded to each bridge in each category. The data for each bridge are given in Appendix A. The "Significance Rating" ranged from a low of 3.0 to a high of 24.0 out of a possible 27.0. The ratings were high because the 58 bridges were initially believed to be significant. It is doubtful that high ratings will be received by any of the remaining 450 bridges. The 58 bridges are listed in descending order of significance in Appendix B.

Because this was the initial effort to develop numerical ratings for significance it was necessary to establish a standard by which significance would be judged. Recognizing that the system was subject to further refinement and considering practical questions that suggested initial designation of a comparatively small number of bridges, it was decided to set the level higher than might otherwise be the case. After various possibilities were considered, it was decided to consider bridges with a rating of 20.0 or greater historically significant, and those with a rating of 10.0 or greater potentially significant. The nine bridges with ratings of 20.0 or greater are shown in Figures 1-9. One of these, the Phoenix bridge on Rt. 685 over Craig Creek in Botetourt County (Figure 8), was already on the National Register of Historic Places. This bridge received a Historic Significance Rating of 20.0. Another of these bridges (Figure 5), the one on Rt. 802 over the Rappahannock between Culpeper and Fauquier Counties, received a rating of 21.0 but was demolished despite the Department's belated efforts to save it. The remaining seven are being nominated to the National Register of Historic Places by the Department.

Two other bridges of interest are shown in Figures 10 and 11. The bowstring arch truss shown in Figure 10, Virginia's oldest surviving metal truss, was removed from service in 1972. Plans have been approved to incorporate this bridge as a pedestrian bridge in a rest area on Route I-81 in Montgomery County. An artist's conception of the proposed rest area is shown in Figure 12.

At the time it was abandoned the bridge was serving at its third location, which had no particular historic significance or aesthetic qualities. It thus received none of the 11 potential environmental points. Its significance rating was 13.0, which represents a substantial portion of the 16 points possible in the two remaining categories and hence emphasizes its technological significance. The lack of environmental significance adds justification to the decision to relocate the bridge rather than to maintain it in place.

The bridge shown in Figure 11 was nominated to the National Register of Historic Places by local residents in 1975. It has a significance rating of 12.5, which means that 37 of the 58 structures evaluated were rated higher. Because this is an attractive bridge with a low priority for future replacement and has high visibility thanks to its relocation near a popular tourist area (the town of Waterford), its retention is certainly warranted, but the need for an objective rating system is clearly demonstrated by this case.

The bridges shown in Figures 1-10 represent a diversity of types, materials, and geographical distribution. Five of the bridges (Figures 1, 2, 4, 8, and 9) are multi-span structures. In addition to the common Pratt configuration, a camelback (Figure 9), a bowstring (Figure 10), and an unusual hybrid double-intersection configuration (Figure 7) are included. The works of seven nineteenth century bridge companies are represented, including at least one example from each of the four companies identified as being innovative or unusual designers. In addition, because of their technological and environmental significance, two of the bridges reflect interesting nineteenth century relationships between road bridges and industrial development. One (Figure 1) was built for the county by a railroad company and the other (Figure 2) was built by a land development group. Three materials available for nineteenth century construction — wood, wrought iron, and steel — are also represented.

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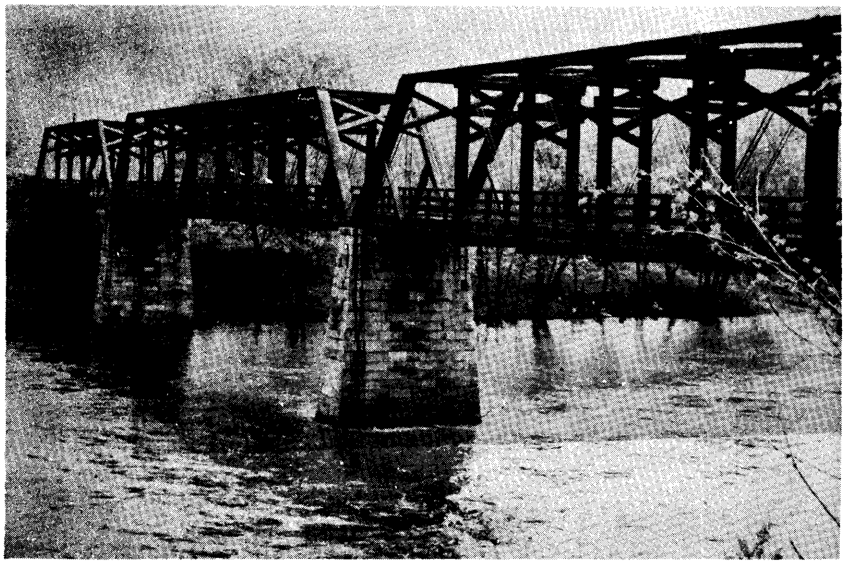

Figure 1. Three span timber and wrought iron Pratt through truss on Route 630 over the James River in Botetourt County. This bridge was built in 1884 by the Richmond and Alleghany Railroad for Botetourt County. The Chesapeake and Ohio, successor to the R & A, has continued to maintain this highway structure under the original 1884 agreement. These are the only wooden and iron (combination) truss spans remaining in Virginia. Significance rating 24.0.

