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EVALUATION AND REHABILITATION OF HISTORIC METAL TRUSS BRIDGES: PRESERVATION ISSUES

by

Matthew Haberling and Daniel Leary

Research Report 0-1741-4

Research Project 0-1741

PRESERVATION ALTERNATIVES
FOR HISTORIC TRUSS BRIDGES

conducted for the

Texas Department of Transportation

in cooperation with the

U.S. Department of Transportation
Federal Highway Administration

by the

CENTER FOR TRANSPORTATION RESEARCH
BUREAU OF ENGINEERING RESEARCH
THE UNIVERSITY OF TEXAS AT AUSTIN

June 2004

Research performed in cooperation with the Texas Department of Transportation and the U.S. Department of Transportation, Federal Highway Administration.

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DISCLAIMER

M. D. Engelhardt, P.E., TX # 88934

Research Supervisor

TABLE OF CONTENTS

SUMMARY

This report documents the results of a survey of preservation issues for the evaluation and rehabilitation of historic metal truss bridges. The survey included twenty Departments of Transportation from states other than Texas and was conducted by telephone interviews and/or the exchanging of information by fax. The survey may contribute to the development of a manual for Texas Department of Transportation engineers considering rehabilitation options for metal truss bridges. This information may assist in identifying preservation methods that will likely be accepted by the State Historic Preservation Officer.

Chapter 1
INTRODUCTION

Texas has a rich legacy of historic metal truss bridges, many of which are important to, and serve as landmarks in their communities. One of the principal reasons for the development of this manual is to demonstrate that there are ways to rehabilitate a historically significant metal truss bridge to accommodate modern day safety and service requirements while preserving the features of the bridge which give it its historic character. While the ideas presented in this manual may not be appropriate for every historic bridge structure, this manual is intended to provoke thought and consideration to implementing innovative engineering techniques to preserve those historic truss bridges which are the best candidates for rehabilitation and continued use.

A bridge rehabilitation solution must not only take into account structural and geometric deficiencies, but in the case of structures deemed historically significant, it must also consider issues associated with maintaining the historic integrity of the bridge. In some cases, the preservation of a bridge's historic integrity takes precedence, which may affect the outcome of the project. As a result, it is imperative to focus on typical preservation issues specific to bridge rehabilitation. Preservation issues are very complex and can be dealt with on a number of intervention levels. The ideal solution is one that least disturbs the historic fabric, the visual character, the intended function, the distribution of loads within the structural members, and the original location of the bridge. Because an ideal solution is seldom completely feasible, the agency responsible for the bridge and the State Historic Preservation Officer (SHPO) must often reach a compromise balancing safety requirements and preservation of historic fabric.

Chapter 2:
WHY PRESERVE BRIDGES

Within the architectural realm, bridges have the unique characteristic of being almost exclusively formally dependent upon their function. This is especially true of truss bridges, which are the product of a combination of advanced engineering methods and a highly organized labor force. The production method of truss bridges is the result of advances made throughout all the sectors of industry during the Industrial Revolution. This includes development of new materials: cast iron, wrought iron, steel; methods of production of structural elements; modes of transportation of bridge elements throughout the country by wagon, boat, railroad, and truck; and finally methods of assembly: pin connected, riveted, shop welded, and field welded. Due to the evolutionary and complex cooperative nature, every old ferrous skeleton is saturated with clues from the past.

First and foremost, a truss is an aesthetic form based purely on functional criteria. Trusses have a clear and defined path of development. By knowing when certain truss types were developed and the date of construction of a bridge, it is possible to determine how quickly a particular geography region acquired the new technology. The same can be said for the use of new materials, the most notable being the switch from wrought iron to steel. A related historic issue may stem from the fact that certain communities simply did not have a need for a new type of truss, since the main purposes behind developing new trusses were to increase the span and improve load carrying capacities. That in itself is a snapshot frozen in time illustrative the level of development of that community at that time.

Truss bridges are invaluable time capsules encompassing historic information about the communities they inhabit. Bridges are and always were expensive and intrusive undertakings involving a great deal of planning and coordination among communities, often from different states. For instance the Pennsylvania truss bridge in Waco was made with steel manufactured in Tennessee, and the builder came down from Missouri. As a result of the magnitude of the undertaking, historically, bridges were the product of the individual community's wealth, the importance placed on the crossing, and the mode of transportation prevalent at the time in that region. This makes them vital indicators of the historic makeup of the community at the time of construction. An intriguing historic timeline showing the growth of a community can be drawn simply by chronologically studying the bridges, specifically their location, indicating direction of growth; their construction method, indicating the technological advances available in the region and the patterns of traffic; the features being crossed, whether it's a body of water, a railroad, or another roadway, indicates the expansion of traffic and therefore growth within a community; and the dates of construction, which are usually indicators of economic growth.

It is possible to continue almost infinitely listing the valuable information bridges can provide contemporary researchers and historians. All this means that positive action must be undertaken immediately, before any more bridges degenerate and begin to resemble modern steel sculptures rather than magnificent trusses of the late Industrial Revolution. However, in order to have this living archive preserved for future

generations it is of extreme importance that proper conservation techniques be employed. This includes the development of a statewide preservation plan with a continued education program for professionals directly involved with historic bridges. Also, the development of a cooperative effort between all state agencies involved with historic bridges, and a method of sharing information not only between the agencies but also with the public. The following document is the result of gathered information from a survey of twenty states, results of which are listed in Appendix A. This document is not a preservation plan, because it is impossible to write a plan without field testing the ideas prior to their implementation; but rather this is a proposal for setting up an infrastructure that will lead to the development of a successful statewide preservation plan.

Chapter 3:
METAL TRUSS BRIDGE PRESERVATION ISSUES

When investigating any historic property there are always certain issues that are unique to the type of structure. Historic truss bridges are no exception. Below is a list of items a researcher should keep in mind when looking at a truss bridge. These lists are in part from *Analysis and Preservation of Historic Bridges*, prepared by the American Society of Civil Engineers and presented by Joseph J. Pullaro and Mary E. McCahon from A. G. Lichtenstein & Associates, Inc.

3.1 SIGNIFICANT ELEMENTS

- Rareness of a truss type and design. This includes: number of a particular truss type remaining in the country, state or county; the number of a truss type originally constructed; and significant achievements such as longest clear span at the time of its construction.
- Early examples of truss types are a record of the evolution of a significant technology. New truss types were continually developed to span ever-increasing distances. A record of the successful, as well as, if possible, less successful truss types and their development should be preserved.
- Unusual, non-standard details or field connections such as pins, rivets, bolts, or welds can provide significant clues into the history of a bridge and surrounding community.

3.2 PRESERVATION CONCERNS

- Retain the history of technology, even if non-transportation use is implemented (adaptive reuse).
- Unique, non-standard details should be considered significant and should be preserved.
- Field connection type is one of the defining characteristics of a truss bridge.
- Relationship of bridge to the setting or context: This can be a character-defining feature and should be documented if it cannot be preserved.
- A maintenance and inspection program should be established and diligently followed to keep the historic fabric in good condition.
- Usually it is better to keep a historic property in service either for vehicular or pedestrian use, rather than shutting it down for display purposes.

Chapter 4:
SURVEY

The first step in developing an effective and useful manual for TxDOT engineers considering rehabilitation options for historic metal truss bridges is to identify the preservation techniques that will likely be accepted by the SHPO. Evaluation of preservation techniques and the formulation of guidelines begins with information gathering (i.e., determining what has been done successfully or unsuccessfully) in other states to identify the most effective methods of historic bridge rehabilitation and preservation. Since there is very little literature available on this subject, a telephone/fax survey of the Departments of Transportation of twenty other states was conducted. The following subsections explain the methodology and summarize the results of the survey. The complete results are located in Appendix A.

4.1 METHODOLOGY

I. Questions were prepared for the survey.

1. Do you have a historic bridge preservation process?
   - What is the goal of the preservation process?
   - Do you have a set of criteria developed to determine the preservation strategy for the individual bridges?
   - Does this plan emphasize continued vehicular use?
   - How do you involve the local public with the preservation or replacement efforts?
2. From a preservation standpoint, how do you deal with alterations that must be made to the bridge (e.g., railings, geometric deficiency, structural upgrading)?
   - What kind of allowances are made in the case of historic bridges?
   - Are the alterations generally sensitive to the historic fabric?
3. How do you conduct structural inspections of historic bridges?
   - Who conducts the inspections?
   - Are the inspection methods the same for all bridges?
   - Do you load test the historic bridges to obtain a more accurate rating?
4. How do you oversee the maintenance of historic bridges?
   - Who is in charge of overseeing the maintenance?
5. What other preservation techniques have you used in the past?

II. A sampling pool of twenty state Departments of Transportation (DOTs) was compiled for polling their experiences with historic bridge rehabilitation and preservation (see Table 2.1). The twenty states were chosen on the basis of the following varying factors: to obtain a diversity of geographic locations, the number

of historic bridges in each state, population density, a diversity of wealth, and various stages of preservation plan development.

Table 2.1

	State	Contact's Name	Office	Response
1	Arkansas	Burney McClurkan	Environmental Affairs	Mail
		George McCluskey	SHPO	Telephone
2	California	John Snyder	Environmental Affairs	Telephone
3	Georgia	Gail D'Avino	Environmental Affairs	Telephone
4	Illinois	Jerry Jacobson	Environmental Affairs	Fax
		Anne Haaker	SHPO	Telephone
5	Indiana	Jim Jurisic	Environmental Affairs	None
6	Louisiana	Michele Deshotels	Environmental Affairs	Telephone
7	Maryland	Laura Hollenczer	Environmental Affairs	None
8	Massachusetts	Steven Roper	Environmental Affairs	None
9	Michigan	Margaret Barondess	Environmental Affairs	None
10	New Jersey	Miriam Crum	Environmental Affairs	Telephone
		Anil Mehta	Engineering	Telephone
11	New Mexico	Steven Koczan	Environmental Affairs	Fax
		Mary Ann Andrews	SHPO	Telephone
12	New York	Karen McCann	Environmental Affairs	Fax
13	North Carolina	Barbara Church	Environmental Affairs	Telephone
14	Ohio	Colleen Butterworth	Environmental Affairs	None
15	Oklahoma	John Hartley	Environmental Affairs	Telephone
		Marshall Gettys	SHPO	Telephone
16	Pennsylvania	Susan Peters	Environmental Affairs	Telephone
17	Rhode Island	Mike Hebert	Environmental Affairs	Mail
18	Vermont	Robert McCullough	Environmental Affairs	Mail
19	Virginia	Tony Opperoman	Environmental Affairs	Telephone
		Ann Miller	H.S.T.G.*	Telephone
20	Wisconsin	Bob Newbery	Environmental Affairs	None

*Historic Structures Task Group

III. The appropriate individuals from the Environmental Affairs Departments were contacted by telephone so that the project could be properly introduced.

IV. The questions were then faxed to those individuals so that they could prepare their responses.

V. After allowing some time for preparation, the responses were either faxed back or a telephone interview was conducted. In several cases, a copy of the state preservation plan was provided.

VI. The responses were compiled and are presented in the following sections.

4.2 SURVEY RESULT SUMMARY

State Preservation Plan: The development of a state historic bridge preservation plan is an integral step in considering rehabilitation options for historic metal truss bridges. Section 110 of the National Historic Preservation Act of 1966 (16 USC 470) requires that federal agencies assume responsibility for the preservation of historic properties owned or controlled by the agency, and establish a preservation program for the identification, evaluation, protection, and nomination to the National Register of Historic Places of historic properties within its jurisdiction. The Federal Highway Administration has delegated all cultural resource management issues regarding federally funded projects in Texas to TxDOT, including the establishment of a preservation plan for highway bridges. TxDOT has completed a statewide inventory of metal truss bridges, and in consultation with the Texas Historical Commission, has evaluated the historical and architectural significance of each, identifying bridges which have sufficient significance as eligible for inclusion in, or listed in the National Register of Historic Places.

By developing a plan, a state DOT acknowledges that it has bridges which could be considered historic, and that those bridges may be worthy of preservation. While all the states that responded to the survey are aware of the importance of a bridge preservation plan, most of them are still in the initial stages of the developmental process, i.e. conducting their state historic bridge inventories to identify all potentially historic bridge structures. Of the fourteen states that responded, three (Arkansas, Rhode Island, and Vermont) have clearly defined programs, and three (Illinois, Virginia, and Pennsylvania) are either at intermediate or advances stages of preservation plan development. Besides the six states mentioned above only North Carolina and Oklahoma clearly stated that they have completed their historic bridge inventories.

When developing their preservation plans or programs, other states have defined goals, and in some cases, lists of criteria, that help guide the general philosophies of their plans. Several states have developed their own specific ways of dealing with their historic resources. The differences in approach are the result of the following factors:

1. The number of historic bridges in the state determines if the preservation of bridges can be handled on a case-by-case basis, or if it is more feasible to develop a general plan. Most of the states interviewed are dealing with bridges on an individual basis because it is not feasible for them to develop a general plan for the number of bridges they own. Some states like Louisiana, Georgia, and New York do not have plans developed yet, as a result it is easier to deal with specific bridge problems on an individual basis. Texas, due to its large number of historic truss bridges, is currently developing an all-encompassing preservation plan for those bridges.

2. Population density is a major factor that determines how much state tax money can be made available for bridgework. It also gives an estimate of the loading demand placed on the structure, which helps to determine if it is feasible to leave the bridge open to traffic. Density also influences the possibility of building a companion bridge to take some of the load off the historic structure. For instance, in Rhode Island there is very little room to bypass historic bridges, as a result the bridges must either be strengthened to handle the increased load requirements, or they must be replaced with new structures. In Texas there is usually little problem with finding room to build companion bridges. However, there are situations such as in Llano, where a truss bridge is an integral part of a National Register listed historic district. Therefore, it is impossible to build any other bridges within close proximity without either moving or demolishing historically significant buildings. As can be seen, population density is a very important factor in small states like Rhode Island, as well as in vast states like Texas, where communities tend to be concentrated in small regions.

3. The importance of the bridges to tourism is another factor that helps pay for the restoration or maintenance of historic bridges. A clear example of this is in Vermont, where historic bridges are a big part of that state's scenic historic character. Many tourists visit Vermont to get a glimpse of American history. As a result, it is worthwhile for the State of Vermont to invest a lot of money and effort to maintain its historic bridges.
4. Climate is another major factor that influences the condition of historic bridges, and as a result, determines the amount of money that must be spent to preserve them. Obviously, truss bridges in warm and dry climates will need less maintenance than those in the northern states where salt is applied on the roads every winter. Of the states that have lower maintenance costs a larger number of historic bridges may be saved, partly because they have more money to spend on more bridges and partly because those bridges tend to be in better condition.
5. Geographic location and topography is loosely tied into the climactic factor, but topography also limits the possibilities of a bypass or, in some cases, new construction. In Regency, Texas, a suspension bridge was saved because it was much cheaper to rehabilitate that bridge rather than build a new one. In this case the bridge's high placement above a wide river worked in favor of its preservation.
6. Finally the percentage of bridges owned by the state versus bridges own by counties, cities, or the private sector is another factor. The more bridges that are owned by a state transportation agency the easier it is to control the inspections and maintenance of the bridges. If most of the bridges are owned by non-state agencies then a centralized system of controlling the evaluation and upkeep of historic bridges must be developed.

The basic concept behind a preservation plan is the identification of potentially historic bridge structures, usually in conjunction with the state historic preservation office. Communication with the state historic preservation office, as well as with other public and private historic preservation entities is crucial not only at the initial stages of the project, determining the significance of the bridges, but most importantly, maintaining them to preserve the integrity of the historic fabric. Arkansas' preservation plan revolves around the notion of sharing information and responsibility not only between the Arkansas Highway Traffic Department, AHTD, and the SHPO, but also between the different departments within the AHTD. The AHTD furnishes all relevant data pertaining to historic bridges, including updating evaluation forms, field inspections and other documentation to the SHPO. "The SHPO's office has been furnished with copies of all printouts as they have been produces plus a great deal of the inter-office correspondence generated in AHTD relative to Historic Bridges. The SHPO has been brought up to date on a frequent basis on all AHTD activities. It has been AHTD's intention that the SHPO be in possession of all significant Historic Bridge records and correspondence as they occur so that everyone concerned knows virtually the same thing as it happens. This is not only an open method of dealing with a relatively complex activity, it is also, hopefully, assurance that if AHTD overlooks some factor or action which would be of benefit to this project, the SHPO's office might be aware of this oversight and bring attention to it."[1] It is also the SHPO's responsibility to help AHTD develop specific solutions on individual projects.

The success of the Arkansas preservation plan is primarily due to a well-developed communication system between all the agencies and departments involved in a bridge rehabilitation of restoration project. The information is shared through a database, and it is the responsibility of the AHTD Environmental Division to incorporate historic bridge data into this database, and if necessary, on the bridge location maps utilized by AHTD Bridge Division. It is also the responsibility of the AHTD Environmental Division to furnish all divisions and

[1] *Arkansas Historic Bridge Inventory Review and Evaluation,* AHTD, p. 10.

administrators responsible for bridge replacement and rehabilitation, and program management, lists of existing historically significant structures, as well as lists of bridges that will reach the 50-year mark in the new future. In order to maintain an accurate list of historic structures the AHTD Environmental Division must be kept up to date of the conditions of the bridges. It is the joint responsibility of the AHTD Bridge Division and the AHTD Programming and Scheduling Section to inform the AHTD Environmental Division of all problems concerning historic bridges on Federal, State, County and urban road systems. Lastly, the AHTD Environmental Division is responsible for producing any Special Provisions for contract inclusion relative to historic bridge problems. The Environmental Division, in conjunction with the concerned Design Division, is responsible for informing AHTD field construction personnel, and contractors' personnel of any special consideration relating to historic bridges.