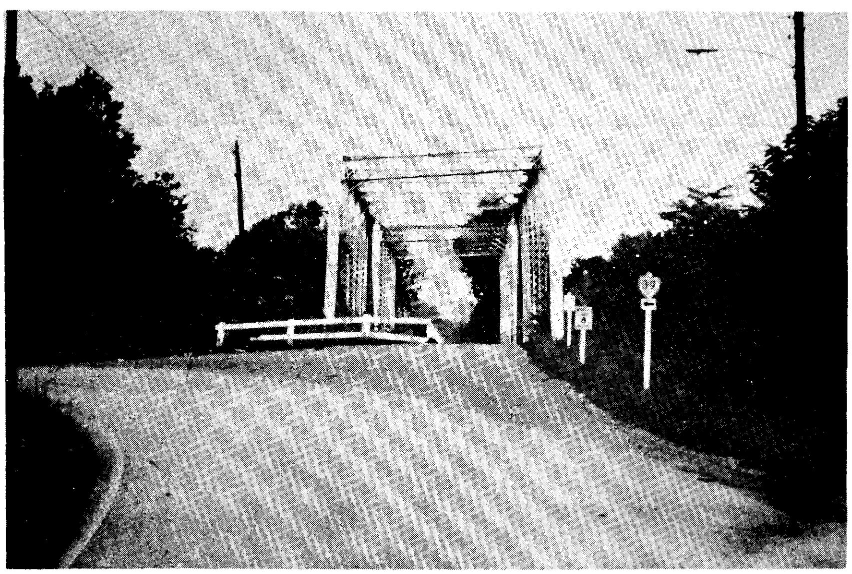

Figure 2. This two span through Pratt truss on Route 746 over the Calfpasture River in Rockbridge County was built in 1890 by the Groton Bridge Company for the Goshen Land and Improvement Company during the period when the Valley area was undergoing a boom and the developers of Goshen hoped their town might become the "Birmingham of Virginia". The bridge is built with a 30° skew on handsome stone masonry piers and features an ornate cresting sign listing the officers of the Goshen Company. Significance rating 24.0.

Figure 3. A single span through Pratt truss carrying Route 653 over the Southern Railroad in Nelson County. This bridge was built in 1882 by the Keystone Bridge Company, a pioneer in bridge technology. One of the oldest metal bridges in Virginia, its location is significant because it lies within Oak Ridge, the estate of Thomas Fortune Ryan, a Nelson County youth who ultimately became a multimillionaire traction magnate in New York City. The bridge was built by the same company and in the same year as one in Prince William County, shown in Figure 6. Significance rating 21.0.

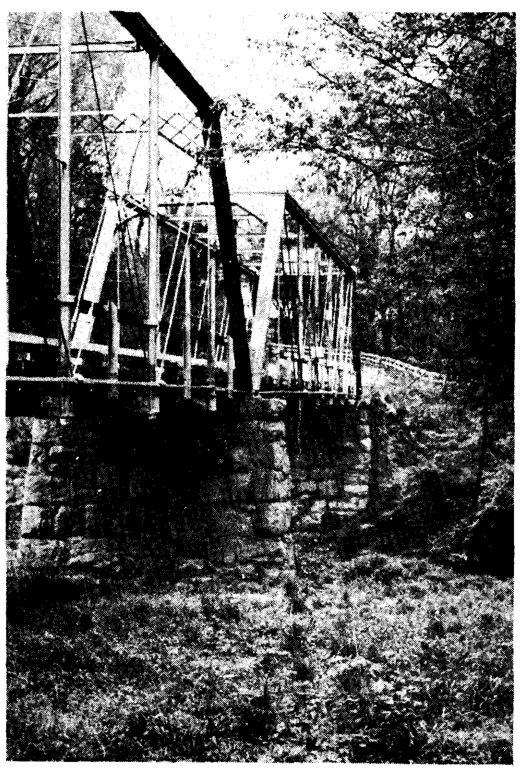

Figure 4. A two span through Pratt truss on Route 715 over the Meherrin River in Brunswick County. This bridge was erected in 1884 by the Wrought Iron Bridge Company and is the oldest multi-span metal truss in Virginia. It is on its original site and was erected to replace an older bridge known as Gholsen's Bridge. Significance Rating 21.0.

1566

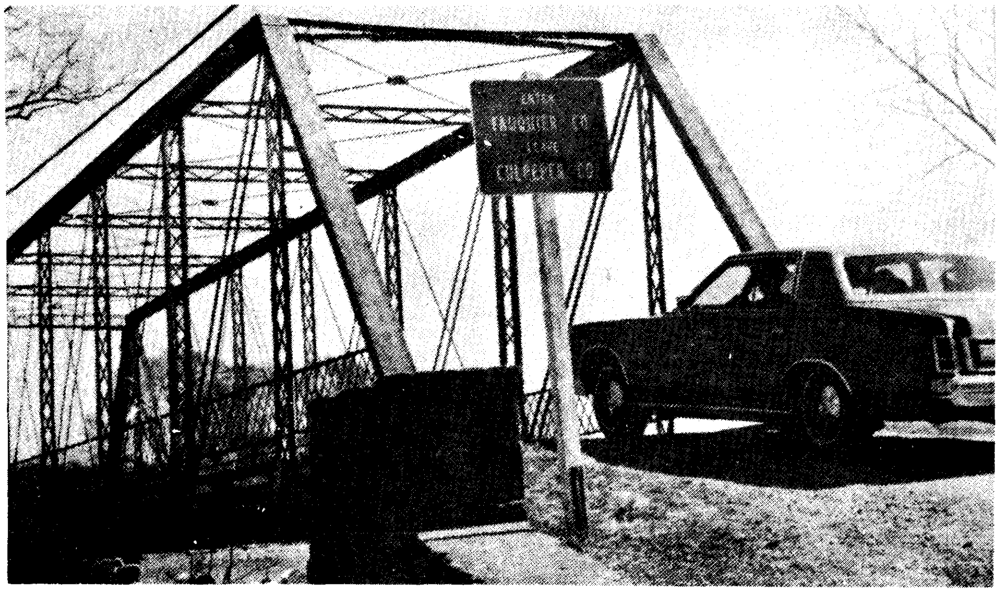

Figure 5. A single span through Pratt truss carrying Route 802 over the Rappahannock River between Culpeper and Fauquier Counties. Built in 1879 by the King Iron and Bridge Company, the span was the oldest surviving at its original site in Virginia at the time of its removal in 1976. Earlier wooden bridges had served the site which adjoins Fauquier Springs, a popular nineteenth century spa. One bridge at this site was burned during the Civil War and was reerected by General Stonewall Jackson's troops. Significance Rating 21.0.

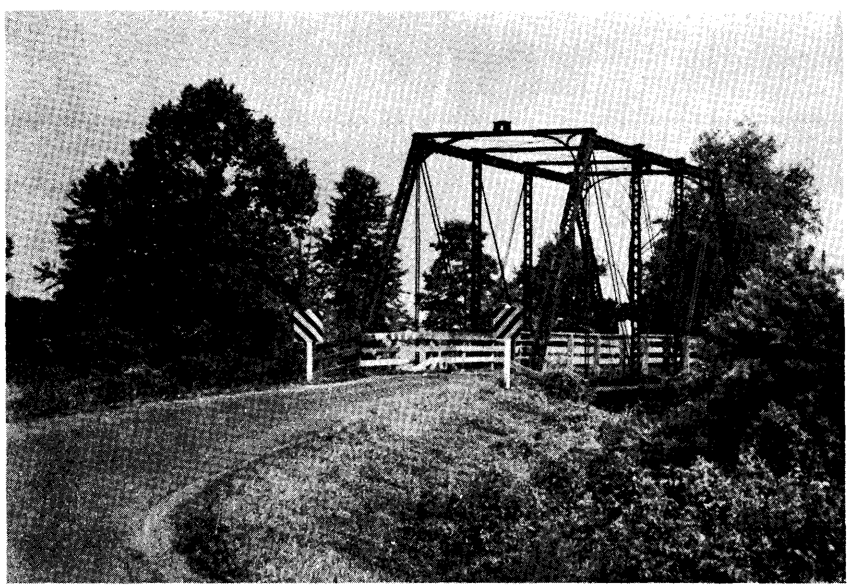

Figure 6. This single span through Pratt truss carries Route 646 over the Southern Railroad just north of Nokesville, a community in Prince William County. Like the bridge shown in Figure 3, it was built in 1882 by the Keystone Bridge Company. Significance Rating 21.0.

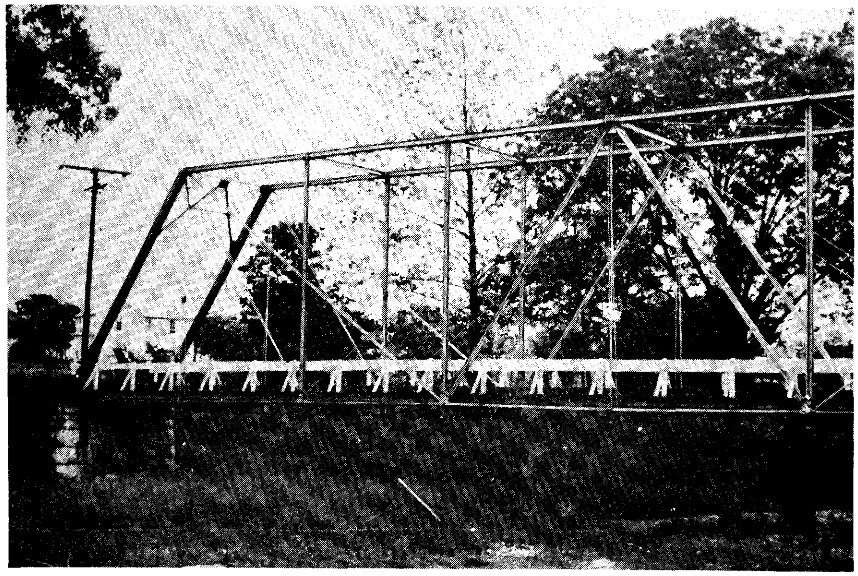

Figure 7. This single span through truss on Route 1421 over Daphna (Linville) Creek at Broadway in Rockingham County was built in 1898 by the Wrought Iron Bridge Company. It is of hybrid configuration, combining elements of the Stearns and Whipple types. Its span of 134 feet is significant for its age and the configuration is unique in Virginia. Significance Rating 21.0.

Figure 8. This two span bridge comprising one through Pratt truss and one triangular deck truss carries Route 685 over Craig Creek in Botetourt County. Built in 1887 by the Phoenix Bridge Company, it originally served as a railroad bridge. It contains the patented Phoenix columns and all of its original ornate portal plates and finials. The bridge was placed on the National Register of Historic Places in 1975. Significance Rating 20.0.

Figure 9. A two span through Camelback truss carrying Route 640 over the Staunton River at Mansion, near Altavista, in Campbell County. This bridge was built in 1903 by the Brackett Bridge Company. This impressive structure sits atop cylindrical piers — or lolly columns — in a picturesque setting at the foot of the hill on which stood the eighteenth century mansion of John Smith, prominent early settler of the area. Significance rating 21.0.

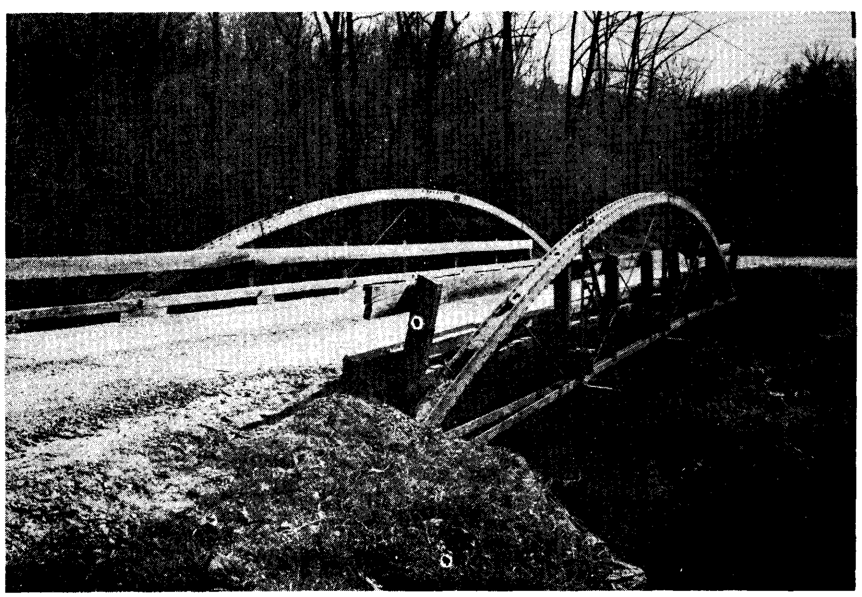

Figure 10. The bowstring arch truss on Route 637 over Roaring Run in Bedford County was built by the King Iron and Bridge Company in 1878. It was one of six similar bridges constructed under the same contract to replace wooden bridges lost during the destructive floods in November 1877. This bridge remains the oldest metal bridge in Virginia. The truss will be preserved as a pedestrian bridge in a rest area on Route I-81 in Montgomery County. Significance Rating 13.0.