In Vermont, where towns, cities or villages own 90% of the historic bridges, development of a unifying system was essential for bridge preservation. The Vermont Agency of Transportation developed a program in which all the different bridge owners are asked to participate. In order to encourage participation the Vermont Agency of Transportation, VAOT agrees to pay all costs of future rehabilitation or restoration, carried out in accordance with the Secretary of Interior's Standards. VAOT also provides financial assistance and help for municipal bridge owners to develop a maintenance schedule for each bridge. In exchange for these services, the bridge owners agree to preserve the bridges that have been identified in the state wide historic bridge survey. Those historically significant bridges must then be nominated to the National Register of Historic Places as soon as possible. In Vermont, despite the great variety of bridge owners, there is one governmental body which has the responsibility for safeguarding the bridges and developing a unified plan for preservation. Vermont's plan is considered to be one of the most successful in the country. A statewide survey taken on July 15, 1996, by Wilbur Smith Associates, shows that 100% of historic bridge projects successfully preserved the historic integrity of the bridge. The breakdown is as follows: 17.9% underwent the full treatment, reconstruction to some degree, 29.6% were rehabilitated, and 52.5% required only minor preservation work. The astounding success of the preservation program is primarily due to its developmental process. The program is a well-defined legislative document that has been developed in a cooperative effort with the Federal Highway Administration, the Advisory Council of Historic Preservation, the VAOT, the VSHPO, and the Vermont agency of Natural Resources. As a result, the Vermont system works well because of the unification of preservation authority in one entity, and because VDOT has provided financial incentives to preservation.

New Mexico takes a different approach to the preservation of their bridges. While they are currently not trying to develop any preservation plan beyond simply following the requirements of the National Historic Preservation Act, they are attempting to educate all the people involved with a preservation project. This includes everyone, from historians, to engineers, to the local public. The written work is the customary mode of transferring preservation ideas; unfortunately this method is not always the most effective one. To counter this, New Mexico has developed a video with the help of a local public television station, in hopes that more people will be willing to watch, and more importantly, listen. The video is made available to everyone in the DOT department, and is put up for sale to the public. The importance of making preservation issues and philosophies easily available to everyone cannot be understated. An increase in education will lead to an increase of awareness resulting in a better and easier decision-making process. The most important aspect of New Mexico's video is that it is easily available to the local public, limiting or eliminating miscommunication between the public and the DOT or SHPO, which can result in disputes leading to costly project delays.

Some states that are currently developing their preservation plans start with a list of criteria. Virginia is working on a list of factors that must be considered during a bridge analysis. The Virginia criteria include:

1. Treatment options (rehabilitation under the Secretary of the Interior's Standards, relocation, recordation and demolition, storage, and salvage);
2. Current and potential funding sources for historic bridge rehabilitation;
3. Liability, right-of-way, and safety concerns;
4. Present and future uses for the bridge;
5. Political issues;
6. Examination of conflicting requirements of various agencies, federal and state;
7. Cost/benefit analysis;
8. A bridge decision matrix (comparisons of various factors including condition, average daily traffic, sufficiency rating, required load capacity, posted load capacity, width and length, vertical clearance, available detours, and the ability to carry school buses and emergency vehicles);
9. Vulnerability to natural disaster;
10. Citizen interests;
11. Current design standards.

However, it has become clear in Virginia that balancing all of these criteria has made a cumbersome process of developing a statewide preservation plan. Virginia has instead adopted a philosophy of treating every bridge on an individual basis.

There is considerable nationwide debate regarding the criteria that provides for continued vehicular use of a bridge. A complete bridge preservation project not only maintains the historic appearance of the bridge in its original location, but also manages to preserve its original function. Unfortunately, many historic bridges are considered to be inadequate either geometrically or structurally, therefore safety and liability issues become paramount in evaluating options for an older bridge. In many cases it is considered desirable to maintain the bridges in vehicular use, as a result engineering methods are being developed which allow for geometric adjustments or structural strengthening while maintaining the historic integrity of the bridge. The prevailing line of thought in Virginia is that a historic bridge may be removed from vehicular service and that this does not detract from its historic significance. Maintaining a bridge for vehicular use is not a primary concern since vehicles are the main cause of historic bridge deterioration, and transportation planners must consider whether a bridge is a good candidate for rehabilitation. Some historic bridges simply cannot bear the stress of continued vehicular use, and may be better suited for conversion to a pedestrian facility. Others, however, may be rehabilitated and strengthened to continue to serve vehicular traffic, and in those cases, innovative engineering processes may be employed to maintain both the historic integrity of the structure as well as its function of carrying traffic safely. An argument can be made for maintaining the bridge in vehicular service if it can be shown that the structure has the capability to support the increased load and that there are no detrimental fatigue stresses within the structural members.

One principal reason for the preservation of historic bridges is that the local community has strong ties to the bridge, and can become quite vocal if their bridge is slated for demolition or replacement. Effective bridge preservation plans must take the sentiments of the local community into consideration, and communication with community leaders and the general

public is essential to determining the level of local support for a bridge rehabilitation project. The most common forms of determining local interest in a bridge include press releases to local newspapers, radio, or television stations, inviting public feedback to a proposed bridge rehabilitation or replacement project. Public meetings or workshops to discuss the proposed project also provide a means of communication with the public, so long as the time and place of the workshop is widely and effectively advertised. No matter how the proposal is communicated, it is important to allow a certain amount of time for public relations when proposing any alterations to a bridge with historical or local significance.

Alterations of Historic Fabric: A well-developed preservation plan must also present a preservation philosophy as its backbone. Preservation of the structure for continued vehicular service is the focus of this manual, but a preservation plan must also afford the opportunity to consider other alternatives for the structure. The best possible options for historic bridges are those which result in the least possible adverse effect to the historic fabric and appearance of the structure.

Safety considerations most often dictate the alterations proposed for a historic bridge, and generally involve some modification of the bridge's historic materials to allow the bridge to remain in service. When altering any portion of the bridge, whether to improve the structural capacity of the bridge, adjust its geometry, or to bring the railings up to code, the work may result in an effect upon the historic characteristics of the structure. Any federally funded project that will alter a historic bridge, even cleaning and painting, must be submitted to the State Historic Preservation Officer (SHPO} for a determination of effect. Therefore, the potential effect of a project on a bridge is best considered during the earliest phases of planning.

The Advisory Council Regulations promulgated with the National Historic Preservation Act of 1966 contains the Criteria of Effect and Adverse Effect (36 CFR 800.9), which define the circumstances under which a project will affect a historic structure. The basic premise is that a project will have an effect upon a historic bridge if the project alters the characteristics of the bridge which qualify it for the National Register of Historic Places. However, the level of effect resulting from a project is subject to determination, and is accomplished through consultation with the Texas Historical Commission. Effects may be adverse or not adverse, or the project may have no effect on the structure whatsoever. An adverse effect occurs when the project is likely to significantly diminish the integrity of the structure's location, design, setting, materials, workmanship, feeling, or association. Examples of projects with adverse effects include bridge demolition, relocation, or those proposing significant alterations which compromise the structural integrity of the bridge or its historic appearance. Of course, the best possible options for bridge rehabilitation is to work toward an engineering solution which will have no effect or no adverse effect upon a historic bridge. Alterations to a structure must serve current needs, but designers should also keep an eye to the future and consider whether the current alterations could be reversed should other techniques be developed in the future that could further prolong the life of the historic bridge.

The appearance of alterations is very important to consider during the early planning phases of the project. Bridge railings are the primary component subject to rehabilitation on historic bridges, and there are several schools of thought on how best to rehabilitate or upgrade railings while attempting to maintain the historic appearance of the structure. New Mexico and Illinois undertake alterations only if they match the original fabric. Virginia uses a railing which has the feel of the historic railing, but does not necessarily imitate the original. The third possible option is to replace the historic material with a contemporary design, which shows the new, replaced element without trying to make it look as if it is original. This approach can be appropriate in certain limited situations, especially when adding an element that never originally existed, such as crash-guards.

The primary issue regarding alterations is to attempt to remain truthful to the original historic features of the bridge. It is one thing to preserve the physical character of the structural or decorative members, but the issue of maintaining authenticity of use is another major topic of debate. The interviewee from Virginia cited an example of a bridge built in 1873 which today accommodates 800 cars per day. He believes that in this particular case such heavy traffic use is limiting the life span of the bridge and that it should be bypassed and used only for light pedestrian traffic. This example brings up a very important issue, that of maintaining the historic bridge in its original use. In 1873 it is impossible for this bridge to have been used by motorized vehicles, since they did not yet exist. Therefore, a bridge that was built to carry only pedestrians and horse and buggy type vehicles is not subjected to considerably higher loading conditions imposed by rather high daily traffic use. The question raised by preservationists is that of authenticity; since the loads on the bridge are not the original loads, is it fair to place those kinds of demands on this structure? One could argue that bridges were designed to carry loads across an obstacle and if the loads change over time, the bridge must carry those loads. Well, if this is the case then it makes sense to consider closing the bridge to vehicular traffic and turning it into a pedestrian bridge because as long as the bridge is carrying some form of traffic it is still fulfilling its original function, and the structural members are not stressed to their absolute limit.

Questions like the authenticity of use must be addressed by the individual states and the authorities in charge of bridge restoration/preservation. An agreement must be reached between the SHPO and the DOT, but quite often compromises must be made if the bridge is to be saved. If the SHPO does not allow for some compromise, the bridge will most likely end up being removed from service, or it will have to be taken off the National Register. Fortunately most of the states reported a good relationship with their SHPO, North Carolina DOT is the only one that reported to the contrary. Currently North Carolina DOT is basically trying to preserve as many historic bridges as possible, but with limited cooperation from NCSHPO, the program enjoys limited success. It comes as no surprise that the states that work in cooperation with their SHPOs are the ones with the most advances preservation plans.

Inspections: Most of the state DOTs surveyed for this study handle historic bridge inspections in a similar fashion. The initial inspection of historic bridges determines whether or not they are good candidates for rehabilitation, and if so, helps determine the best possible options. This type of evaluation must be very detailed and hands-on because it must accurately record the true condition of the bridge. As a result, bridge inspectors must have the specialized knowledge to identify the adequacies or deficiencies of historic metal truss bridges. The second type of inspection is part of the maintenance program of historic bridges. The most common method is either an annual or biannual inspection of historic bridges that are in service, with less frequent inspections for those bridges closed to vehicular traffic. None of the fourteen states that responded conduct specialized inspections or load testing unless there is a situation that specifically warrants one. In most cases, cost is the prohibiting factor of regular hands-on inspections. New Jersey is very successful in implementing regular inspections concurrently with their historic bridge maintenance program to correct deficiencies as quickly as possible.

Maintenance: Development of a maintenance program is a vital part of a successful preservation plan. Without a functioning maintenance plan the condition of historic fabric deteriorates very quickly. It is therefore in the best interest of the owners, as well as the users of the bridge to maintain it in the best possible condition. The problem with the majority of maintenance programs is that while a maintenance schedule can be established, the work is carried out by the owners of the bridge. As a result, there is no guarantee that the maintenance schedule is actually being followed. Vermont's solution to this problem is to control the maintenance process by providing the bridge owners with maintenance funding. By providing the funding and by conducting frequent inspections, they ensure the proper maintenance of all

their historic bridges. Coordination between the inspection and maintenance programs seems to be the most accepted method of bridge preservation. Only close monitoring and immediate responses to all deficiencies noted in an annual inspection report must be efficiently incorporated into a maintenance project.

Other Methods of Preservation: Rehabilitation and preservation of historic bridges involves a complex set of considerations. It is not always possible to preserve the bridge in its original location or to rehabilitate it to keep it in vehicular service. Therefore, engineers and planners must work together from the earliest phases of a project to determine whether a particular bridge is a good candidate for rehabilitation, and develop a checklist of criteria to aid them in their evaluation. Primary considerations in devising the checklist would include:

1. Is the bridge historically significant?
2. What is the condition of the historic features of the bridge?
3. Can the bridge be rehabilitated to accommodate a lower level of service, i.e., what are the possibilities of employing the bridge as a component of a one-way pair, or for reduced service, such as use as a boat ramp access?
4. What is necessary to bring the bridge up to acceptable safety and service standards? Among the factors that planners should consider are the current and projected level of use for the structure, its location (highway, rural road, or urban street) along with attendant safety standards for railings based upon speed limit and average daily traffic, and the amount of damage to the historic features of the bridge.
5. What is the relative cost of rehabilitation versus replacement of the structure?
6. What are the feelings of the local community/state preservation organization regarding rehabilitation of the structure?

If, after an honest evaluation of the bridge, project planners determine that rehabilitation for any vehicular use is not a feasible option, preservation planners then explore other options for the structure before simply condemning it to demolition. Some of the most common solutions include leaving the bridge in place but closing it to vehicular traffic, moving the bridge to another location, such as a park, hike and bike trail, or wayside, marketing the bridge for private ownership, dismantling the bridge and storing it for future use, or if the bridge has deteriorated beyond the point of any possibility of salvage, recording it according to HAER standards prior to demolition.

If engineers and planners conclude that a bridge can be preserved, the first concern is to determine the level of rehabilitation necessary for the continued use of the structure. Attendant with this determination is a thorough evaluation of the existing and proposed use of the bridge and its service requirements. Limiting the loads that a bridge must accommodate is one method of preservation, and may be accomplished by a variety of means. Posting a load limit for the bridge discourages heavy truck traffic on an older structure, but effectively closes the road to full vehicular service. Load posting also does not require the exploration of engineering solutions to rehabilitate a bridge and correct its deficiencies, although planners and engineers should keep in mind that not all historic bridges need to be brought up to a current full service standard, particularly those which do not accommodate heavy loads, or have a low average daily traffic. Due to liability, engineers tend to be conservative in historic bridge inspection reports, resulting in some historic bridges being rated well below their actual capacity. However, load posting does achieve a goal of preserving the bridge while limiting alterations to the original structure. Other methods of rehabilitating a historic bridge by reducing its level of service or load capacity include converting the historic bridge into a one way pair by constructing a new bridge next to the only

one, strengthening or reinforcing the structural members of the bridge, or concealing a new structure within the old, thereby relieving the original members.

One unusual method used in Virginia to rehabilitate and preserve pin-connected trusses is to dismantle and hot-dip galvanize them. The bridge is then re-erected and new steel pins are used. This method of protecting the bridge is sensitive to preservation concerns because it does not change the bridge to a great extent. In fact, the galvanization and new steel pins ensure almost maintenance free operation for a number of years. Galvanization also addresses lead paint removal issues on historic structures, since the disposal of lead is carried off-site. Virginia entrusts lead paint removal to the galvanizing contractor, thereby eliminating a very costly and environmentally dangerous process of lead removal in the field. However, while galvanization is not the most inexpensive method for bridge rehabilitation, it seems well suited for small truss bridges, or even large span bridges that are assembled from smaller elements.

Two of the surveyed states have formed task groups that deal specifically with the preservation of historic bridges. Arkansas established its *Historic Bridge Analysis Team* which is chaired by the State Bridge Engineer and is made up of engineers from AHTD's Bridge, Roadway Design, Surveys, and Maintenance Divisions, the Chief of the Environmental Division, the state's Heavy Bridge Engineer, and an archeologist historian from the Environmental Division. Virginia's *Historic Structures Task Group* is made up of members from the Virginia Traffic Research Council, Virginia Department of Transportation's Environmental Affairs and Engineering Departments, the Federal Highway Department, and the State Historic Preservation Officer. The tasks of both teams are very similar in that they review all projects that are to be carried out on historic bridges. If any bridges are scheduled for demolition, each team reviews the bridge and submits a report to the chairperson, who prepares a final recommendation for approval by the SHPO. Both state task force teams have found that in some cases, demolition is unavoidable; however, both teams have very often been able to propose an alternative solution for the bridge. As state DOTs recognize that rehabilitation of historic bridges can be a viable alternative to demolition and replacement, this type of cooperative effort and open communication will continue to be a key element to preserving historic bridges and promoting more innovative engineering solutions to address historic bridge rehabilitation issues.

Chapter 5:
HISTORIC BRIDGE DOCUMENTATION

Documentation is the first and most important step of any preservation project. It is the process by which a historic property is analyzed structurally, historically, and architecturally. Initial time spent researching a property can save a great deal of money and time during the latter phases of the construction phase. Eliminating unknowns is a vital aspect of any construction project, however, when a historic property is involved the amount of unknowns skyrockets. All aspects of the property must be investigated prior to the design phase because informed decisions have to be made at that time. The documentation of historic properties is composed of several equally important steps. These steps are outlined in a concise and well-researched document prepared by the Construction Specifications Institute and the Association for Preservation Technology. The following is an excerpt from that document which has been modified to apply specifically to bridges. Changes to the original text are indicated with square parentheses.