Figure 11. Single span through Pratt truss on Route 673 over N. F. Catoctin Creek in Loudoun County, north of Waterford, built by the Variety Iron Works at an unknown date. It apparently was moved to its present site from Route 7, where it crossed Goose Creek, east of Leesburg. It is a relatively long span (157'), but the lack of date hinders conclusive evaluation. Placed on National Register of Historic Places in 1974. Significance Rating 12.5.

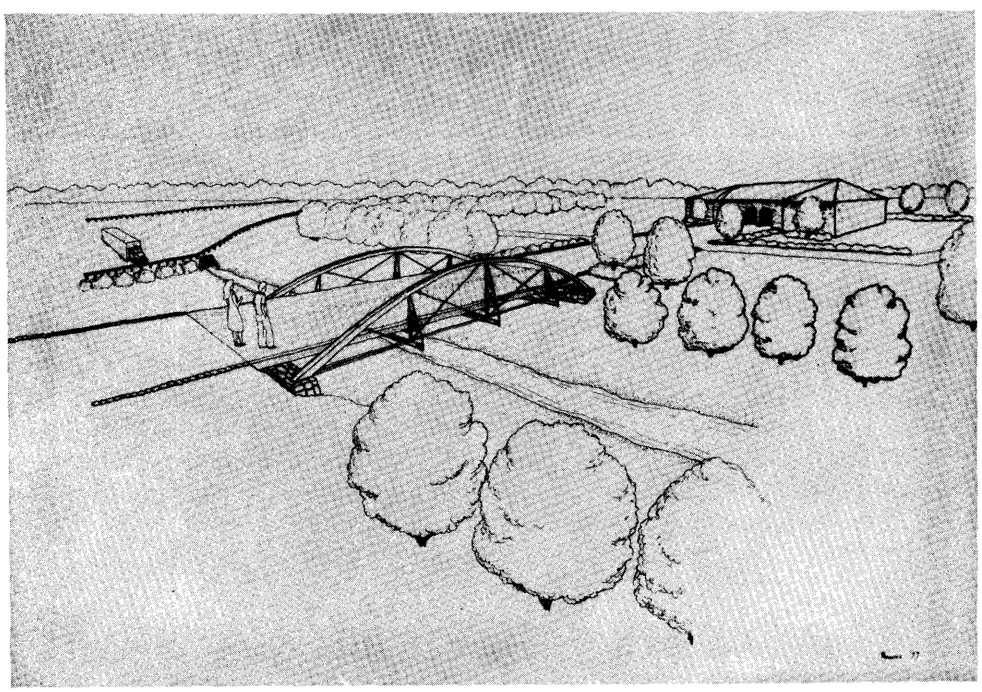

Figure 12. Artist's conception of the bowstring truss shown in Figure 10 as it will be incorporated into a rest area on Route I-81 in Montgomery County. (Sketch by Reid Reams.)

The structures include interesting features and unusual details such as Phoenix columns (Figure 8), ornate portal struts, plates and finials (Figure 8), attractive stone masonry, piers and abutments (Figures 1, 2, 4, 7 and 8), and lolly columns (Figure 9).

Finally, the structures are distributed over a wide geographic area with at least one representing each of the Department's eight construction districts except the easternmost (Suffolk) and the westernmost (Bristol). It should be noted that in each of these two districts there was one bridge with a significance rating of 19.0.

In addition to the nine bridges with a significance rating of 20.0 or above, there were 39 with a rating of 10.0 to 19.5. Bridges in this category, particularly those between 17.0 and 20.0, will be of particular interest because more detailed study should clarify some unknown factors. For example, the 3 span through Pratt truss at Castlewood (Tazewell County) was built in 1891 by the Chicago Bridge Company, a firm about which nothing is known. Simply learning more about the company will elevate the bridge to the highest significance category.

NEW YORK APPLICATION

The trial rating system has been applied by Chamberlin to a group of metal truss bridges surveyed in three New York counties.* The numbers comprising the New York and Virginia samples were 57 and 58, respectively. The samples differed in one important respect. The Virginia sample had been selected as "interesting" from a larger sample, while the New York sample underwent no preselection. The results are shown in Figure 13. The distribution between the two groups is as would be expected. The mean score for the Virginia sample is 14.5 as compared with 12.1 for the New York sample. There were about twice as many Virginia bridges in the highest grouping and one half as many in the lowest grouping as for the New York bridges, which reflects the effect of the preselection for the Virginia sample. Interestingly, no bridge in either sample scored higher than 24.0. The portions between 10.0 and 20.0 and between 15.0 and 20.0 are approximately the same. It is to this "second-look" category that attention must be directed in refining the rating system. The general agreement of results from the independent application of the rating system is encouraging.