Historical Research:

Historical research is an important preliminary step in any rehabilitation, restoration or preservation project. Depending upon the scope of the project, the research may be extensive, or it may target finding a specific item of information. For example, when restoration of an entire [bridge] is to be undertaken, research may involve locating available drawings or archival photographs showing the original or later appearance of the [structure]. If repair of [only one particular element] is to be undertaken, the research may be directed toward determining relevant detailing of [that element's] installation. Following is a list of some sources of information about historic [fabric]:

- Federal archives
- State and local preservation agencies
- State Historic Preservation Office (SHPO)
- Municipal preservation commissions
- Museums and historical societies
- Libraries or University Archives
- Architectural drawing collections
- Private collections
- Oral history
- [Patent documentation]
- [Manufacturer catalogs]

In addition to documentation of previous repairs, reports may have been prepared specifically to record the structure. The types of documentation and reports that are especially useful, and may be available for research, include:

- Historic American Engineering Record (HAER) documentation – HABS and HAER documentation is kept in the collection of the Library of Congress in Washington, DC. The HABS and HAER offices are at the National Park Service, P.O. Box 37127, Washington, DC 20013-7127.
- National Register Nomination or National Historic Landmark Nomination – The National Register offices are at the National Park Service, P.O. Box 37127, Washington, DC 20013-7127.
- Sanborn maps – Sanborn maps are found in many university libraries, public libraries and state historical society libraries. A history and description of the San born maps can be found in "Charts of Change," by Kim Keister, published in *Historic Preservation*, Volume 43, Number 3, May-June 1993.
- Historic Structure Report
- Condition survey report – Historic Structure Reports and condition survey reports are typically kept by the governmental agencies, private institutions, owners that commission these studies, and by their authors. The National Trust for Historic Preservation Library at College Park, Maryland, is also gathering a collection of Historic Structure Reports provided by those who write or commission the studies.

Drawings and specifications may be available for newer structures, and sometimes for older structures. [Drawings are usually available for on-system bridges constructed by the Texas Highway Department or the Texas Department of Transportation.] These documents, however, may not reflect actual as-built construction because of unrecorded field changes or substitutions made during construction. In addition to the documents prepared for the original construction, drawings and specifications may also be available that describe later repairs after the original construction. Copies of old construction documents are sometimes kept at the [local TxDOT office]. Other sources include the architectural or engineering firm that designed the structure [or] successor firms. [In these cases it is helpful to know the history of the firms involved with the bridge. This includes the material suppliers, the design firm, and the contractor.]

The sources examined during a study of an historic structure should be recorded as part of the project documentation. An annotated list of sources and a bibliography are useful additions to any report. Where historic photographs are discovered, photocopies or copies of the photographs can be added to the project documentation. Reviews and publications about the original construction may be found in newspapers and [professional] journals. [Lastly], contemporary technical publications may be relevant to the historic structure. For example, for [metal truss bridges *Modern Steel Construction Magazine* can be] a useful reference guide.

5.1 EXISTING CONDITIONS SURVEY

The purpose of an existing condition survey is to examine and document materials conditions and construction details at the time of the inspection. Obtaining a good understanding of the project and what is happening to it is critical to the success of a project. The condition of the property and the extent of existing damage or deterioration are determined at this phase. In addition, areas or features that may require immediate

intervention (stabilization, repair, or other treatment) are identified. Good documentation of existing conditions provides the information for a well-defined scope of work, and results in more accurate bids and better control of repairs. Time invested during the investigation stage will generally more than pay for itself during construction by reducing the chance for errors. The existing condition survey builds upon information gathered in the historical information about how a [structure] is constructed; the visual survey confirms, refutes, or supplements this information. The survey is also helpful in raising questions about conditions that need to be addressed by field or laboratory investigation. For example, observed conditions may suggest hidden deterioration. Or, that causes of distress may be related to inherent problems in the materials or installation that need to be addressed.

5.1.1 Historic Structures Report (HSR)

An Historic Structures Report is a document prepared for an historic building, structure, landscape or group of properties to record and analyze initial construction and subsequent alterations through documentary, physical and pictorial evidence. The report also documents the current state of the [bridge's] architectural [features], engineering systems, and overall structural stability, and identifies an appropriate course of treatment.

An Historic Structures Report is useful in making decision for an historic structure. Typically, an Historic Structures Report contains chapters on the history, architectural features, oral history (interviews), and significance (critical interpretation) of the [structure]. It also contains an evaluation of the existing conditions of all materials, structural systems, and site features. The report also includes design guidelines for repair and restoration work. The completed Historic Structure Report is used by the owners or caretakers of a building in planning for its restoration, preservation, and maintenance, and sometimes for interpretation and public presentations.

The information gathered and prepared is compiled in a written, illustrated, or multi-media Historic Structures Report summarizing the results of the research, inspection, and recommendations. The report also contains an outline scope of work based on the research, survey and inspection. The outline scope of work is developed for the recommended treatment of the site, the [structure], and its materials. Where appropriate alternatives exist for restoration or repair measures, these are discussed. The outline scope of work also provides cost estimates and a construction project schedule required to execute the recommended work. Work is identified in terms of priority, for immediate, short-term or long-term application.

5.1.2 Identification of Significant Features

The primary significance of the property may be historical rather than architectural; in other cases, specific physical features of the property may be noteworthy for their design or craftsmanship. The features and elements may be designated as 'contributing' or 'non-contributing' in much the same way as individual properties are designated in a historic district evaluation. This review of the significance of individual features provides a basis for determining which elements are appropriate for preservation, conservation, or restoration, and which components are not significant and may be changed. For example, in a historic bridge, less visible elements such as floor beams may be strengthened to accommodate a new floor system.

Chapter 6:
APPROPRIATE TREATMENTS

Once the site condition of the bridge has been properly documented and the historic research has been carried out there is an abundance of information that must be utilized to generate a sympathetic design solution not only for the historic fabric but also to the community that supports it. The basic premise of this section is based on the fact that it is not feasible and in most cases impossible to rehabilitate every truss bridge in Texas for unlimited vehicular use. As a result, it should be decided from the earliest phases of a project to determine whether a particular bridge is a good candidate for rehabilitation. In order to make the evaluation process more efficient and easier a checklist of criteria is utilized. The basic points used to evaluate a property's historic eligibility are:

1. Is the bridge historically significant, and if so why, and are there features that are more significant that other?

   The information gathered during the historic research phase of the pre-design process is used at this time to determine exactly what is significant about the property. If the property is listed in the National Register of Historic Places (NRHP) the significance will be stated in Section 8 of the NRHP Form. If the bridge is not yet listed or the initial research has not been carried out the sources listed in the preceding section are good places to find information on the property.

   The criteria under which the bridge is nominated will, in most cases, help determine the preservation treatment. For instance, if the bridge is significant due to its association with a historically significant event (or series of events), or a person (criteria A or B respectively) moving the bridge may not be a sympathetic solution since the historic significance of the bridge is most likely closely linked to its location. On the other hand if the bridge is nominated solely for its engineering or architectural features (criteria C), features not related specifically to the site, it may be possible to relocate the bridge and still retain the engineering or architectural character which makes the property eligible. The previous statement is only one possible scenario, and may not be applicable in all situations. As is the norm with historic properties a concise evaluation must be carried out before making a preservation proposal.

   Lastly, if certain members of the bridge are more significant than others, for instance railings, or chamfered floor beams, it becomes very important to preserve that historic fabric. In general, it is good preservation practice to retain as much of the original fabric as possible, however because human safety is an issue, in many cases when dealing with bridges, certain members may be replaced in kind or strengthened. When railings are considered significant, secondary railings may need to be installed depending upon the safety requirements determined by the state. In conclusion, no matter what the final solution is all changes to the structure must be properly documented and archived in the proper repository so that future generations will have the benefit of utilizing this information.

2. What is the condition of the significant historic features of the bridge?

   The condition of significant historic features on the bridge becomes important when determining the budget for the project. If the significant elements are deteriorated money may have to be allocated for manufacturing reproductions.

   Another important aspect of the condition of the significant features has to do with the retention of integrity of the historic fabric. If a large number of significant features have to be replaced the project becomes a reconstruction rather than a rehabilitation and the structure can lose its historic integrity. It is up to the individual SHPO and DOT to decide at what point the bridge becomes a replica thereby losing its historic standing. In order to prevent this from occurring, TxDOT has to be in close communication with the SHPO, and possibly with a coordinated effort the bridge can be saved and its historic integrity may be preserved.

3. What is necessary to bring the bridge up to acceptable safety and service standards?

   As is the case in Arkansas, a task group consisting of preservation and engineering experts, is responsible for determining what steps must be taken to successfully complete a preservation project. Based on their findings they determine what has to be done to make a bridge structurally sound while maintaining its historic integrity. This evaluation should be carried out in the initial planning stages so as to help determine how much money and resources are going to be needed to complete the project. It may turn out that opening the bridge to vehicular traffic is not a feasible alternative, forcing other options to be considered. The earlier unfeasible options are eliminated the more time and money can be reallocated to investigate more feasible alternatives.

4. What are the physical characteristics and demographics of the surrounding landscape? How will a rehabilitation of the historic bridge impact the current community?

   The designer must consider how the new project will affect the immediate users of the bridge. Some of the issues to keep in mind are:

   - The functional classification of the highway – Did the community, and therefore the roadway, grow beyond the capacity of the historic bridge? It may be detrimental to the bridge to subject it to loads it was not intended to carry; therefore, solutions other than rehabilitation have to be sought out.
   - The load capacity – Is the historic bridge carrying more vehicles or larger vehicles than it was originally designed for, and are these loads adversely affecting the structure?
   - Geometric constraints – In the case of through trusses, can the historic bridge accommodate large contemporary trucks? Is there a possibility of rerouting them?
   - Availability of alternate routes – Can some of the traffic be rerouted to take some of the stress off the structural members?

- Disruption to homes and businesses and environmental impacts – What is the impact on the community of all possible solutions: rehabilitating the historic bridge, limiting access to the bridge, bypassing, closing the historic bridge to vehicular access and rerouting traffic to another existing bridge, and finally demolishing the old bridge and construction a new one in its place?
- The potential effect on local and state economies – In many cases historic bridges contribute greatly to tourism, which in turn generates income for the local communities, for instance Bastrop, Texas or states such as Vermont.
- Safety, as determined by factors such as accident history for motorists, pedestrians, and bicyclists – Has the bridge been historically safe, or do approaches need to be altered, or does traffic flow need to be controlled with, for instance signal lights?
- The impact on the historic, scenic, and aesthetic values of the community, as interpreted by the community in which the bridge is located – What is the impact on the "feeling" of the community? A study should be carried out to determine how all proposed solutions would affect the community from a contextual standpoint.
- Maintenance needs – How often will the bridge have to be maintained? Frequent scheduled or unscheduled maintenance may disrupt the flow of traffic in a community. Also, depending on who is funding the maintenance of the bridge, the local community may end up paying for these frequent interruptions in vehicular service.

5. Can the bridge be rehabilitated to accommodate a lower level of service?

   Depending on the surrounding topography and proximity to buildings it may be possible to construct a companion bridge to help ease some of the load on the historic structure. Generally, it is acceptable to alter the loads on a historic bridge as long as the nature of the function remains the unchanged. For instance, turning a vehicular bridge into a pedestrian bridge is not an uncommon solution to the problem of structural member fatigue.

6. What is the relative cost of rehabilitation versus replacement of the structure?

   Quite often the make or break factor of a preservation project is the cost of rehabilitation versus the cost of building a new structure. Until recently the cost of a rehabilitation project was evaluated strictly on a dollar basis; however, amidst rising environmental concerns engineers and planners are starting to consider other factors such as embodied energy when evaluating historic structures. Embodied energy is measured in BTUs (British Thermal Units) and it measures the energy input required for all aspects of the construction process including: retrieving raw materials, production, manufacturing, transportation and handling, storage, erection, finishing, and maintenance. When compared on this level, most often, rehabilitation projects turn out to be significantly more affordable. However, unfortunately when dealing with historic bridges other negative factors must be incorporated into the equation. Factors such as geometric deficiencies, load restrictions, lead abatement, and inspection costs add to the cost and may

make the project sufficiently inefficient to warrant replacement. If this is the case the historic bridge can still be saved in numerous ways, including bypassing, moving, or dismantling and storing for future adaptive reuse.

7. What are the feelings of the local community/state preservation organization regarding rehabilitation of the structure?

   One principal reason for the preservation of historic bridges is that the local community has strong ties to the bridge, and can become quite vocal if their bridge is slated for demolition or replacement. Effective bridge preservation plans must take the sentiments of the local community into consideration, and communication with community leaders and the general public is essential to determining the level of local support for a bridge rehabilitation project. The most common forms of determining local interest in a bridge include press releases to local newspapers, radio, or television stations, inviting public feedback to a proposed bridge rehabilitation or replacement project. Public meetings or workshops to discuss the proposed project also provide a means of communication with the public, so long as the time and place of the workshop is widely and effectively advertised. No matter how the proposal is communicated, it is important to allow a certain amount of time for public relations when proposing any alterations to a bridge with historical or local significance.

If it is determined that rehabilitation for continued unrestricted vehicular use is not feasible other options for the structure must be explored. The first step is to determine the level of rehabilitation necessary for the continued vehicular use of the structure. Attendant with this determination is a thorough evaluation of the existing and proposed use of the bridge and its service requirements. The following preservation options are used in Rhode Island and are published in the *Rhode Island Historic Bridge Inventory, Part III: Preservation Plan.*

The preservation strategies identified in this [section] are not to be considered as specifications for the ultimate action to be take for any given bridge. Instead, they represent alternatives and considerations which ought to be weighed in the planning process. [This section] follows the overall approach developed in the following Federal Highway Administrative FHWA (Office of Environmental Policy) documents:

> Programmatic Section 4(f) Evaluation and Approval for FHWA Projects that Necessitate the Use of Historic Bridges. 1983.
>
> Guidance on the Consideration of Historic and Archeological Resources in the Highway Project Development Process. 1984.
>
> Review of Efforts to Market Historic Highway Bridges. 1986.

No Action

Retain in Service: The option of first choice with an historic bridge is to leave it in place as a functioning part of the transportation system. Planning for replacement or rehabilitation [of structurally inadequate] projects should distinguish between what is necessary for public safety and what would be desirable in a new bridge at the site. Section 4(f) considerations specifically reference "serious and unacceptable safety hazards" and "intolerable restrictions on transport and travel" as the measure of justifying

going beyond leaving the bridge in place and addressing problems with normal maintenance procedures. Federal regulations (23 CFR 625) allow flexibility in meeting American Association of State Highway and Transportation Officials (AASHTO) standards, and this flexibility can be applied to historic bridges.

The needs assessment implied by the consideration of the no-action option is useful for more than simply justifying the project. Careful and complete articulation of the functional and structural inadequacies of a bridge may help point the way to an option (or combination of options) which will allow it to function with a minimum of harm to its historic qualities.

Posting: Posting weight limits and restricting truck travel may allow an historic bridge to remain in service. The availability of nearby alternative routes will determine the feasibility of this option, as well as public safety considerations, especially fire-vehicle access. Posting will only provide a safe crossing and promote the preservation of the bridge if there is a reasonable expectation that it will be observed. [Also, while posting a load limit for the bridge discourages heavy truck traffic, but effectively closes the road to full vehicular service, load posting also eliminated the exploration of engineering solutions for rehabilitation and correction of deficiencies. On the other hand, load posting does achieve the goal of preserving the bridge while limiting alterations to the original structure.]

Bypass: In some cases, inadequate historic bridges can be bypassed, either at the site or at a distance from the bridge. The possibility of upgrading or establishing an alternative route should be considered as part of this option. The by-pass option should be weighed against any "extraordinary construction difficulty or costs or… adverse social, economic, or environmental effects" associated with the new structure (quoted from Programmatic 4(f)).

While bypassing does avoid the immediate loss of the historic bridge, it does not assure its long-term survival if it is allowed simply to deteriorate next to the new structure. When feasible, provision should be made for its continuing protection and maintenance. Keeping the old bridge in use (with repair as needed) for local traffic, restricting it to one-way use, or using it for pedestrians or bicycles can help to justify the continuing cost of maintenance. Also, in the case of bypass at the site, providing a pedestrian crossing on the old bridge may eliminate the need for sidewalks on the new structure, providing a small savings. Some bridges may be so severely deteriorated that even total bypass could not significantly extend their lifetime.

A special case of bypass is the use of a parallel span to carry one direction of traffic. Parallel spans may allow the retention of a bridge that is too narrow to function as a two-way structure. A length of approach sufficient to allow safe direction-separation is required. This option has the advantage of keeping the historic bridge as a functioning entity entitled to ongoing maintenance.

While generally not considered an adverse effect on the historic bridge, construction of a new structure close by may well have an effect on the historic bridge's setting and public visibility. Moreover, [some] bridges are located within (or just outside the boundaries of) National Register-listed historic districts. New construction of a bypass or parallel span should not intrude on the significant qualities of the historic bridge or a

surrounding historic district (see New Construction, below). Some historic districts may make the close-by bypass or parallel span options undesirable from the historic preservation viewpoint if important buildings or archeological resources must be sacrificed to save the bridge.

In constructing the new bridge in the close-by bypass or parallel span options, care must be taken not to damage the old by overloading it with heavy construction vehicles, undercutting its footings with altered flow patters due to temporary dams, and other such secondary impacts.

Bypass options may offer opportunities beyond those of simply saving the historic bridge. Relocating the crossing may actually improve alignment and alleviate problems with adjacent intersections. Bypass also may allow better traffic flow during construction, as the old bridge remains in use. On a larger scale, serious consideration of a remote alternative, either upgrading a parallel route or establishing a new one, may promote the solution of other problems (such as impact on historic districts or congestion, curves, or grade) which are associated with the route itself and which simple replacement of the bridge will do little to solve.

6.1 SELECTIVE REHABILITATION

Where the problem with an historic bridge is inadequate load capacity, selective rehabilitation, either alone or combined with other options, may allow the bridge to return to a state of usefulness. Replacement of deteriorated structural members with exactly duplicated material can sometimes result in increased capacity. In order for such repair to avoid affecting the historic integrity of the bridge, new work should exactly match historical conditions in dimensions, materials, workmanship, and finish.

Trusses: With trusses, deteriorated members can be removed and replaced with new but otherwise identical parts, tension rods can be tightened and rivets replaced with high-strength parts.