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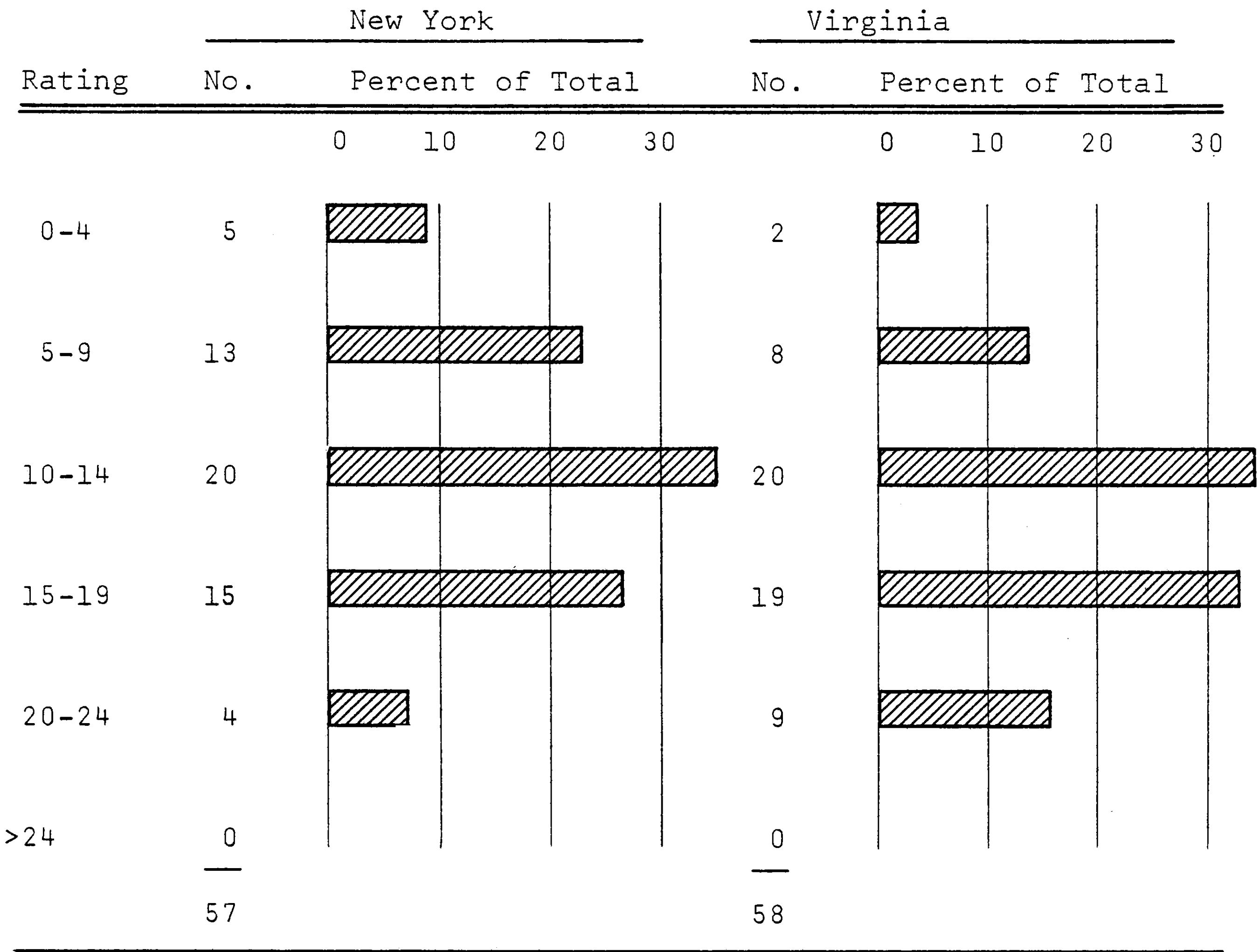
*William Chamberlin 1977: personal communication.



	New York	Virginia
Mean	12.1	14.5
% ≥ 20	7.0	15.5
% > 10, < 20	57.9	63.8

Figure 13. Distribution of Preservation Rating Scores for "Interesting" bridges in Virginia and "Ordinary" bridges in New York.

UNRESOLVED QUESTIONS

While the initial use of the trial rating system has provided a useful tool for identifying some historic truss bridges in Virginia, there remain some significant questions concerning its application that will need to be pursued as the project continues. Most of these questions were raised by Chamberlin during his application of the criteria, but they agree with questions that arose as the system was being developed.

The question of whether distinction should be made among bridges based on their primary level of significance — whether national, state, or local — and whether different criteria should be applied to each must be addressed. From a purely local perspective, a good case for preservation could be made for a bridge that complements the rural landscape or the nineteenth century character of a small community, whether or not it has high points under *documentation* and *significance*. Likewise, a case for preservation could be made for a structure of national significance regardless of its score in the *environmental* category. In both instances, scores of less than 20 would be highly probable. In this report the preservation has been considered primarily from the perspective of state significance, which justifies the relatively balanced weighting given to the three categories. Another way to express this is to note that national significance relates more to *what* a bridge is than to *where* it is, and local significance to the *where* rather than the *what*. State significance then might suggest a balanced weighting between the *what* factors (documentation and significance) and the *where* factors (environmental).

Should the criteria permit extra points for bridges built by a local company to reflect the importance of the company to the locality as opposed to the importance of its bridges? Should points be awarded to the remaining bridge of its type by a local company, or sole remaining bridge by a local company? These would probably be of value for purposes of state significance, and also *local* significance if the company was in (say) the same county. On the other hand, should points be given for a sole example of a bridge built by a prolific builder if the example is at considerable distance from his home state?

These and other questions will need additional attention as the project progresses, as will the development of criteria for non-truss structures.

CONCLUSIONS

The following conclusions from this study appear warranted.

1. While historic significance is in some measure subjective (no more so than the sufficiency rating), an objective numerical rating system provides a useful tool for identifying bridges of special significance and guiding decisions on preservation or adaptive use.

2. Information in three broad categories — documentation, technological significance, and environmental factors — provides necessary characteristics for establishing significance.

3. While developed from data on metal trusses in Virginia, the system is generally applicable to other types of bridges in other areas.

4. While few metal truss bridges of national significance survive in Virginia, there are several examples worthy of preservation and numerous examples reflecting the various technologies of nineteenth century bridge design and construction.

5. Virginia still possesses a sufficient diversity of truss types, materials, and geographical distribution to serve as a valuable resource for appreciation by lay persons and study by specialists.

RECOMMENDATIONS

It is recommended that the Virginia Department of Highways and Transportation, using the rating system described in this report, adopt the following policy:

> Nominate for the Virginia and National Register of Historic Places bridges that have a significance rating of 20.0 or greater, and give special consideration during project planning to any bridge with a significance rating greater than 10.0.

ACKNOWLEDGEMENTS

The rating system and the information on which it is based are largely the result of the interest and dedication of Dan G. Deibler, formerly a research analyst with the Council. His many contributions are gratefully acknowledged. Appreciation is also expressed to the members of the History Research Advisory Committee for their input and aid, particularly in refining and applying the initial rating system. Special acknowledgement is due Committee Chairman H. M. Shaver for his continuing efforts to implement the output of the Council's research within the Department's operating divisions.