Railings: Railings present a special challenge in the rehabilitation of historic bridges. Railings are important decorative features which identify a bridge's period; in some cases, they are among the bridge's essential historical features. Modern standards call for railings which not only will resist the impact of crashes but also provide smooth surfaces with no snap points. Neither the lattice rails found on the small pony trusses, the iron-picket railings on some of the stone arches and beam bridges, nor the square-balustrade railings of the 20th century concrete arches appear to meet the criteria for vehicular guardrails. Safety is the paramount consideration when evaluating the type of guardrail needed, but, where possible, guardrail standards should be considered with flexibility in light of actual traffic and safety needs. Use of a guardrail between the vehicle lane and the sidewalk, where feasible and safe, will avoid physically affecting the historic railing and minimize the visual impact. Attaching ordinary guardrail to historic iron or concrete railings will impair their physical integrity and greatly obscure them from view and is preferable only to removing the historic railings entirely. On the other hand, installing guardrail on the inside of the trusses where no railings presently exist, despite having a visual impact, is desirable if it will protect the historic material.

Limited rehabilitation does not by itself address problems of alignment and inadequate width. However, when combined with other options, such as the upgrade of an alternate route, lane/division with a parallel span, or posting, limited rehabilitation may allow an historic bridge to function without impact on its historic qualities.

6.2 MAJOR STRUCTURAL REHABILITATION

When the above options are inadequate to meet a project's needs, the historic bridge will probably be either substantially altered or replaced. Either case creates an adverse effect on the historic bridge which must be mitigated through a combination of documenting the historic bridge to the standards of the Historic American Engineering Record (HAER), performing major rehabilitation in such a way that the bridge's historic features are minimally harmed, or relocating the bridge to a new site.

Determining whether a proposed action constitutes "rehabilitation without affecting the historic integrity of the bridge" (language taken from Programmatic 4(f)) or substantial alteration is a matter of degree. Too much replacement of the historic fabric, even with exactly matching material, might be judged substantial alteration from an historic preservation viewpoint. The following actions, however, should always be considered substantial alterations and should have their harmful effects mitigated by minimizing the extent of alteration.

Widening: Usually, widening adversely affects historic bridges by destroying the original proportions. For example, the narrowness of 19th century trusses is part of their characteristic appearance, indicating their origin in a period before modern traffic needs. Widening should always be kept to a minimum, and should be considered only as an alternative to outright demolition. Except in the case of simple beam bridges, widening also will destroy or obscure important historic material such as spandrels, railings, or floor beams (though many bridges' floor beams have already been replaced or altered). Widening raises the same issues of impact on surrounding historic districts as new construction (see below).

Widening Trusses: Trusses can be theoretically widened, especially in combination with the installation of secondary structural systems (below). In addition to the loss of original proportions, increasing the width will require new members between the trusses, such as floor beams and struts (on through trusses), thereby substantially affecting the historic integrity of the bridge. Widening may nevertheless be appropriate as an alternative to total demolition, especially where the bridge contributes to a surrounding historic district. Except where the setting is of paramount importance, relocation is more respectful of the bridge's integrity than the substantial alteration required by widening.

6.2.1 Substitute Structural System

Trusses: The load capacity of an historic truss can be improved by supporting it with intermediate piers or on beam or rigid-frame structures which essentially carry the load of the bridge. The introduction of a substitute or secondary structure should be done in such a way as to minimize removal of historic fabric. Thus, introduction of a substitute or secondary structure should be considered as a last resort and done in such a way as to

minimize removal of historic fabric. At its worst, such a technique can visually overwhelm the historic bridge and reduce the trusses to ornamental railings on a modern-appearing bridge. However, if a bridge is eligible for its engineering significance, introducing a substitute structural system will almost certainly cause the bridge to become ineligible by destroying its structural integrity.

The depth of the new structure below the lower chord should be minimal, both to retain the historic appearance of the bridge and to avoid impinging on the vertical clearance below the span. The effect of the new structure on the historic abutments should also be minimized.

6.2.2 Relocation

For historic bridges which must be entirely replaced, moving the bridge to a new location can mitigate the adverse effect of replacement; consideration of such mitigation is required.

As a practical matter, relocation only applies to truss or beam bridges. The feasibility of relocation is further constrained by the condition, dimensions, and form of the historic bridge. Long bridges, deck trusses, and multiple-span bridges all pose problems in finding a workable setting. The short pony trusses and beam bridges are the best candidates. Possible relocated settings include hike and bike trails, state parks and trails, local parks, and private ranches. Some trusses might be repositioned beside the new bridge to serve as a pedestrian crossing.

FHWA procedures require that historic bridges be considered for re-use as highway bridges where conditions are less demanding than their original site. However, the narrowness, lightness of construction, and condition of most of the historic trusses eligible for relocation suggest that such opportunities are very limited.

An FHWA review of marketing of historic bridges implies that it is more productive in certain cases than others: personal contacts work better than general advertising, and government entities are the chief category of recipient in successful marketing.

Disassembly for relocation should respect the historic integrity of the bridge and allow reassembly with a minimum of alteration. Existing joints should be maintained intact by removing pins or drilling out rivets, and members should not be cut to ease disassembly. Storage conditions should be planned for minimal deterioration of the disassembled parts. Continued inspection and maintenance (and preservation restrictions on recipients) to assure long-term retention of the bridge's integrity is a necessary part of any relocation plan.

Relocation is not a meaningful action in the case of some historic bridges. The location and/or setting of certain bridges are so much a part of their historic significance that relocation to another site would be pointless.

The following steps will make the required marketing and relocation effort more productive:

- Develop personal contacts between the Department and relevant state and local agencies with jurisdiction over trails, parks, and historic sites. Determine in advance what the physical requirements are for possible relocated bridges, including type of traffic, length, and funds available for re-erection. Current statutes allow an amount up to the cost of demolition as an eligible expense; in most cases, this will be insufficient to relocate the bridge without additional funds.
- Concentrate relocation/marketing efforts on the small trusses which have the best chance of reuse.
- Review currently identified local bridge needs to ensure that opportunities for relocated highway use (fully eligible for funding) have not been overlooked.
- Restrict storage of disassembled trusses without a definite site for eventual relocation to a reasonable period.

6.2.3 New Construction

Construction of a new bridge in place of the historic bridge will in some cases have a visual impact on surrounding historic districts. In general, new construction should be as unobtrusive as possible so that the bridge will not visually overpower the remaining historic resources. Primarily this is an issue of scale. Making the new bridge wider, longer, deeper or higher than necessary or using visually heavy elements such as large beams or solid railings will create an intrusion into the historic character of most districts. Raising the level of the roadway will also often have an impact on nearby historic-district buildings. Modestly proportioned deck bridges with tubular railings are suitable when no alternatives exist to the replacement of historic bridges within historic districts.

In the case of historic districts, incorporating some of the form or materials of a replaced historic bridge into the design of a new bridge may be aesthetically desirable. Use of arches and stone facing may make a bridge accord better with surrounding historic buildings. However, attempting to reproduce some or all of a demolished historic bridge will not, from a historic preservation point of view, mitigate the loss of the actual bridge. Also, if too close a reproduction is built, some people will be confused as to whether the bridge is new or old, creating a false impression of the district's true character.

Similar considerations apply when a parallel span for by pass or lane division is constructed close to an historic bridge, whether or not it is in an historic district. The new span will diminish the public visibility of the bridge and will introduce a modern element into what might have been a relatively unchanged setting. The new design should be as visually unobtrusive as possible. Locating the new span as far from the bridge as practical will also improve the visibility of the older span. Again, traditional forms and materials can be used, but not to mask the honest fact of new construction.

The options listed above are the most commonly applied conservation methods for historic bridges; however, there are other less conventional preservation methods utilized in the United States. For instance, in Virginia rehabilitation of pin-connected trusses involves dismantling and hot-dip galvanizing the individual structural members of

the bridge. The bridge is then re-erected and new still pins ensure almost maintenance-free operation for years. Galvanization also addresses lead paint abatement issues. By removing the lead coated bridge elements from the site and into the controlled environment of the galvanizing plant, the contaminated paint can be disposed of properly. While galvanization is not the most inexpensive method of bridge rehabilitation, the savings in maintenance costs alone may make it worthwhile. Unfortunately, this method is not suited for all bridges. The ideal candidate is a small, pin-connected bridge, preferably in a location where its removal for a period of time will not greatly disrupt local traffic.

Other innovative preservation techniques include: the formation of task groups to develop, plan, and manage the preservation of historic bridges (Arkansas, Virginia); special state sponsored incentives to encourage regular maintenance (Vermont); development of a program to educate the general public about the importance of bridge preservation (New Mexico); and adjustments to the state preservation philosophy that accommodate the unique topographic restrictions or transportation needs of the state (Rhode Island).

As demonstrated above, when dealing with historic bridges there does not seem to be a shortage of excellent preservation options. The only way a preservation program can fail is if it fails to be implemented. Some of the states that were interviewed realize this and they make an effort to coordinate with as many experts as possible to aide in the decision-making process. This makes for a more efficient bureaucratic system, and it also means that things get done. Innovations in maintenance also lead to better preservation programs because they ensure that the bridges are in better condition. After all, the cost of upkeep in most cases is much less than the cost of reconstruction, not to mention more sympathetic to the historic fabric.

Each of the interviewed states determines their preservation philosophy and then tries to follow it as closely as possible. So far, however, no state has achieved a successful statewide program; preservation/rehabilitation options for each bridge tend to be considered individually. Individual evaluation has its benefits, as sometimes a design exception may be obtained to preserve the historic features of a bridge; however, no state has yet elevated an individual design exception for a design standard to be applied to all similar bridges. As historic bridge rehabilitation becomes more common, the body of technical knowledge will also grow, increasing the likelihood of standardizing engineering solutions to common deficiencies on similar bridge types.

Chapter 7:
STANDARD PRESERVATION PLAN

When making a preservation proposal the investigation must be carried out on two distinct levels. The first level focuses specifically on the physical condition, as well as, the historic significance of the entire bridge and its individual elements. This part of the investigation is covered in previous sections of this report and in the report overseen by Dr. Michael Engelhardt, *Preservation Alternatives for Historic Truss Bridges,* project number 0-1741. At the second level of investigation, the historic bridge is considered within a larger context. Specifically, how the historic bridge fits into its surrounds today, and how can it best serve the community in the present and the future.

When developing a statewide preservation plan it is at this second level that there is the greatest hope of success. Due to the fact that no bridge is identical, that each one resides in a different micro environment, and that all of them have a unique history, the first documentation level, condition evaluation and historic research, must be catered to each individual bridge. Detailed inspections must be carried out on a case-by-case basis, and even though engineering solutions to common structural deficiencies may become more standardized in the future they can never generate a statewide preservation plan. There is no doubt that standardized engineering solutions are a great benefit to historic bridges since they make preservation more affordable and therefore, a more acceptable alternative to new construction. However, there are simply too many independent variables and not enough commonalities at this micro level to sustain an effective general preservation plan. On the other hand, if the goal of the preservation plan is to establish a standard for determining how historic bridges can best serve present day and future needs of the surrounding community a standardized system can be developed.

Unless there is expressed public support it is very difficult to initiate and later sustain a public preservation project. This is especially true of bridges, since their basic function is to provide a transportation service to the community. Whether that service is to provide a crossing for pedestrians, bicycles, cattle, wagons or cars this basic function remains constant. Historic bridges can provide a great deal of information for engineers, architects, and historians. But, if the bridge is closed down and academic interest becomes its only function, sooner or later the historic fabric will fall into decay. After all, what community wants to pay for the maintenance of a bridge they cannot use? Added to this is the possibility of vandalism, something every boarded-up historic property is familiar with, and the chances of having the bridge survive becomes minimal.

There are two steps, in addition to those outlined in the previous sections, that should be taken to ensure that a preservation proposal for a bridge provides the services a community can use. First, determine the current and projected vehicular requirements of the local community. Second, make it possible for the community to get in touch with preservation professionals after the project is completed.

7.1 VEHICULAR TRAFFIC PATTERN EVALUATION

The first step is to ensure that the preservation proposal fulfills the current and projected future vehicular transportation needs of the community. In order to determine

how a historic bridge can be incorporated into the community's transportation scheme, a three-part investigation of the traffic loading condition must be carried out. Depending on the outcome and the structural condition of the bridge a realistic proposal can be presented to the community. The following are the three transportation related factors pertinent to a preservation investigator:

1. Roadway Functional Class[2]
   a) Alley – An alley, also known as a minor rural or urban arterial, is a passageway designed primarily to provide access to or from the rear or side of a property abutting on a public street. [The amount of vehicular traffic on this type of road is minimal.]
   b) Local Street – The primary function of a local street is to serve abutting land use and traffic within a neighborhood or limited residential district. A local street is not generally continuous through several districts and carries moderate levels of traffic and may run through historic districts. [The type of vehicular traffic on this road may include school buses and emergency vehicles.]
   c) Collector Street – The primary function of a collector street is to intercept traffic from intersecting local streets and expedite the movement of this traffic in the most direct route to an arterial street or other collector street. Traffic flow can fluctuate between moderate and heavy depending on the time of day. [The type of vehicular traffic on this road may include school and municipal buses, emergency vehicles, and delivery trucks.]
   d) Arterial Street – Arterial streets are designed to carry high volumes of through traffic. Access is usually limited to intersections and major driveways. Arterial streets serve as a link between major centers within the urban area. [Traffic flow can fluctuate between moderate and heavy depending on the time of day.]
   e) Freeways – Freeways are divided arterial highways designed with full control of access and grade separations at all intersections. Freeways provide movement of high volumes of traffic at relatively high speeds. This system carries most of the trips entering and leaving the urban area, as well as most of the through movements bypassing the central city. [Vehicular traffic is usually heavy at peak times and also carries large vehicles such as tractor trailers and buses.]
   f) Parkway – A parkway is a freeway which does not have continuous frontage roads. Parkways have a green space buffer between the roadway and adjacent development and preserves and enhances the natural landscape as much as possible. [Vehicular traffic is generally moderate and steady with a full range of vehicle occupancy types.]
2. Average Daily Traffic (ADT) – Several counts should be taken at different times of day and week to ensure an accurate assessment of the load demands on the bridge.
3. Equivalent Single Axle Loadings (ESAL) – This measures the truck, or other similar, traffic on the bridge and just like ADT should be counted several times over an extended period of time to ensure accuracy.

The items listed above are used to establish the land use condition of the community by identifying the roadway type, the amount of traffic supported by that roadway and the type of traffic. A responsible preservation proposal must respond to those specific conditions. When the bridge was originally built the size, truss type, and materials used, were the result of the volume and type of traffic, as well as the wealth of the community. As time passes and

[2] *Transportation Criteria Manual.* pp. 1-3.

the community undergoes changes it is only logical to have the historic bridge reflect those changes. This does not mean that the bridge has to be modified, but rather that solutions be sought out that do not exceed the capacity of the bridge, resulting in either insensitive strengthening techniques or eventual failure due to fatigue.

Figure 3.1 is a diagram of the relationship between land access and vehicular mobility with the roadway types. This diagram can be used to determine the type of bridge required to best serve the community. It can also be used to determine the most probable future land access and mobility relationship if readings are taken over time and recorded on the same diagram. If vehicular traffic is expected to increase given the past and current pattern of growth within a community a responsible preservation plan should address this issue. For instance, is it proper to subject the historic bridge to increased loading or should other preservation options such as one-way pairing or bypassing be considered?

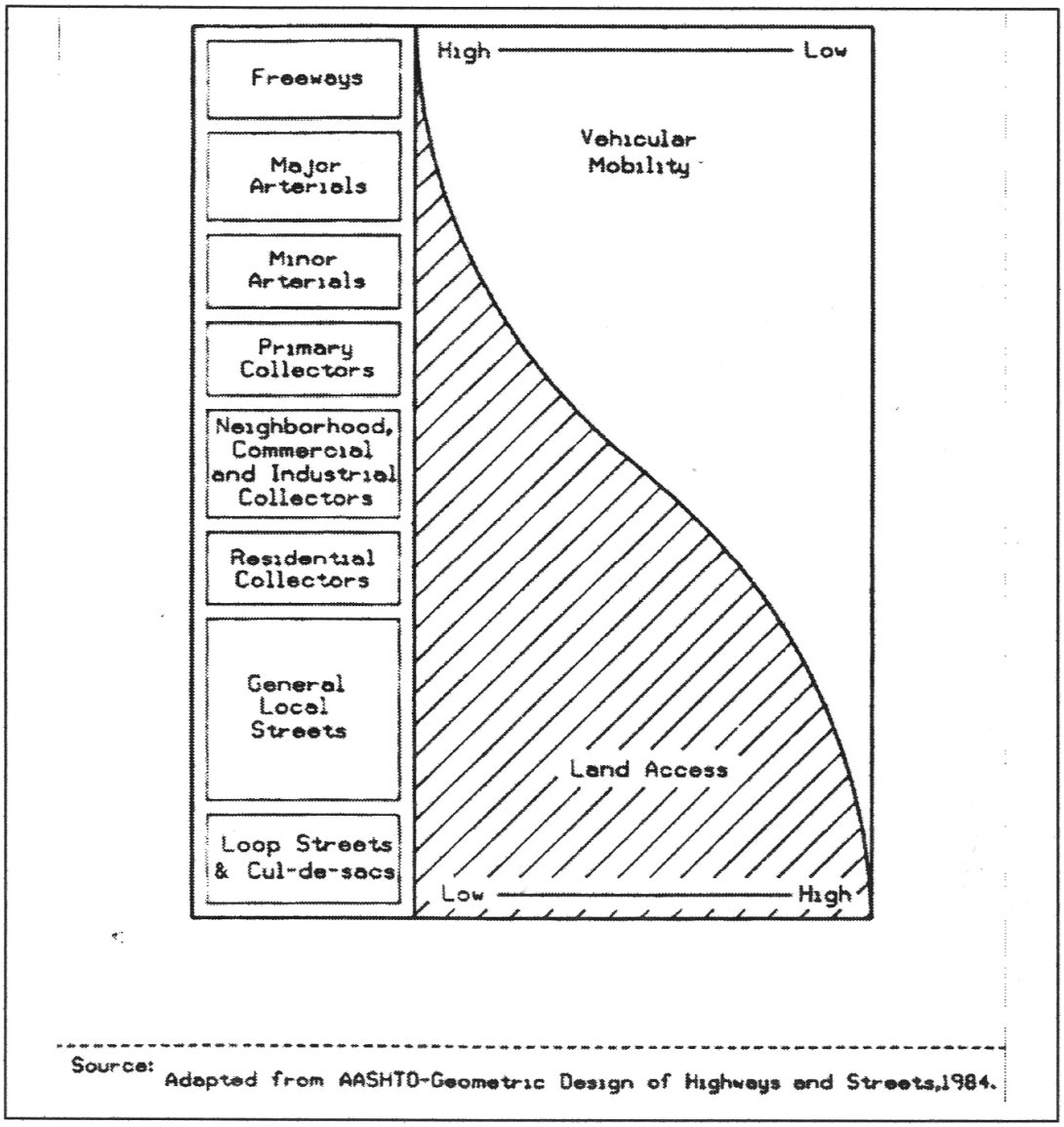

FIGURE 3.1 – Relationship of Street Classifications with Access and Mobility.

7.2 OPEN COMMUNICATION

Given the size of Texas and the large number of historically significant metal truss bridges, it would make sense for Texas to employ a system that would allow for easier transfer of information. The most effective and efficient way to accomplish this is to develop a web page. Publishing information on the Internet has many advantages, one of the most vital ones being, that it guarantees access to anyone who requires this information. Allowing public access to preservation information raises awareness on all levels of the community; from the concerned local resident, who just happens to like the old bridge, to the district engineer, who is in charge of evaluating it. The following is a list of suggested items that could be incorporated into the web page.

- A detailed listing of all historic bridges in Texas, with photographs of each bridge and a short statement of significance. To ensure that the bridges can be found easily they would be indexed by name, route and feature crossed, county, district, or point-and-click on a map of Texas. This information would be especially useful to district engineers who may not know exactly which of the bridges in their district are historically significant and which are not.
- A set of guidelines on the homepage which outline general preservation concepts, as well as case studies from previous successful and less successful bridge preservation efforts. This sharing of information can be very helpful to districts with little preservation experience. The fact that the information is on the Internet means that it can be easily updated and made available to the public as soon as it is entered.
- An e-mail link to TxDOT, BRINSAP and the THC. This will provide an important direct link to help identify and solve individual problems associated with any particular bridge. This exchange of information would also be used to report problems with a bridge as soon as they are discovered, which may initiate immediate action and can save valuable time and money, and possible extend the life of the bridge. The e-mail link can also serve as an electronic mailing list sent out by the TxDOT, THC or BRINSAP that would update interested parties in new bridge preservation techniques or other news.
- Links to preservation specialists in Texas and other DOTs throughout the United States. As demonstrated in this report, some of the best sources of information are other DOTs which have more developed bridge preservation programs than Texas.

7.3 CONCLUDING STATEMENT

When dealing with preservation, rehabilitation, restoration, or reconstruction of historic bridges, it is very difficult to objectively evaluate the degree of success of a preservation proposal. Generally, standards are established for comparative purposes. However, this field is still relatively young and due to the nature of the projects a great deal of work is carried out on a case by case basis; placing the outcome of the evaluation in the hands of individuals (SHPOs), each with their own understanding of preservation ideology. One way to standardize the process is to establish a common language with well-defined terms; unfortunately, even the most explicit terminology is subject to misinterpretation often ending in miscommunication. As long as preservation solutions are based on personal dogma it will be very difficult to render consistent solutions with predictable results. On the other hand, and this is said with a full appreciation for the difficulty of its implementation, if preservation solutions resulted from logical analysis and all personal influences are removed from the equation the process may begin to better serve all remaining bridges. This does not mean that public concerns should be ignored; quite the opposite, only by analyzing the immediate and future needs of the community can solutions be generated that are both sympathetic to the historic fabric and provide optimal service to the community.

BIBLIOGRAPHY

Pertinent Preservation Process Resources

McCLurkan, Burney, B. *Arkansas Historic Bridge Inventory Review and Evaluation.*

Newlon, Howard, Jr. *A Trial Rating System for Truss Bridges.* Charlottesville, VA: Virginia Highway & Transportation Research Council, 1978.

Spero, Paula, A. C.; Kittell, Howard, J. *Trial Guidelines for the Conservation of Virginia's Historic Bridges.* Charlottesville, VA: Virginia Highway & Transportation Research Council, 1985.

Zuk, William; Newlon, Howard, Jr.; McKeel, Wallace, T., Jr. *Methods of Modifying Historic Bridges for Contemporary Use.* Charlottesville, VA: Virginia Highway & Transportation Research Council, 1980.

American Society of Civil Engineers. *Analysis and Preservation of Historic Bridges.*

Construction Specifications Institute. *Guide to Preparing Design and Construction Documents for Historic Projects.* Alexandria, VA: Construction Specifications Institute, 1996.

National Trust for Historic Preservation. *Preservation and Conservation: Principles and Practices.* Washington, DC: The Preservation Press, 1982.

Office of Engineering – Bridge Division, Bridge-Management Branch. *Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges.* Washington, DC: U.S. Department of Transportation – Federal Highway Administration, 1995.

Rhode Island Department of Transportation. *Comprehensive Bridge Improvement Plan.* Providence, RI: Rhode Island Department of Transportation, 1990.

State of Vermont Agency of Transportation. *Vermont State Standards for the Design of Transportation Construction, Reconstruction and Rehabilitation on Freeways, Roads, and Streets.* 1997.

Transportation Criteria Manual. Austin, TX: City of Austin, 1988.

Pertinent Historic Resources

Darnell, Victor, C. *A Dictionary of American Bridge-Building Companies, 1840-1900.* Washington, DC: Society for Industrial Archeology, 1984.

Paskoff, Paul, F. *Encyclopedia of American Business History and Biography: Iron and Steel in the Nineteenth Century.* New York: Bruccoli Clark Layman, Inc., 1989.

The American Iron and Steel Association. *Directory to the Iron and Steel Works of the University States, Also of Canada and Mexico, 1982, Eleventh Edition.* Philadelphia: Allen, Lane & Scott, 1982.

APPENDIX A:

Survey Questions

1. Do you have a historic bridge preservation process?
    - What is the goal of the preservation process?
    - Do you have a set of criteria developed to determine the preservation strategy for the individual bridges?
    - Does this plan emphasize continued vehicular use?
    - How do you involve the local public with the preservation or replacement efforts?

2. From a preservation standpoint, how do you deal with alterations that must be made to the bridge (e.g., railings, geometric deficiency, structural upgrading)?
    - What kind of allowances are made in the case of historic bridges?
    - Are the alterations generally sensitive to the historic fabric?

3. How do you conduct structural inspections of historic bridges?
    - Who conducts the inspections?
    - Are the inspection methods the same for all bridges?
    - Do you load test the historic bridges to obtain a more accurate rating?

4. How do you oversee the maintenance of historic bridges?
    - Who is in charge of overseeing the maintenance?

5. What other preservation techniques have you used in the past?

APPENDIX B :
Survey Responses

Arkansas – Burney McClurkan
Tel: 501-569-2611
Fax: 501-569-2009

Arkansas has provided a copy of their preservation plan for historic bridges titled, "Arkansas Historic Bridge Inventory Review and Evaluation," by Burney B. McClurkan.

The purpose of this Preservation Plan is to outline what is to be done with the Historic Bridge Inventory.

For a Preservation Plan to be functional in the practical sense it must be concerned with two general categories of relationships: 1) the mutual obligations and responsibilities of AHTD and the SHPO, and 2) the inter-divisional responsibilities within AHTD.

In regard to the first area of concern, AHTD/SHPO, it should be noted that throughout the formulation of the Historic Bridge Inventory, and all attendant work, the SHPO's office has been furnished with copies of all printouts as they have been produced plus a great deal of the inter-office correspondence generated in AHTD relative to Historic Bridges. The SHPO has been brought up to date on a frequent basis on all AHTD activities. It has been AHTD's intention that the SHPO be in possession of all significant Historic Bridge records and correspondence as they occur so that everyone concerned knows virtually the same thing as it happens. This is not only an open method of dealing with a relatively complex activity, it is also, hopefully, assurance that if AHTD overlooks some factor or action which would be of benefit to this project, the SHPO's office might be aware of this oversight and bring attention to it.

AHTD/SHPO RESPONSIBILITIES

1. The AHTD will continue to furnish the SHPO with any forthcoming data relative to historic bridges generated within the AHTD. This includes updated evaluation forms, field photos of bridges accurately numbered and titled for file purposes, plus updates on programming and scheduling as it affects historically significant Bridges on the AHTD inventory.
2. The AHTD will, beginning with the year 1990, jointly review with the SHPO, those bridges which achieve an age of 50 years. This review will be done on an annual basis at a mutually agreed time late in the calendar year prior to the year under construction, i.e. bridges coming of age in 1990 will be reviewed in late 1989.
3. AHTD will maintain an updated file on all evaluation forms, photos, photo records, field notes and correspondence on historic bridges. This data will be forwarded to the SHPO as needed (see item 1 above).
4. The AHTD will furnish specific additional data on individual bridges to the SHPO on an as-needed basis for purposes of significance determinations, or other purposed germane to mutual knowledge on historic bridges.
5. The SHPO, being in possession of all pertinent historic bridge data, will be able to make joint determinations of significance on individual structures in conjunction with the AHTD Review Committee in a timely manner.
6. The SHPO will assist AHTD in formulating guidelines for the future treatment of historic bridges, and will assist in the development of mitigation plans when this need arises.

AHTD INTER-DIVISIONAL RESPONSIBILITIES

1. The AHTD Environmental Division will furnish to all divisions and administrators responsible for bridge replacement and rehabilitation, program management, and existing and future listings of historically significant structures.
2. AHTD Environmental Division will be responsible for the incorporation of historic bridge data into the OASIS computer program, and if necessary, on the bridge location maps utilized by AHTD Bridge Division.
3. AHTD Environmental Division will be responsible for producing any Special Provisions for contract inclusion relative to historic bridge problems. The Environmental Division, in conjunction with the concerned Design Division, will be responsible for informing AHTD field construction personnel, and contractors' personnel of any special consideration relating to historic bridges.
4. AHTD Bridge Division will inform AHTD Environmental Division of any problems concerning historic bridges on the Federal and State highway systems.
5. AHTD State Aid Division will inform AHTD Environmental Division of any problems concerning historic bridges on county and urban road systems.
6. AHTD Programming and Scheduling Section will inform AHTD Environmental Division of any problems concerning historic bridges on urban street systems.
7. AHTD Programming and Scheduling Section will work with the Environmental Division in maintaining up to date knowledge of bridge replacement and rehabilitation schedules relating to historically significant or sensitive bridges.

This list of duties and responsibilities no doubt will not cover all possible contingencies relative to historic bridges in Arkansas. It is, however, a good faith attempt to deal with the basic problems, as they are now understood.

REPLACEMENT OF SIGNIFICANT BRIDGES

Since the initial determination of those bridges considered eligible to the National Register of Historic Places, some of these structures have been scheduled for replacement. To cope with this situation in a timely and comprehensive manner a Historic Bridge Analysis Team has been formed. The Team consists of the Engineers of Bridge, Roadway Design, Surveys, and Maintenance Division, the Chief of the Environmental Division, Heavy Bridge Maintenance Engineer, and an archeologist historian from Environmental Division. The Team is chaired by the State Bridge Engineer.

When a historically significant bridge is scheduled for replacement, each team member visits the bridge and submits a report to the team chairperson. The chair then drafts a report combining all this information which considers the possible options and alternatives for the subject structure. The report explains the options possible and states the Team's preferred option for the bridge, i.e. do-nothing, retain in service, rehabilitate, demolish, etc. The Analysis Team report is then submitted to the Historic Bridge Review Board which consists of the Assistant Chief Engineers for Planning and Design and

personnel from FHWA Arkansas Division. The Review Board either approves the Team's recommendation or requests another option be considered.

The Team report and Review Board statement are forwarded to the SHPO for concurrence and/or comment. This review process is in keeping with Section 106 proceedings. If there is no feasible alternative to the demolition of a bridge, then the structure is documented according to the procedures and standards of the Historic American Engineering Record (HAER), a division of the National Park Service. This HAER procedure has been done for the Anthony Island Bridge in Hot Springs, Arkansas already and will probably be done for other structures in the future when demolition is unavoidable.

Bridges on county and urban systems present a slightly different set of problems. Since these bridges are not owned by the AHTD, the Department is not in a position to make a decision or commitment relative to the ultimate treatment of the structures. When the request for bridge replacement of one of these historic structures is made, the local government will be informed by AHTD of the options available for dealing with historic bridges. Once the local entity decides how it will proceed, then AHTD will assist in the procedures and documentation necessary for Section 106 review with the State Historic Preservation Officer. When this review process has been completed to the satisfaction of the SHPO, the project may proceed with Federal Bridge Replacement funding.

SHPO – George McCluskey
Tel: 501-324-9880

So far the preservation plan is working well. Bridges are hard to save because safety and liability are a major concern. A few years go eleven children were drowned when a historic bridge they were swinging on collapsed. Such events tend to focus public concern primarily on safety. Nevertheless the state is trying to save as many bridges as possible. A review of bridges is done on a sliding fifty-year criteria. The next review will be carried out sometime within the next few years. If a bridge must be dismantled, it is documented to HABS/HAER standards. Currently, Arkansas is using the Secretary of Interior Standards for rehabilitation work.

California – John Snyder
Tel: 916-653-1273
Fax: 916-653-6126

A statewide inventory is currently underway but no specific preservation plan exists at this time for historic bridges; each bridge is investigated on an individual basis. At this point there is only a seismic retrofit program in place for all bridges.

Georgia – Gail D'Avino
Tel: 404-699-4415
Fax: 404-699-4440

Currently working on developing a preservation plan. The plan has not yet been developed enough to properly answer the questions on the survey. The completion date of the plan is estimated to be in the last part of 1998.

Illinois – Jerry Jacobson
Tel: 217-785-2835
Fax: 217-524-9356

1. Yes, we have an historic bridge preservation process.

   Goal: provide safe, efficient transportation while preserving bridges of engineering or other historic significance.

   Where feasible and prudent.

   Newspaper advertisements, public meetings and letters to local historic and/or preservation organizations.

   We follow federal and/or state criteria

   Federal: Advisory Council on Historic Preservation; State: Illinois Historic Preservation Agency.

   The undersigned.

2. Either the Advisory Council and/or the National Park Service keeps records of bridge preservation processes by states. Also the Transportation Research Board recently conducted a state-by-state survey of such programs.

3. Such alterations are typically negotiated between the undertaking agency and the Illinois Historic Preservation Agency, acting as the State Historic Preservation Officer, for federal projects, or as itself, for state funded licensed, or permitted jobs.

   The piers of a covered bridge were raised higher than the original conformation to avoid flooding.

   Railings. New ones have been permitted if they match old; geometries; virtually no allowances for historic bridges; structural upgrading: permitted if little or no visual impact.

   Yes.

   Approach spans are generally considered part of the bridge as a whole, but more flexibility in alterations would probably be permitted if practicality so dictated.

4. Historic bridges are inspected no differently from other bridges. State-maintained bridges: IDOT Bureau of Bridges and Structures for major river crossings, IDOT highway district bridge offices for others; local roads bridges: local (county, township, municipal) agencies in 7 highway districts, IDOT district local roads bridge personnel in the other two districts.

Inspection methods follow National Bridges Inspection Standards.

No: ratings obtained by analyses.

Mr. Todd E. Ahrens, Chief, Structural Services Section, Bureau of Bridges and Structures, IDOT, this address.

5. Historic bridge maintenance generally follows the maintenance procedures for other bridges.

   State-owned bridges: highway district personnel; local bridges: local agencies.

   Mr. Ahrens.

6. Other preservation techniques: marketing and moving bridges to new locations; storage: restoration or rehabilitation.

7. To some extent. A few bridges have been moved to new locations to prevent demolition; others have been rehabilitated in compliance with preservation standards, very few avoided by building a new bridge nearby.

   A security program to protect our five remaining covered bridges is under study.

SHPO – Anne Haaker
Tel: 217-785-5027

Currently the SHPO and the DOT are reworking the preservation plan that has been in use for the past 8 years. Anne feels that their old plan is out of date and needs to be updated. The new plan will be a programmatic approach to all bridges. In other words, the officials at Illinois are trying to develop an all-encompassing methodological plan for historic bridges. They are going to try to eliminate the case-by-case approach currently adopted by the state. At this point the plan is not yet developed enough to provide any information to other states.

Louisiana – Michele Deshotels
Tel: 504-929-9192
Fax: 504-929-9188

A preservation plan is currently being developed for the state of Louisiana, but it will not include any special maintenance or inspection processes specific to historic bridges. All bridges, including National Register listed or eligible ones, must meet all minimum requirements if they are to remain in service. The reason is that Louisiana law does not provide immunity against lawsuits as a result of injury sustained on a bridge.