The research is under the general guidance of Jack H. Dillard, without whose support of a new and somewhat different research effort this work would not have been possible.

Finally, the continued support and willingness of the Department's top level administrators to consider new approaches and to seek implementation of research findings is an essential and greatly appreciated feature of the Council's research program.

REFERENCES

Anon. "One in Six U. S. Highway Bridges is Deficient", Engineering News Record, March 10, 1977.

Deibler, Dan Grove, "Metal Truss Bridges in Virginia: 1865-1932: An Examination of the Development of the Truss Form along with an Annotated List of Nineteenth and early Twentieth Century Bridge Companies". VHTRC 75-R51, Virginia Highway and Transportation Research Council (May 1975).

__________________, "Metal Truss Bridges in Virginia: 1865-1932: The Staunton Construction District", VHTRC 75-R53, Virginia Highway and Transportation Research Council (May 1975).

_________: The Culpeper Construction District", VHTRC 76-R11, (December 1975).

_________: The Fredericksburg Construction District", VHTRC 76-R53, (May 1976).

_________: The Richmond Construction District", VHTRC 76-R63, (June 1976).

DeLong, Eric, "Bridge Replacement", 11593, National Park Service, (October 1977).

"Emergency Bridge Replacement Act", Title 23, Section 144, U. S. Code, 1971.

Federal Highway Administration, "Recording and Coding Guide for the Structural Inventory and Appraisal of the Nation's Bridges," U. S. Department of Transportation (July 1972).

Fowler, John M., "Federal Historic Preservation Law: National Historic Preservation Act, Executive Order 11593, and other Recent Developments in Federal Law", Wake Forest Law Review, Winston Salem, North Carolina, Spring 1976.

Greenburg, Ronald M., Editor, The National Register of Historic Places, U. S. Department of the Interior, Washington (1976).

Newlon, Howard, Jr., and Dan G. Deibler, "Criteria for the Preservation and Adaptive Use of Historic Highway Structures", VHTRC 76-WP30, Virginia Highway and Transportation Research Council (March 1976).

Sackheim, Donald E., "Historic American Engineering Record Catalog," U. S. Department of the Interior, Washington (1976).

Waddell, James A. L., The Designing of Ordinary Iron Highway Bridges, John Wiley & Sons, Inc., New York (1891).

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APPENDIX A

RESULTS OF INITIAL APPLICATION OF RATING SYSTEM

BRIDGE			DOCUMENTATION		SIGNIFICANCE									ENVIRONMENT			TOTAL
					Technology						Config-uration						
No.	County	Route	Company/Builder	Date	PAT	SPN	LTH	MTL	INT	UD	UQ	UL	NL	Aesthetics	History	Integrity	
				BRISTOL DISTRICT													
1034	Bland Wolf Creek	61	Phoenix 3	Ca.1890 1.5	1	0	1	1	1	0	0	2	0	0	3	4	17.5
1035	Bland Wolf Creek	61	Phoenix 3	Ca.1890 1.5	1	0	1	1	1	0	0	2	0	0	3	4	17.5
6102	Grayson Big Wilson Creek	767	Penn.Bridge Co. 1	Ca.1910 1	0	0	0	0	1	0	0	0	0	0	0	0	3.0
6014	Lee Wallen Creek	616	Unknown 0	Ca.1895 1.5	0	0	0	0	1	0	3	0	0	4	3	4	16.5
6498	Lee Powell	833	Unknown 0	Ca.1920 0.5	0	0	1	0	0	0	3	0	0	4	0	0	8.5
6025	Russell Clinch	615	Chicago Iron & Br. 1	1891 3	0	1	1	0	1	1	0	0	0	4	3	4	19.0
6096	Russell Clinch	652	Groton 3	1889 3	0	1	0	0	1	1	0	0	0	4	0	0	13.0
6197	Scott NF Clinch	638	Unknown 0	1925 1	0	0	0	1	1	0	0	0	1	4	0	4	12.0
	Smyth Chilhowee St. MF Holsten		King Iron & Bridge 3	1885 4	0	0	0	1	0	1	0	0	0	0	3	0	12.0
6016	Wythe Cripple Creek	619	Phoenix 3	Ca.1890 1.5	1	0	0	1	1	1	0	2	0	0	3	4	17.5
6027	Wythe Reed Creek	640	Pittsburgh Bridge 1	1881 4	0	0	0	1	0	1	0	0	0	4	3	0	14.0

APPENDIX A (CONT.)

BRIDGE			DOCUMENTATION		SIGNIFICANCE									ENVIRONMENT			TOTAL
					Technology						Configuration						
No.	County	Route	Company/Builder	Date	PAT	SPN	LTH	MTL	INT	UD	UQ	UL	NL	Aesthetics	History	Integrity	
				SALEM DISTRICT													
Abandoned	Bedford Roaring Run	637	King Iron & Bridge 3	1878 4	1	0	0	1	1	0	3	0	0	0	0	0	13.0
6087	Bedford Elk Creek	666	Camden Iron Works 1	1915 2	0	0	0	0	1	0	0	2	0	4	3	4	17.0
6144	Bedford Goose Creek	747	Unknown 0	Ca.1910 1	0	0	0	0	0	0	3	0	0	0	3	0	7.0
1021	Botetourt James	220	Va.Dept.of Hwys. 2	1931 1	0	1	0	0	1	0	0	2	0	0	0	4	11.0
6077	Botetourt James	630	Rich. & Alleg.RR 1	1884 4	0	1	1	1	1	1	3	0	0	4	3	4	24.0
6386	Botetourt Craig Creek	685	Phoenix 3	1887 3	1	0	1	1	1	1	0	2	0	0	3	4	20.0
1709	Giles Walker Creek (aband.)	(old 696)	Unknown 0	Ca.1900 1	0	0	1	0	1	1	0	2	0	4	0	4	14.0
6057	Giles Norfolk & Western RR	730	Unknown 0	Ca.1915 1	0	1	1	0	1	0	0	2	0	4	3	0	13.0
6129	Henry Smith	622	Unknown 0	1887 3	0	0	1	1	0	1	0	2	0	0	0	0	8.0
6907	Montgomery Little	613	Champion Bridge 2	1916/17 2	0	1	0	0	1	0	0	0	0	4	3	4	17.0
6045	Montgomery NF Roanoke	821	King Iron Bridge 3	1892 3	0	0	0	0	1	1	0	0	0	4	0	0	12.0
1816	Roanoke(City) Roanoke	116	American Ir.& Br. 1	1890 3	0	1	0	0	0	1	0	2	0	0	3	4	15.0

APPENDIX A (CONT.)