Therefore, a historic bridge can be structurally upgraded, turned into a one-way pair, bypassed, marketed, or documented according to HABS/HAER and dismantled.

New Jersey – Miriam Crum
Tel: 609-530-2996
Fax: 609-530-5787

Currently a preservation plan is being developed, but there is no focus on any one particular type of bridge. The goal is to identify 100 bridges and identify preservation options specific to each bridge type. Funding is a major problem, since only approximately 1/3 of the eligible bridges are state-owned; the rest are either owned by the counties or the municipalities. For the 2/3 of the non-state-owned bridges the state DOT can only make suggestions and put forth proposals, but there is no way to enforce them. Majority of the bridges are being documented and dismantled. Some bridges are moved to new locations, but this is very rare due to the high costs involved and the difficulty of finding someone to take the bridge.

Interview with Anil Mehta, New Jersey DOT Engineering Office.

Enhanced inspections are conducted for some historic bridges. All bridges are still inspected biannually, unless there is a major problem with a specific bridge. The difference is that inspections are more hands on when dealing with historic fabric. If there are any serious signs of fatigue, tests are conducted to determine the integrity of the structural members. There is also a maintenance program in place which works in conjunction with the inspections. As required, deteriorated or damaged members are replaced.

New Mexico – Steven Koczan
Tel: 505-827-5235
Fax: 505-827-6862

1. We follow the requirements of the National Historic Preservation Act and state historic preservation laws to evaluate the importance of structures that may be affected by projects. We do not have a separate historic bridge preservation process.

   We try to keep historic bridges in service whenever possible. It depends on the condition of the structures, traffic volumes, and safety issues. Usually, though, the structures need to be replaced because rehabilitation does not correct deficiencies. In these cases, we build a new structure near the old one, save the old one, close the old one to traffic and put up a small sign.

   New Mexico only has a few types of historic bridges so we try to save as many of the good examples as we can. We are trying to save a representative sample in the different parts of the state.

   The public can get involved through our regular public involvement process conducted during the project development and design state.

   We completed coordination with the State Historic Preservation Officer, Advisory Council, and any land managing agencies or tribal entities that have jurisdiction or management responsibility.

2. We are not aware of any other states that have implemented preservation plans.

3. Alterations that are needed on bridges that continue to be used are usually designed to resemble that character and feeling of the original elements. For example, a railing might need to be replaced so the new one will be designed to meet the appropriate standards but will maintain some of the original visual characteristics.

   The approach spans will be treated the same way and are considered part of the historic bridge structure.

4. There is regular inspection on historic bridges that are open to traffic. The inspections are conducted by the state or by a consultant. The inspection methods are the same for old and new bridges. We do not load test the structures.

Contact Jimmy Camp at 505-827-5532.

5. Historic bridges that are still in use are maintained by the owner (state, county, or local government). When the structures are owned by the state, the district offices notify us when a maintenance project is proposed and we complete coordination with regulatory authorities. I do not know about county or local government procedures.

   We informally monitor the condition of historic bridges that have been preserved but are no longer in use. If we find a problem, then we will propose a project to correct the situation. In general, we make sure that the bridges we save are in good shape before they are taken out of service. We may complete some rehabilitation at the time the structure is replaced so that we leave them in good condition. This rehabilitation is intended to preserve the structure. It does not correct the transportation related deficiencies because they are usually more complex.

6. We have not used other techniques. Moving a structure is an alternative that can be considered and other options such as documentation and then removal may also be considered in complicated situations. In one case we have a historic bridge at a small rest area and people can walk on the structure. Usually we close the bridges to all uses if it is preserved in place.

7. Yes. We have preserved important bridges and have managed to save examples in most parts of New Mexico. There has been positive public comment. So far we have preserved historic bridges that need replacement. In the future, we will have situations where preservation is not possible. In these cases, we will complete appropriate mitigation measures prior to removal.

SHPO – Mary Ann Andrews
Tel: 505-827-3990

New Mexico is presently not interested in further developing a preservation plan specific to their needs. At this point the SHPO reviews every project on a case-by-case basis, and it does not appear that this will be changing anytime soon. There is also a sharp reduction in the number of nominations to the National Register coming out of New Mexico. In fact the only way a new bridge will be nominated is if it is a very rare example of a specific type, or if the bridge has very significant historic ties.

The one thing the SHPO and the DOT developed is a video which shows the evolution of bridge technology in New Mexico. The video is meant to be viewed by all DOT staff

involved with historic bridge preservation, as well as the public. The primary purpose for the development of the video was to encourage bridge preservation and to raise awareness of preservation issues.

New York – Karen McCann
Tel: 518-457-7313
Fax: 518-457-6887

1. We do not have a preservation plan of bridges that are eligible or listed on the National Register of Historic Places (historic bridges) at this time.
2. While we are not aware of any states with preservation plans, you may want to contact Sally Liff, Project Coordinator of the ongoing National Cooperative Highway Research Program (NCHRP) Project 20-5, Topic 28-08, "Historic Bridge Preservation Practices." The study included sending questionnaires to all state highway agencies. Twenty-nine agencies responded with information about their historic bridge preservation practices. The final report will not be available for a while, but Sally can provide you with more information about it or put you in contact with the NCHRP consultant. Her telephone number is 202-334-3244 and her address is National Research Council, Transportation Research Board, 2101 Constitution Ave., NW, Washington, DC 20518.
3. Alterations to historic bridges are addressed on a case-by-case basis in consultation with the NYS historic Preservation Officer (NYSHPO) to identify sensitive treatments. Rehabilitation is always the first consideration.
4. No special inspection is done of historic bridges. All bridges in NYS are inspected by the NYSDOT Structures Division.
5. We make Maintenance aware of the historic bridges and the need to coordinate any work on these bridges with the Regional Cultural Resource Coordinator.
6. Concerning special techniques we have used the "Texas Rail" to replace concrete railings on historic bridges. We also have replicated the design of concrete rail in rail replacements. To preserve an historic truss bridge, we have reinforced the existing structure with superimposed arches that did not compromise the bridge's integrity.
7. The existing case process eventually works but is very time consuming. We have included the development of a preservation plan for all historic bridges within the scope of a contract now being advertised to inventory bridges built after 1924. (The pre-1925 bridges were previously inventoried).

North Carolina – Barbara Church
Tel: 919-733-7844
Fax: 919-733-9794

1. Yes.

   The goal is to preserve as many bridges as possible.

The emphasis is not necessarily on continued vehicular use. However, most bridges remain in vehicular use.

The local public is informed through advertising in local and regional newspapers.

The head of bridge maintenance determines if a bridge is capable of being reused.

No.

2. Not really.
3. If a bridge requires structural upgrading then usually a new bridge is put up and the old one is closed to traffic.

   Approach spans may or may not be treated the same as main spans depending on the material used in their construction. Generally, if wooden construction is implemented then the approach spans have to be replaced.
4. Inspections are carried out by the State Engineering Group. The inspection methods vary with the type of bridge (e.g., truss vs. stone).
5. The maintenance of historic bridges is controlled by the owners of the bridge. If in private hands, then the private owner takes over liability. The state accepts responsibility for state-owned bridges.
6. Other preservation techniques include moving bridges to private sites. Another option is to record the bridge and then dismantle and store it. A time restriction is usually placed on bridges that are stored. If no buyer is found within the allotted time, the idea is to have the bridge scrapped. In reality no bridge is scrapped, they just wait long after the deadline for an interested party. Moving is the typical solution today; however, in the past the bridges were usually bypassed.
7. Yes, the process is effective. The SHPO has not been very happy with the amount of bridges saved in the past. This in fact is a false accusation because, since 1988, all the bridges have been saved in one way or another. As a result of disagreements like these there is no communication between the NCDOT and the SHPO.

Oklahoma – John Hartley
Tel: 405-521-2515
Fax: 405-521-6917

A state inventory was done and National Register eligible bridges were identified with agreement of the State Historic Preservation Office. If eligible the bridges were placed into one of the categories under Section 106: retain the bridge in service, turn it into a pedestrian bridge, put the bridge up for sale, or lastly document the bridge to HABS/HAER specifications and dismantle it. Storage of dismantled bridges is not usually an option, due to high costs.

ODOT has not yet had to deal with rehab issues. Railings were never officially upgraded; in some cases, secondary railings were installed without DOT's knowledge. Due to a very small number of large on-system through trusses, height has never been a

geometric deficiency. In cases where the bridge is too narrow, an accompanying bridge is usually constructed and the two are turned into a one-way pair.

For more information on bridge inspections, call: 405-521-2606

For more information on bridge maintenance, call: 405-521-6493

SHPO is very lenient, as long as ODOT makes a good effort to save the bridge, and a long enough duration of time is allotted for marketing the bridge. The time required to sell the bridge depends on the historical significance of the bridge.

SHPO – Marshall Gettys

Tel: 405-521-6249

The inventory completed by ODOT is very good. It established which bridges are significant and which ones are a write-off. The significant bridges were investigated and in most cases arrangements were made for them to be taken out of service and moved. It was decided it was worth keeping the bridges open because of liability issues.

Taking the bridges out of service is good preservation practice because the really important part, the engineering aspect, is still being preserved and the location is not nearly as important. In a lot of cases the bridges are moved to parks and hike/bike trails and a plaque is erected giving the history of the structure. This is still a very good educational tool for the public because these bridges are constantly being used in the new locations. Keeping the bridge open to traffic only contributes to rapid deterioration of the structure. Therefore, closing it is the best solution.

Another important reason to move the historic bridge is that most of these bridges were built in the best possible locations for that area. Bridge builders from the 19th century used the same criteria to locate a site for the bridge as are used today. Therefore, it is logical to move the historic bridges, and place the new ones, which are better able to serve contemporary traffic needs, in that same location.

Pennsylvania – Susan Peters
Tel: 717-705-1482
Fax: 717-772-0834

Currently the preservation plan is being redone. There is one from the 80's published in *Historic Highway Bridges in Pennsylvania,* but for some reason it was never used. At this point the management system is being re-engineered, to better deal with the issues of historic bridge preservation.

The inspection and maintenance of historic bridges is handled by each individual district. Some districts are more responsive to preservation issues; others are not. Usually, all historic bridges are evaluated using section 106 guidelines. However, in the case of an emergency, for example a bridge is washed out in a flood, then the solution which allows the quickest opening of the crossing is implemented.

Load testing is not conducted during the inspection of historic bridges. However, Penn DOT is trying to work out some kind of deal with Penn State, initiating a study to help

test bridges more accurately. According to Susan, too many good bridges are being demolished at this point, and something has to be done about it soon.

Rhode Island – Mike Hebert
Tel: 401-277-2023
Fax: 401-277-3006

Goals of the Preservation Plan

The Rhode Island Department of Transportation (RIDOT) recognized that historic bridges are a cultural resource of public importance. Accordingly, RIDOT has sponsored this Preservation Plan to help provide for the preservation of significant historic bridges within the context of the Department's overall mission to provide safe and efficient transportation for the people of Rhode Island.

This Preservation Plan is also intended to assist RIDOT in meeting its statutory and regulatory responsibilities under state and federal historic preservation requirements. These requirements are discussed in detail below.

It is not within the scope of this Plan to address the structural soundness of any of the bridges discussed in the report. Structural elements may be determined to be significant, but the current physical condition of the bridges, including their stability, state of general wear, and overall adequacy to accommodate present or future traffic conditions, has not been evaluated by this project.

Nor is the Plan intended as a substitute for historic preservation planning on an individual project basis. The optimal solution for each individual historic bridge problem is dependent upon several sets of elements beyond the scope of the present project:

- Detailed engineering studies of what the particular requirements are and of the cost and practicality of various alternatives; in many cases, there is no way to know what future structural and functional requirements may call into question the continued usefulness of these bridges.
- Policy considerations such as economic development, budget restraints, local opinion, and resolution of conflicting public goals.
- Determination of whether an alternative is both "feasible and prudent," something which is properly the role of the public agencies themselves.

Instead, this Plan seeks to identify in detail the effects of various options on the significant characteristics of historic bridges both as a group and individually. Then, engineering studies for specific bridge projects can better address historic preservation concerns and thereby minimize the projects' adverse effects.

The preservation strategies identified in this Plan are not to be considered as specifications for the ultimate action to be taken for any given bridge. Instead, they represent alternatives and considerations which ought to be weighed in the planning process.

GENERAL PRESERVATION AND MITIGATION OPTIONS

This section presents general historic preservation options that apply to all the bridges covered by this Preservation Plan. It follows the overall approach developed in the following FHWA (Office of Environmental Policy) documents:

Programmatic Section 4(f) Evaluation and Approval for FHWA Projects that Necessitate the Use of Historic Bridges. 1983.

Guidance on the Consideration of Historic and Archeological Resources in the Highway Project Development Process. 1984.

Review of Efforts to Market Historic Highway Bridges. 1986.

NO ACTION

Retain in Service. The option of first choice with an historic bridge is to leave it in place as a functioning part of the transportation system. For many of the bridges in this study, present conditions are adequate and no projects are planned. Other historic bridges are functionally or structurally inadequate. For these, planning for replacement or rehabilitation projects should distinguish between what is necessary for public safety and what would be desirable in a new bridge at the site. Section 4(f) considerations specifically reference "serious and unacceptable safety hazards" and "intolerable restrictions on transport and travel" as the measure of justifying going beyond leaving the bridge in place and addressing problems with normal maintenance procedures. Federal regulations (23 CFR 625) allow flexibility in meeting American Association of State Highway and Transportation Officials (AASHTO) standards, and this flexibility can be applied to historic bridges.

The needs assessment implied by the consideration of the no-action option is useful for more than simply justifying the project. Careful and complete articulation of the functional and structural inadequacies of a bridge may help point the way to an option (or combination of options) which will allow it to function with a minimum of harm to its historic qualities.

Posting. Posting weight limits and restricting truck travel may allow an historic bridge to remain in service. The availability of nearby alternative routes will determine the feasibility of this option, as well as public safety considerations, especially fire-vehicle access. Posting will only provide a safe crossing and promote the preservation of the bridge if there is a reasonable expectation that it will be observed.

Bypass. In some cases, inadequate historic bridges can be bypassed, either at the site or at a distance from the bridge. The possibility of upgrading or establishing an alternative route should be considered as part of this option. The bypass option should be weighed against any "extraordinary construction difficulty or costs or… adverse social, economic, or environmental effects" associated with the new structure (quoted from Programmatic 4(f)).

While bypassing does avoid the immediate loss of the historic bridge, it does not assure its long-term survival if it is allowed simply to deteriorate next to the new structure. When feasible, provision should be made for its continuing protection and maintenance. Keeping the old bridge in use (with repair as needed) for local traffic, restricting it to one-

way use, or using it for pedestrians or bicycles can help to justify the continuing cost of maintenance. Also, in the case of bypass at the site, providing a pedestrian crossing on the old bridge may eliminate the need for sidewalks on the new structure, providing a small savings. Some bridges may be so severely deteriorated that even total bypass could not significantly extend their lifetime.

A special case of bypass is the use of a parallel span to carry one direction of traffic. Parallel spans may allow the retention of a bridge that is too narrow to function as a two-way structure. A length of approach sufficient to allow safe direction-separation is required. This option has the advantage of keeping the historic bridge as a functioning entity entitled to ongoing maintenance.

While generally not considered an adverse effect on the historic bridge, construction of a new structure close by may well have an effect on the historic bridge's setting and public visibility. Moreover, many of the bridges in this Plan are located within (or just outside the boundaries of) National Register-listed historic districts. New construction of a bypass or parallel span should not intrude on the significant qualities of the historic bridge or any surrounding district (see New Construction, below). Some historic districts may make the close-by bypass or parallel span options undesirable from the historic preservation viewpoint if important buildings or archeological resources must be sacrificed to save the bridge.

In constructing the new bridge in the close-by bypass or parallel span options, care must be taken not to damage the old by overloading it with heavy construction vehicles, undercutting its footings with altered flow patterns due to temporary dams, and other such secondary impacts.

Bypass options may offer opportunities beyond those of simply saving the historic bridge. Relocating the crossing may actually improve alignment and alleviate problems with adjacent intersections. Bypass also may allow better traffic flow during construction, as the old bridge remains in use. On a larger scale, serious consideration of a remote alternative, either upgrading a parallel route or establishing a new one, may promote the solution of other problems (such as impact on historic districts or congestion, curves, or grade) which are associated with the route itself and which simple replacement of the bridge will do little to solve.

SELECTIVE REHABILITATION

Where the problem with an historic bridge is inadequate load capacity, selective rehabilitation, either alone or combined with other options, may allow the bridge to return to a state of usefulness. Replacement of deteriorated structural members with exactly duplicated material can sometimes result in increased capacity. In order for such repair to avoid affecting the historic integrity of the bridge, new work should exactly match historical conditions in dimensions, materials, and finish.

Trusses. With trusses, deteriorated members can be removed and replaced with new but otherwise identical parts, tension rods can be tightened, and rivets replaced with high-strength bolts. Steel is generally substituted for the iron of original parts.

Railings: Railings present a special challenge in the rehabilitation of historic bridges. Railings are important decorative features which identify a bridge's period; in some

cases, they are among the bridge's essential historical features. Modern standards call for railings which not only will resist the impact of crashes but also provide smooth surfaces with no snap points. Neither the lattice rails found on the small pony trusses, the iron-picket railings on some of the stone arches and beam bridges, nor the square-balustrade railings of the 20th century concrete arches appear to meet the criteria for vehicular guardrails, though they probably can serve as pedestrian railings on sidewalks. Safety is the paramount consideration when evaluating the type of guardrail needed, but where possible guardrail standards should be considered flexibly in light of actual traffic and safety needs. Use of a guardrail between the vehicle lane and the sidewalk, where feasible and safe, will avoid physically affecting the historic railing and minimize the visual impact. Attaching ordinary guardrail to historic iron or concrete railings will impair their physical integrity and greatly obscure them from view and is preferable only to removing the historic railings entirely. On the other hand, installing guardrail on the inside of the trusses where no railings presently exist, despite having a visual impact, is desirable if it will protect the historic material.

Limited rehabilitation does not by itself address problems of alignment and inadequate width. However, when combined with other options, such as the upgrade of an alternate route, lane/division with a parallel span, or posting, limited rehabilitation may allow an historic bridge to function without impact on its historic qualities.

Major Structural Rehabilitation

When the above options are inadequate to meet a project's needs, the historic bridge will probably be either substantially altered or replaced. Either case creates an adverse effect on the historic bridge which must be mitigated through a combination of documenting the historic bridge to the standards of the Historic American Engineering Record (HAER), performing major rehabilitation in such a way that the bridge's historic features are minimally harmed, or relocating the bridge to a new site.

Determining whether a proposed action constitutes "rehabilitation without affecting the historic integrity of the bridge" (language taken from Programmatic 4(f)) or substantial alteration is a matter of degree. Too much replacement of the historic fabric, even with exactly matching material, might be judged substantial alteration from an historic preservation viewpoint. The following actions, however, should always be considered substantial alterations and should have their harmful effects mitigated by minimizing the extent of alteration.

Widening: Except where the original proportions have already been changed widening adversely affects historic bridges by destroying the original proportions. For example, the narrowness of 19th century trusses is part of their characteristic appearance, indicating their origin in a period before modern traffic needs. Widening should always be kept to a minimum, and should be considered only as an alternative to outright demolition. Except in the case of simple beam bridges, widening also will destroy or obscure important historic material such as spandrels, railings, or floor beams (though many bridges' floor beams have already been replaced or altered). Widening raises the same issues of impact on surrounding historic districts as new construction (see below).

Widening Trusses: Trusses can be theoretically widened, especially in combination with the installation of secondary structural systems (below). In addition to the loss of original

proportions, increasing the width will require new members between the trusses, such as floor beams and struts (on through trusses), and possibly the destruction of the original lower joints, thereby substantially affecting the historic integrity of the bridge. Widening may nevertheless be appropriate as an alternative to total demolition, especially where the bridge contributes to a surrounding historic district. Except where the setting is of paramount importance, relocation is more respectful of the bridge's integrity than the substantial alteration required by widening.

Substitute Structural System

Trusses: The load capacity of an historic truss can be improved by supporting it with intermediate piers or on beam or rigid-frame structures which essentially carry the load of the bridge. The introduction of a substitute or secondary structure should be done in such a way as to minimize removal of historic fabric (the lower joints are especially important to save intact). The substitute structural system should be as unobtrusive as possible. At its worst, such a technique can visually overwhelm the historic bridge and reduce the trusses to ornamental railings on a modern-appearing bridge.

The depth of the new structure below the lower chord should be minimal, both to retain the historic appearance of the bridge and to avoid impinging on the vertical clearance below the span. The effect of the new structure on the historic abutments should also be minimized.

Relocation

For historic bridges which must be entirely replaced, moving the bridge to a new location can mitigate the adverse effect of replacement; consideration of such mitigation is required.

As a practical matter, relocation only applies to truss or beam bridges. The feasibility of relocation is further constrained by the condition, dimensions, and form of the historic bridge. Long bridges, deck trusses, and multiple-span bridges all pose problems in finding a workable setting. The short pony trusses and beam bridges are the best candidates. Possible relocated settings include [hike and] bike trails, state parks and trails, local parks, [and private ranches]. Some trusses might be repositioned beside the new bridge to serve as a pedestrian crossing.

FHWA procedures require that historic bridges be considered for continued use as highway bridges where conditions are less demanding than their original site. [However,] the narrowness, lightness of construction, and condition of most of the historic trusses [eligible for relocation] suggest that such opportunities are very limited.

An FHWA review of marketing of historic bridges implies that it is more productive in certain cases than others: personal contacts work better than general advertising, and government entities are the chief category of recipient in successful marketing.

Disassembly for relocation should respect the historic integrity of the bridge and allow reassembly with a minimum of alteration. Existing joints should be maintained intact by removing pins or drilling out rivets, and members should not be cut to ease disassembly. Storage conditions should be planned for minimal deterioration of the disassembled parts. Continued inspection and maintenance (and preservation restrictions on recipients) to assure long-term retention of the bridge's integrity is a necessary part of any relocation plan.

Relocation is not a meaningful action in the case of some historic bridges. The setting of certain bridges is so much a part of their historic significance that relocation to another site would be pointless.

The following steps will make the required marketing and relocation effort more productive:

- Develop personal contacts between the Department and relevant state and local agencies with jurisdiction over trails, parks, and historic sites. Determine in advance what the physical requirements are for possible relocated bridges, including type of traffic, length, and funds available for re-erection. Current statutes allow an amount up to the cost of demolition as an eligible expense; in most cases, this will be insufficient to relocate the bridge without additional funds.
- Concentrate relocation/marketing efforts on the small trusses which have the best chance of reuse.
- Review currently identified local bridge needs to ensure that opportunities for relocated highway use (fully eligible for funding) have not been overlooked.
- Restrict storage of disassembled trusses without a definite site for eventual relocation to a reasonable period.

New Construction

Construction of a new bridge in place of the historic bridge will in some cases have a visual impact on surrounding historic districts. In general, new construction should be as unobtrusive as possible so that the bridge will not visually overpower the remaining historic resources. Primarily this is an issue of scale. Making the new bridge wider, longer, deeper or higher than necessary or using visually heavy elements such as large beams or solid railings will create an intrusion into the historic character of most districts. Raising the level of the roadway will also often have an impact on nearby historic-district buildings. Modestly proportioned deck bridges with tubular railings are suitable when no alternatives exist to the replacement of historic bridges within historic districts.

In the case of historic districts, incorporating some of the form or materials of a replaced historic bridge into the design of a new bridge may be aesthetically desirable. Use of arches and stone facing may make a bridge accord better with surrounding historic buildings. However, attempting to reproduce some or all of a demolished historic bridge will not, from a historic preservation point of view, mitigate the loss of the actual bridge. Also, if too close a reproduction is built, some people will be confused as to whether the bridge is new or old, creating a false impression of the district's true character.

Similar considerations apply when a parallel span for by pass or lane division is constructed close to an historic bridge, whether or not it is in an historic district. The new span will diminish the public visibility of the bridge and will introduce a modern element into what might have been a relatively unchanged setting. The new design should be as visually unobtrusive as possible. Locating the new span as far from the bridge as practical will also improve the visibility of the older span. Again, traditional forms and materials can be used, but not to mask the honest fact of new construction.

CRITERIA OF EFFECT AND MITIGATION

As used in Federal and State regulations, a bridge project will affect an historic bridge if the undertaking "may alter the characteristics of the property" that qualify it for the National Register. Since National Register eligibility requires that an historic resource have integrity of "location, design, setting, [and] materials," virtually any action beyond painting, routine maintenance, or posting traffic restrictions will affect the historic qualities of a bridge.

Effects need not be adverse. Many of the bridges in the inventory have components which are not original to the bridge and which have not achieved historic significance in their own right. Removal or alteration of such features would normally not be considered an adverse effect. For example, the floor stringers, deck, and paving of move trusses have been periodically replaced over time, and replacement of any of these would normally not be an adverse effect so long as the floor-beams running between the trusses were not affected. Several bridges have sidewalks and railings which are neither original nor significant as historic alterations; their removal would not be an adverse effect. However, the replacement for such features should physically and visually affect the historic material and appearance of the bridge as little as possible.

New construction, such as for a parallel span or bypass will affect an historic bridge, but the effect may not be judged adverse if measures are taken to minimize visual impact. Even if the effect is determined to be adverse, new construction which addresses the issues identified above can be considered as mitigation of the effect.

Relocation, substantial alteration, and demolition of historic bridges are always adverse effects. Federal regulations require mitigation of these effects, first by considering actions which minimize the effect by substantially retaining the important characteristics of the historic resource, as discussed above, and then by preserving the historical information embodied in the resource.

HAER DOCUMENTATION

Adverse effects on historic bridges can be mitigated by recording the bridge to the standards of the Historic American Engineering Record (HAER). In this way, the information present in the bridge as an historical artifact can be partly preserved through photographs, drawings, and written text, all prepared to archival standards as a permanent record of the bridge. While the information value is thus retained, the heritage value of having the actual bridge in its present condition is partly or wholly lost, and the public's opportunity to perceive history in the landscape is thereby diminished.

Generally, HAER recording requires large-format (4x5") black and white photography, including the bridge's side and end views, underside, abutments and piers; close-up construction details, such as typical masonry or truss connections; and detail views of architectural and ornamental features such as plaques, lamps, railings, or any operating machinery (as on a movable span). Original drawings are reproduced onto large format negatives (selectively if they are extensive), and old photographs are also copied as available. The photo-documentation is accompanied by a Narrative Report which describes the bridge in detail and discusses the bridge's engineering and transportation

significance. The standards for preparing written and photographic documentation are contained in:

Guide for the Preparation of Photographic Documentation in Accordance with the Standards of the Historic American Buildings Survey/Historic American Engineering Record. Philadelphia: Mid-Atlantic Regional Office, National Park Service, May, 1987.

Guidelines for the Preparation [of] Written Historical and Descriptive Data in Accordance with the Standards of the Historic American Engineering Record. Philadelphia: Mid-Atlantic Regional Office, National Park Service, May, 1987.

HAER Standards for Documenting Historic Bridges (Draft). Washington: National Park Service, 1986.

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PROGRAMMATIC AGREEMENT

AMONG THE FEDERAL HIGHWAY ADMINSTRATION,

THE ADVISORY COUNCIL ON HISTORIC PRESERVATION,

THE VERMONT AGENCY OF TRANSPORTATION,

THE VERMONT STATE HISTORIC PRESERVATION OFFICER, AND

THE VERMONT AGENCY OF NATURAL RESOURCES,

REGARDING IMPLEMENTATION OF A PROGRAM FOR PROJECTS

INVOLVING HISTORIC BRIDGES

Draft – November 4, 1997

WHEREAS, the Federal Highway Administration (FHWA), Vermont Agency of Transportation (VAOT), the Vermont State Historic Preservation Officer (VSHPO) and the Vermont Agency of Natural Resources (VANR), desire to implement the Vermont Historic Bridge Program (the Program), a copy of which is attached hereto as Appendix A, and to employ available state and federal funds in such a manner, that the maximum benefit possible accrues to the state as a whole; and

WHEREAS, FHWA and VAOT have determined that the Program will have an effect upon properties included in or eligible for inclusion in the National Register of Historic Places, have consulted with the Advisory Council on Historic Preservation (Council) and VSHPO pursuant to Section 800.13 of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (16 USC 470f), have conducted a comprehensive study of the state's historic timber bridges and metal truss bridges, and have reached an agreement regarding preservation alternatives.

NOW, THEREFORE, FHWA, the Council, VAOT, VSHPO, and VANR agree that the Program shall be administered in accordance with the following stipulations to satisfy FHWA's responsibilities under Section 106 of the National Historic Preservation Act of

1966, as amended, and the regulations adopted to implement that law for all individual undertakings of the Program.

STIPULATIONS

FHWA and VAOT will ensure that the following measures and programs will be carried out:

1. **Vermont Historic Bridge Program.** FHWA and VAOT will implement the Program and its various components as described on the attached Appendix A, and sponsor any legislation, state or federal, necessary to establish the Program, bridges must be eligible for the National Register of Historic Places and must be identified in an Historic Bridge Preservation Plan, developed according to bridge type by VAOT in consultation with VSHPO. Nominations to the National Register of Historic Places will be prepared for all bridges enrolled in the Program and not already listed on the National Register.

2. **Historic Bridge Preservation Plans.** VAOT will place those bridges identified on the Historic Metal Truss Bridge Preservation Plan (See Appendix B) into the Program and will undertake to complete similar plans for Timber Bridges, Masonry Arch Bridges, and Concrete Arch Bridges. When plans have been completed, bridges identified by those plans will also be placed in the Program by amendment to this Programmatic Agreement (the Agreement). Data necessary to establish a preservation plan for the state's covered bridges is currently available, and the plan will be completed within twenty-four months.

3. **Town Ownership of Historic Bridges.** All historic bridges identified by the Historic Metal Truss Bridge Preservation Plan, or identified by any other Historic Bridge Preservation Plans incorporated by amendment into this Agreement, will be part of the Program.

   Both VAOT and FHWA stipulate that the preservation alternatives identified by the Historic Metal Truss Bridge Preservation Plan, or by any other Historic Bridge Preservation Plan incorporated by amendment into this Agreement, are feasible and prudent. If any changes in circumstances cause either VAOT or FHWA to question the feasibility or prudence of these preservation alternatives, the parties shall resolve that question according to the procedures described in Paragraph 5 herein.

   For its part, VSHPO acknowledges that the ability of FHWA and VAOT to dictate the preservation of town-owned historic bridges is limited to:

   (a) Withholding federal funding for the replacement of historic bridges when rehabilitation for continued highway use, limited or otherwise, is a feasible and prudent alternative.

   (b) Actively soliciting Historic Bridge Participation Agreements and Bridge Preservation Easements from all towns owning historic bridges that are part of the Program.

   (c) Funding all rehabilitation costs for historic bridges owned by towns that have executed Historic Bridge Participation Agreements and Bridge Preservation Easements.

(d) Developing an education program for town officials, regional planning commissions, VAOT employees, and the public regarding the importance of historic bridges and the need for appropriate and consistent maintenance.

4. **Maintenance Schedule.** Within twelve months from the date of execution of this agreement, VAOT will establish a bridge maintenance schedule for each historic bridge included in the Program. VAOT will provide financial assistance, for maintenance of town-owned bridges that remain in highway use and will develop a mechanism to assure performance of scheduled maintenance tasks. Eligibility for funding to pay for the costs of maintaining bridges adapted to alternative transportation uses will be evaluated according to policies established by the Adaptive Use Program and set forth in its systems manual.

5. **Rehabilitation and Restoration Schedule.** Within twelve months from the date of execution of this agreement, VAOT will establish a bridge rehabilitation or restoration schedule for each historic bridge included in the Program, with separate schedules for bridges that will remain in highway use and bridges that are placed in adaptive use. The schedule will be reviewed annually for those historic bridges that will remain in highway use, and every five years for bridges placed in adaptive use. All work will be conducted according to that schedule. As part of this program, VAOT will pay all costs for rehabilitation or restoration ion of bridges that will remain in highway use. Eligibility for funding to pay for the costs of rehabilitating or restoring bridges adapted to alternative transportation uses will be evaluated according to policies established by the Adaptive Use Program and set forth in its system manual.

6. **Changed Circumstances.** In the event that a change in circumstances causes the alternatives recommended for bridges identified in the Historic Metal Truss Bridge Preservation Plan, or identified by any other Historic Bridge Preservation Plans incorporated by amendment into this Agreement, to be called into question, VAOT and VSHPO agree to consult in an effort to reach an agreement. If no agreement can be reached, FHWA, VAOT and VSHPO agree to submit a review of the recommended alternative to a qualified third party consultant, retained by VAOT upon mutual agreement by VAOT and VSHPO, said consultant to determine the most feasible and prudent alternative.

7. **Project Review and Compliance Documents.** For undertakings implemented by VAOT in accordance with any Historic Bridge Preservation Plan adopted pursuant to this agreement, or any amendments thereto, VAOT shall notify VSHPO in writing that the project will be completed according to the plan and will provide a brief description of the project. Unless VSHPO objects in writing within 15 days, no further review under Section 106 is required.

   For any undertaking implemented by VAOT that proposes to modify and Historic Bridge Preservation Plan adopted pursuant to this agreement, or any amendments thereto, VAOT and VSHPO shall consult pursuant to Paragraph 6. VAOT shall provide VSHPO with a written summary of any agreement reached pursuant to that consultation, and shall notify VSHPO that the project will be completed according to

that agreement. Unless VSHPO objects in writing within 15 days, no further review under Section 106 is required.

8. **Intra-Agency Cooperation.** VAOT agrees to follow established procedure to obtain permits from the Agency of Natural Resources whenever bridges will be adapted to alternative transportation uses, either at existing sites or at new locations. VAOT will make every effort to avoid placing two bridges in close proximity across a single body of water.

   For its part VANR agrees to support, unless circumstances demand otherwise, those few instances when preservation plans recommend adapting an historic bridge to alternative transportation use at the bridge's existing site and constructing a new bridge at a nearby location.

9. **Dispute Resolution.** Any party to this Programmatic Agreement may request that it be amended, whereupon the parties will consult in accordance with 36 CFR 800.13 to consider such amendment. The responsibility of FHWA to carry out all actions under this agreement, other than those subject to dispute, will remain unchanged.

10. **Termination.** Any party to this Programmatic Agreement may terminate it by providing thirty (30) days notice to the other parties, provided that the parties will consult during the period prior to termination to seek agreement on amendments or other actions that would avoid termination. In the event of termination, FHWA will comply with 36 CFR 800.4 through 800.6 with regard to individual undertakings covered by this Programmatic Agreement.

11. **Archeological Resources.** With respect to the location of any bridges placed in Adaptive Use Program, Vermont SHPO will be given an opportunity, to review the proposed new location early in project planning stages. If Vermont AOT's archeologist determines that the new location or site work related to new use has the potential for affecting archeological resources, he or she shall conduct a field inspection to identify the need for a Phase I study. The need for follow-up Phase I, Phase II, and Phase III studies will be considered in evaluating the feasibility of a site. Funding for archeological studies may be considered as part of project costs.