BRIDGE			DOCUMENTATION		SIGNIFICANCE									ENVIRONMENT			TOTAL
					Technology						Configuration						
No.	County	Route	Company/Builder	Date	PAT	SPN	LTH	MTL	INT	UD	UQ	UL	NL	Aesthetics	History	Integrity	
				LYNCHBURG DISTRICT													
6051	Amherst	657	Southern Railroad 1	Ca.1890 1.5	0	0	1	0	1	0	3			0	3	4	14.0
6904	Campbell Staunton	640	Brackett Br.Co. 2	Ca.1903 2	0	1	1	0	1	1	0	2	0	4	3	4	21.0
6006	Nelson Rockfish	613	Pittsburgh Br. 1	Ca.1895 1.5	0	0	0	0	1	1	0	0	0	4	0	0	8.5
6052	Nelson Southern R.R.	653	Keystone Br.Co. 3	1882 4	0	0	0	1	1	1	0	0	0	4	3	4	21.0
				RICHMOND DISTRICT													
6104	Brunswick Meherrin	715	Wrought Iron Br. 2	1884 4	0	1	0	1	1	1	0	0	0	4	3	4	21.0
6061	Mecklenburg Allen's Crossing	677	York Bridge 1	1913 2	0	0	0	0	1	0	0	0	0	0	0	0	4.0
6009	King William Dam Spillway	610	Roanoke Iron & Br. 2	1910 2	0	0	0	0	1	0	0	0	0	4	0	0	9.0
				SUFFOLK DISTRICT													
			Unknown 0	Ca.1905 1	0	1	1	0	1	0	3	0	0	4	3	4	19.0
				FREDERICKSBURG DISTRICT													
6906	King William Pamunkey	615	Virginia Br.& Ir. 1	1919 1	0	0	0	0	1	0	0	0	0	0	3	4	10.0
1004	Westmoreland Nomini Creek	202	Roanoke Ir. & Br. 2	1927 1	0	0	0	0	1	1	3	0	0	4	0	4	16.0

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APPENDIX A (CONT.)

BRIDGE			DOCUMENTATION		SIGNIFICANCE									ENVIRONMENT			TOTAL
					Technology						Configuration						
No.	County	Route	Company/Builder	Date	PAT	SPN	LTH	MTL	INT	UD	UQ	UL	NL	Aesthetics	History	Integrity	
				CULPEPER DISTRICT													
6068	Albemarle Mechum	678	Roanoke Ir & Br. 2	1924 1	0	0	0	0	1	0	0	0	0	4	0	0	8.0
6908	Culpeper/ Fauquier Rappahannock	620	Horseheads Bridge 1	1898 3	0	1	1	0	0	0	0	2	0	4	3	4	19.0
6911	Culpeper/ Fauquier Rappahannock	802	King Iron Bridge 3	1879 4	0	0	1	1	1	0	0	0	0	4	3	4	21.0
6903	Fauquier/ Rappahannock Rappahannock	645	Columbia Br.Works 1	1882 4	0	1	1	1	0	1	0	0	0	0	0	0	9.0
6051	Loudoun Catoctin Creek	673	Variety Iron Works 1	Ca.1890 1.5	0	0	1	1	1	0	0	0	0	4	3	0	12.5
6062	Loudoun Catoctin Creek	812	W.Va.Bridge Works 1	189? 3	0	0	0	0	1	0	0	0	0	4	3	4	16.0
6047	Prince Wm. Cedar Run	611	Walker Bros. 1	1900 2	0	0	0	0	1	1	0	0	0	4	0	4	13.0
6023	Prince Wm. Southern Railroad	646	Keystone Bridge 3	1882 4	0	0	0	1	1	1	0	0	0	4	3	4	21.0

APPENDIX A (CONT.)

BRIDGE			DOCUMENTATION		SIGNIFICANCE									ENVIRONMENT			TOTAL
					Technology						Configuration						
No.	County	Route	Company/Builder	Date	PAT	SPN	LTH	MTL	INT	UD	UQ	UL	NL	Aesthetics	History	Integrity	
				STAUNTON DISTRICT													
C & O. RR	Allegheny Hawthorne St.		Phoenix Bridge 3	Ca.1890 1.5	1	0	0	1	1	0	0	0	0	4	3	4	18.5
6064	Allegheny Cowpasture	633	Nelson & Buchanan 1	1896 3	0	1	0	0	1	1	0	0	0	4	3	4	18.0
6049	Augusta South Bridge	632	Pittsburgh Bridge 1	1.5	0	1	0	1	1	1	0	0	0	4	0	0	10.5
6088	Augusta Calfpasture	687	Champion Bridge 2	1907 2	0	0	0	0	1	1	0	0	0	4	0	4	14.0
6110	Augusta Buffalo Bridge	720	Champion Bridge 2	Ca.1905 1	0	0	0	0	1	1	0	2	0	0	0	4	11.0
6160	Augusta Christian's Cr.	795	Groton Bridge 3	1896 3	0	0	0	0	1	1	0	0	0	4	0	0	12.0
6043	Highland Crab Run	645	W.Va.Bridge Wks. 1	Ca.1896 1.5	1	0	0	1	1	0	3	0	0	4	3	4	19.5
6075	Rockbridge Maury	631	Roanoke Bridge 2	1912 2	0	0	1	0	1	0	0	2	0	4	3	0	15.0
6160 (Dist.#)	Rockbridge Broad Creek	683	Variety Iron Wks. 1	Ca.1890 1.5	0	0	0	0	1	0	0	2	0	0	0	0	5.5
6145	Rockbridge Calfpasture	746	Groton 3	1890 3	0	1	1	0	1	1	3	0	0	4	3	4	24.0
6052	Rockingham Shenandoah	659 or 708	Unknown 0	1903 2	0	1	1	0	1	1	0	2	0	4	3	4	19.0

APPENDIX A (CONT.)

BRIDGE			DOCUMENTATION		SIGNIFICANCE									ENVIRONMENT			TOTAL
					Technology						Config-uration						
No.	County	Route	Company/Builder	Date	PAT	SPN	LTH	MTL	INT	UD	UQ	UL	NL	Aesthetics	History	Integrity	
			STAUNTON DISTRICT (Continued)														
6054	Rockingham Mill Creek	671	Wrought Iron Br.Co. 2	1898 3	0	0	0	0	1	1	0	2	0	4	0	0	13.0
6251	Rockingham North	727	Unknown 2	1916 2	0	0	0	0	0	0	0	0	0	4	3	0	11.0
6095	Rockingham Spring Creek	748	Champion Bridge 2	Ca.1920 0.5	0	0	0	0	1	1	0	0	0	4	3	4	15.5
6154	Rockingham Daphna Creek	1421	Wrought Iron Br.Co. 2	1898 3	0	0	1	0	1	0	3	0	0	4	3	4	21.0
6050	Shenandoah	675	Unknown 0	Ca.1915 1	0	1	1	0	1	0	0	2	0	4	0	0	10.0
6097	Shenandoah NF Shenandoah	758	Wrought Iron Br.Co. 2	1898 3	0	1	1	0	1	1	0	0	0	4	0	4	17.0

APPENDIX B

VIRGINIA'S POTENTIALLY HISTORIC METAL TRUSS BRIDGES

Rating	District	County	Route	Crossing	Bridge No.
24.0	Salem	Botetourt	630	James River	6077
24.0	Staunton	Rockbridge	746	Calfpasture River	6145
21.0	Lynchburg	Nelson	653	Southern RR	6052
21.0	Richmond	Brunswick	715	Meherrin River	6104
21.0	Culpeper	Culpeper/Fauquier	802	Rappahannock	6911
21.0	Culpeper	Prince William	646	South RR	6023
21.0	Staunton	Rockingham	1421	Daphna Creek	6154
21.0	Lynchburg	Campbell	640	Staunton River	6904
20.0	Salem	Botetourt	685	Craig Creek	6386
19.5	Staunton	Highland	645	Crab Run	6043
19.0	Bristol	Russell	615	Clinch River	6025
19.0	Suffolk	Portsmouth		W. Norfolk River	
19.0	Culpeper	Culpeper/Fauquier	620	Rappahannock River (Kelly's Ford)	6908
19.0	Staunton	Rockingham	659 or 708	Shenandoah River	6052
18.5	Staunton	Allegheny	Hawthorne Street	C & O RR	
18.0	Staunton	Allegheny	633	Cowpasture River	6064
17.5	Bristol	Bland	61	Wolf Creek	1034
17.5	Bristol	Bland	61	Wolf Creek	1035
17.5	Bristol	Wythe	619	Cripple Creek	6016
17.0	Salem	Bedford	666	Elk Creek	6087
17.0	Salem	Montgomery	613	Little River	6907
17.0	Staunton	Shenandoah	758	N.F. Shenandoah River	6097
16.5	Bristol	Lee	616	Wallen Creek	6014
16.0	Fredericksburg	Westmoreland	202	Nomini Creek	1004

APPENDIX B (CONT.)

Rating	District	County	Route	Crossing	Bridge No.
16.0	Culpeper	Loudoun	812	Catoctin Creek	6062
15.5	Staunton	Rockingham	748	Spring Creek	6095
15.0	Salem	Roanoke (City)	116	Roanoke River	1816
15.0	Staunton	Rockbridge	631	Maury River	6075 (JHC Mann Bridge)
14.0	Bristol	Wythe	640	Reed Creek	6027
14.0	Salem	Giles	(696old)	Walker Creek (abandoned)	1709
14.0	Lynchburg	Amherst	657		6051
14.0	Staunton	Augusta	687	Calfpasture River	6088
13.0	Bristol	Russell	652	Clinch River	6096
13.0	Salem	Bedford	637	Roaring Run	abandoned
13.0	Salem	Giles	730	Norfolk & Western RR	6057
13.0	Culpeper	Prince William	611	Cedar Run	6047
13.0	Staunton	Rockingham	671	Mill Creek	6054
12.5	Culpeper	Loudoun	673	Catoctin Creek	6051
12.0	Bristol	Scott	638	NF Clinch River	6197
12.0	Bristol	Smyth (Marion)	Chilhowee Street	MF Holsten River	
12.0	Salem	Montgomery	821	NF Roanoke River	6045
12.0	Staunton	Augusta	795	Christian's Creek	6160
11.0	Salem	Botetourt	220	James River	1021
11.0	Staunton	Augusta	720	Buffalo Bridge	6110
11.0	Staunton	Rockingham	727	North River	6251
10.5	Staunton	Augusta	632	South Bridge	6049
10.0	Fredericksburg	King William (Hanover)	615	Pamunkey River	6906
10.0	Staunton	Shenandoah	675	NF Shenandoah	6050
9.0	Richmond	King William	610	Dam Spillway	6009
9.0	Culpeper	Fauquier/Rappahannock	645	Rappahannock	6903
8.5	Bristol	Lee	833	Powell River	6498
8.5	Lynchburg	Nelson	613	Rockfish River	6006
8.0	Salem	Henry	622	Smith River	6129
8.0	Culpeper	Albemarle	678	Mechum River	6068
7.0	Salem	Bedford	747	Goose Creek	6144
5.5	Staunton	Rockbridge	683	Broad Creek	6160 (District No.)
4.0	Richmond	Mecklenburg	677	Allen's Creek	6061
3.0	Bristol	Grayson	767	Big Wilson Creek	6102