Execution and implementation of this Programmatic Agreement is evidence that FHWA has satisfied its Section 106 responsibilities for all individual undertakings of the program.

HISTORIC BRIDGE PROGRAM
November 4, 1997

This document establishes the Vermont Historic Bridge Program (the Program) for covered (timber-framed) bridges, metal truss bridges, masonry arch bridges, and concrete arch bridges, and it establishes a separate division within the parent program. The Program and its divisions recognize that Vermont's historic bridges are distinct resources for the state, with particular benefits and also particular problems. The Program explicitly recognizes that there are economic, aesthetic, and educational benefits achieved by preserving a meaningful collection of these bridges. Reasonably stated, if the benefits of preserving historic bridges accrue to the people of the State of Vermont, the associated costs necessary to obtain these benefits are properly assigned to state government.

The Program provides an ideal opportunity to demonstrate the value of proper maintenance in preserving manageable classes of bridges. Rehabilitation of those historic bridges capable of serving continued highway use will represent a considerable cost-savings to the people of Vermont. Adapting those historic bridges no longer capable of continued highway use to alternative transportation uses, or converting them to recreational and historic sites, will also produce substantial long-term economic benefits.

Part 1
Town Participation

More than 90% of Vermont's historic bridges are owned by towns, cities, or villages and are located on local roads, and serve local transportation needs. Collectively these historic bridges represent a vitality important capital and cultural asset for the people of Vermont. However, while some are superbly maintained and preserved, others are neglected and overlooked. It is critical that a well-defined, cooperative agreement between the Vermont Agency of Transportation (VAOT) and towns owning historic bridges be implemented if these important resources are to be preserved.

To address this objective and to efficiently provide for the long-term preservation of these historic bridges, towns are invited to participate in the Program. By signature of their governing bodies to a document titled "Historic Bridge Participation Agreement," towns, cities, and villages will enroll in the Historic Bridge Program. To encourage town participation, VAOT will pay all costs of future rehabilitation or restoration and will agree to undertake such work according to the Secretary of the Interior's Standards for Historic Preservation Projects. In addition, VAOT will provide financial assistance for future maintenance by developing a separate maintenance program and retaining a contractor to conduct scheduled maintenance tasks.

In return, towns will agree to preserve the identified bridge(s) in perpetuity, subject to loss or damage by catastrophe or by other circumstances beyond human control. Towns will signify their commitment to preserve the identified bridge(s) by granting a "Bridge Preservation Easement" (copy attached) to VAOT.

Part 2
Bridge Maintenance

Success of the Program will also depend upon scheduled maintenance of historic bridges in order to prolong their continued use. Ultimately, too, sustained maintenance will account for substantial cost savings. To encourage proper maintenance, VAOT will establish a bridge maintenance schedule for each historic bridge included in the Program. To encourage towns and cities to participate in the Program, VAOT will provide financial assistance for maintenance of town-owned bridges in highway use and will develop a mechanism to assure performance of scheduled maintenance tasks. For the purpose of this program, work that qualifies as maintenance includes, but it not limited to cleaning, spot painting, grease coating of steel at bearing points and at joints, and repairs made necessary by accidents.

Part 3
Bridge Rehabilitation and Restoration

Success of the Program will depend upon scheduled rehabilitation of historic bridges. For purposes of this Program, work that qualifies as rehabilitation or restoration includes, but is not limited to, the replacement of any deck or any structural members due to advanced deterioration or to less than acceptable load capacity, and full painting.

VAOT will establish a bridge rehabilitation or restoration schedule for each historic bridge included in the Program, with separate schedules for bridges that will remain in highway use and bridges that are placed in adaptive use. The schedule will be reviewed annually for those historic bridges that will remain in highway use, and every five years for bridges placed in adaptive use. All work will be conducted according to that schedule. As part of this program, VAOT will pay all casts far rehabilitation or restoration of bridges that will remain in highway use.

Part 4
Adaptive Use

Success of the Program will depend upon a viable system for preserving bridges that can no longer serve highway uses at their existing location. To meet this need, qualifying bridges will be relocated for continued but limited highway use or will be adapted to alternative transportation used such as pedestrian and bicycle paths, snowmobile trails, recreational sites, or simply historic sites.

The Agency of Transportation will assume responsibility for relocation and rehabilitating all historic bridges that can no longer serve highway uses at their existing locations, including:

(a) Identification of new locations for bridges that will continue to serve highway use;

(b) Identification of new locations and new owners, including the Vermont Division for Historic Preservation, for bridges that will be adapted to alternative transportation uses;

(c) Providing engineering services for relocation and rehabilitation plans;

(d) Providing adequate funding, either pursuant to ISTEA or from other sources, for initial rehabilitation or restoration of bridges adapted to alternative transportation uses. Eligibility for funding of future maintenance, rehabilitation, or restoration will be evaluated according to policies established by the Adaptive Use Program.

(e) Undertaking any legislative initiatives, whether federal or state, necessary to implement relocation and adaptive use or to fund relocation and adaptive use;

(f) Undertaking initiatives to develop partnerships with the Department of Corrections to supply timber for bridge decks and other appropriate materials, as well as labor as permitted;

(g) Providing interpretive markers identifying bridges that have been relocated.

Part 5
Education and Heritage Tourism

Success of the Program will also depend upon a viable educational effort devoted to increasing public awareness regarding the benefits of preserving historic bridges. Accordingly, VAOT will develop a schedule for meeting with town officials, public works engineers, and district transportation officials. There is a coordinated effort to develop heritage tourism, and to educate the public.

Virginia – Tony Opperman
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1. Virginia has a total of approximately 12,000 bridges which are all state owned. Sixty to seventy of these bridges are considered to be historically significant. The exact number is not yet known because an updated inventory of all eligible bridges has not yet been completed. Once the inventory is completed an individual preservation plan will be developed for each eligible bridge.

   Maintaining the bridge in vehicular use is not a primary concern since vehicles are the main cause of historic bridge deterioration. In some cases the historic fabric of the bridge has to be modified too much, either structurally or geometrically, in order to keep it operational, in such situations it is better to save the bridge by making it a pedestrian crossing. Even if modification is at a minimum, heavy vehicular traffic use tends to strain the structure a great deal and in those cases bridges can be made to last longer by taking traffic off of them. Example of a bridge built in 1873, which today accommodates 800 cars per day. In this particular example such heavy traffic use is limiting the life span of the bridge. This bridge should be bypassed and used only for light pedestrian traffic.

   The local public is always made aware of any changes that are planned in their community. They can have their opinions heard either through their local government officials or at public meetings. Unfortunately, quite often not many people are interested in hearing about a project that is scheduled to begin a few years down the line; as a result the turn out at public meetings is very small. At this point all the decisions are made, usually with little public input. Only when the schedule starting date of the project draws near is there public interest to get involved. Quite often this is too late to get anything changed.

   Virginia has a *Historic Structures Task Group* which is responsible for the evaluation of historic structures and the decision making process in that state. The task group is made up of members from the Virginia Traffic Research Council; Virginia Department of Transportation, Environmental Affairs, and Engineering Departments; the Federal Highway Department, and the State Historic Preservation Office. The Chair Person is Ann Miller (tel: 804-293-1955, fax: 804-293-1990, see bottom of section for interview information). SHPO's and ODOT's involvement in the task group ensures that there is agreement on all decisions made concerning historic bridges.

2. When a bridge is structurally deficient usually the bridge will be documented and removed. The success of marketing historic bridges is very limited, especially for large spans. In some cases certain bridges are reinforced and maintained in use, but this is rare. In terms of railings, usually the original railings will be replaced with crash-tested ones. A number of times the Texas Cathedral Rail has been used successfully. They are not concerned with making the new railings look like the old ones, but in most cases they do look as if they could be historic.

   Another method of preserving the bridge is the dismantle it and have it hot dip galvanized. The bridge is then re-erected and new stainless steel pins are used. The method of protecting the bridge is preservation sensitive because it does not change the bridge to a great extent; the color of the bridge in this case is not an issue, and if it was, the bridge could always be painted. Also, this eliminates the problem of dealing with lead paint which is difficult and expensive to remove in the field. In this case the galvanizing company is put in charge of the paint removal. The last advantage of galvanizing the bridge is that it ensures almost maintenance-free operation for a number of years.

   Approach spans are rarely as important as the main span. This is evaluated on a case-by-case basis.

3. Inspection methods are the same for all bridges, and there is no special load testing carried out on historic bridges.
4. Maintenance of all the bridges is financed and carried out by the state. Therefore, historic bridges do not get special treatment in this regard. It is possible to use the entire maintenance budget on the 70 historic bridges alone, but this obviously can not be the case. At this point there is no special budget set aside for historic bridges. However, the maintenance program is responsible for maintaining a large number of bridges in service, much longer than they were originally designed for.
5. The most popular preservation methods used in Virginia are: converting bridges into way sides and keeping traffic off of them, turning bridges into pedestrian crossing, and marketing to the private sector.

Interview with Ann Miller
Tel: 804-293-1955
Fax: 804-293-1990

1. Currently in process of formulating a preservation plan. The progress of development is very slow because there are many more variables than originally thought. To date, there are nineteen factors that will be analyzed for each bridge. Below is the list of factors:
   1. Treatment options (rehabilitation, relocation, recordation and demolition, reuse, storage, salvage)
   2. Secretary of the Interior's Standards (as applied to bridges)
   3. Current and potential funding sources for rehabilitation of historic bridges

4. Liability issues
5. Safety issues
6. Right-of-way issues (including proscriptive easements, ownership, abandonment, discontinuance)
7. Present and future use of bridge
8. Political issues
9. Interagency cooperation including state and federal agencies, examination of conflicting requirements
10. Dispute resolution
11. Cost/benefit analysis
12. History of data gathering (previous and current survey work)
13. History of deliberations regarding historic bridge treatment, determination of eligibility, etc.
14. Explanation of current rating and significance levels
15. Bridge decision matrix (comparisons of various factors including: condition, average daily traffic, sufficiency rating, required load capacity, posted load capacity, width and length, vertical clearance, available detours, ability to carry school buses and emergency vehicles, etc.)
16. Vulnerability to natural or cultural disaster
17. Citizen interests
18. Emergency procedures (avoidance of damage, recommendations for emergency stabilization)
19. Current design standards

During the development process it was also discovered that it was very difficult to come up with one all encompassing plan for all historic bridges. It was determined that it would be more practical to deal with them on an individual basis.

As for the emphasis of maintaining the bridges in vehicular use, "there have been no heroic efforts to do so." First and foremost, liability is a major concern. If it is feasible to keep the bridge open then it is left open, but there are not problems with closing the bridge and even moving it to another location if necessary. In terms of keeping the bridge open to traffic, if it was the original traffic that the bridge was designed to carry there would be no problem. But since the loading requirements have increased so greatly, it sometimes becomes impractical to leave the bridges in service. In some cases this is not a problem and the bridges are left in place.

Currently the Task Group is also looking into clarifying how the Secretary of Interior Standards can be applied to historic bridges.

The public does get involved, but to a great extent it is up to them to do so. Information provided by the public is not always accurate, even though everyone has

access to National Register nomination information; proper technical and social investigations are usually conducted before any changes are made.

Funding is a major problem, there is no budget set aside to rehabilitation of historic bridges. The rehab work could easily use up the entire budget set aside for the maintenance of all the bridges in the state, but this is politically impossible and impractical to do. Currently efforts are being made to find funding for rehab work.

2. When dealing with alterations to the bridge they try to limit them as much as possible. If too many alterations have to be made the bridge will usually just be closed down and/or moved.

   Approach spans are usually not regarded to be as important as the main span, however, in some cases, if the spans are original, special investigations will be carried out to warrant saving them as well.

3. The inspection process is the same for all bridges. If there are serious problems with the bridge it is simply closed down.

4. Preservation Plan includes a maintenance program. In some cases the upkeep is really simple, in others structural work may have to be carried out. Usually the State will supervise the maintenance.

5. Methods already outlined in the above statements.

Secretary of Interior's Standards

Identified below are the Federal Standards for Preservation, Rehabilitation, Restoration, and Reconstruction, developed by the Secretary of the Interior. The Secretary of the Interior is responsible for establishing standards for all programs under departmental authority and for advising Federal agencies on all possible conservation methods. The four methods identified below are the most common options available for historic bridges and they are arranged in ascending order of least intrusive to most destructive of remaining historic fabric. It is the intent of these guidelines to help those working with historic properties to identify the least destructive solution for each specific project, since the general consensus is that whenever possible the least destructive model should be followed. This following is taken from the Secretary of the Interior's Standards for the Treatment of Historic Properties, Rev. 1992.

1. Preservation – The act or process of applying measures necessary to sustain the existing form, integrity and materials of an historic property. Work, including preliminary measures to protect and stabilize the property, generally focuses upon the ongoing maintenance and repair of historic materials and features rather than extensive replacement and new construction. New exterior additions are not within the scope of this treatment; however, the limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make properties functional is appropriate within a preservation project.

   Standards for Preservation

   1. A property shall be used as it was historically or be given a new use that requires minimal change to its distinctive materials, features, spaces, and spatial relationships. Where a treatment and use have not been identified, a property shall be protected and, in necessary, stabilized until additional work may be undertaken.
   2. The historic character of a property shall be retained and preserved. The replacement of intact or repairable historic materials or alteration of features, spaces, and spatial relationships that characterize a property shall be avoided.
   3. Each property shall be recognized as a physical record of its time, place, and use. Work needed to stabilize, consolidate, and conserve existing historic materials and features shall be physically and visually compatible, identifiable upon close inspection, and properly documented for future research.
   4. Changes to a property that have acquired historic significance in their own right shall be retained and preserved.
   5. Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize a property shall be preserved.
   6. The existing condition of historic features shall be evaluated to determine the appropriate level of intervention needed. Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, and texture.

7. Chemical or physical treatments, if appropriate, shall be undertaken using the gentlest means possible. Treatments that cause damage to historic materials shall not be used.
8. Archeological resources shall be protected and preserved in place. If such resources must be disturbed, mitigation measures shall be undertaken.

2. Rehabilitation – The act or process of making possible an efficient compatible use for a property through repair, alterations, and additions while preserving those portions or features which convey its historical, cultural, or architectural values.

Standards for Rehabilitation

1. A property shall be used as it was historically or be given a new use that requires minimal change to its distinctive materials, features, spaces, and spatial relationships.
2. The historic character of a property shall be retained and preserved. The removal of distinctive materials or alteration of features, spaces and spatial relationships that characterize a property shall be avoided.
3. Each property shall be recognized as a physical record of its time, place, and use. Changes that create a false sense of historical development, such as adding conjectural features or elements from other historic properties, shall not be undertaken.
4. Changes to a property that have acquired historic significance in their own right shall be retained and preserved.
5. Distinctive materials, features, finishes, and construction techniques or examples of craftsmanship that characterize a property shall be preserved.
6. Deteriorated historic features shall be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, texture, and where possible materials. Replacement of missing features shall be substantiated by documentary and physical evidence.
7. Chemical or physical treatments, if appropriate, shall be undertaken using the gentlest means possible. Treatments that cause damage to historic materials shall not be used.
8. Archeological resources shall be protected and preserved in place. If such resources must be disturbed, mitigation measures shall be undertaken.
9. New additions, exterior alterations, or related new construction shall not destroy historic materials, features, and spatial relationships that characterize the property. The new work shall be differentiated from the old and shall be compatible with the historic materials, features, size, scale, proportion, and massing to protect the integrity of the property and its environment.
10. New additions and adjacent or related new construction shall be undertaken in such a manner which, if removed in the future, the essential form and integrity of the historic property and its environment would be unimpaired.

3. Restoration – The act or process of accurately depicting the form, features, and character of a property as it appeared a particular period of time by means of the removal of features from other periods in its history and reconstruction of missing features from the restoration period. The limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make properties functional is appropriate within a restoration project.

   Standards for Restoration

   1. A property shall be used as it was historically or be given a new use that interprets the property and its restoration period.
   2. Materials and features from that restoration period shall be retained and preserved. The removal of materials or alteration of features, spaces, and spatial relationships that characterize the period shall not be undertaken.
   3. Each property shall be recognized as a physical record of its time, place, and use. Work needed to stabilize, consolidate, and conserve materials and features from the restoration period shall be physically and visually compatible, identifiable upon close inspection, and properly documented for future research.
   4. Materials, features, spaces, and finishes that characterize other historical periods shall be documented prior to their alteration or removal.
   5. Distinctive materials, features, finished, and construction techniques or examples of craftsmanship that characterize the restoration period shall be preserved.
   6. Deteriorated features from the restoration period shall be repaired rather than replaced. Where the severity of deterioration requires replacement of a distinctive feature, the new feature shall match the old in design, color, texture, and where possible materials.
   7. Replacement of missing features shall be substantiated by documentary and physical evidence. A false sense of history shall not be created by adding conjectural features, features from other properties, or by combining features that never existed together historically.
   8. Chemical or physical treatments, if appropriate, shall be undertaken using the gentlest means possible. Treatments that cause damage to historic materials shall not be used.
   9. Archeological resources shall be protected and preserved in place. If such resourced must be disturbed, mitigation measures shall be undertaken.
   10. Designs that were never executed historically shall not be constructed.

4. Reconstruction – The act or process of depicting, by means of new construction, the form, features, and detailing of a non-surviving site, landscape, building, structure, or object for the purpose of replicating its appearance at a specific period of time and in its historic location.

Standards for Reconstruction

1. Reconstruction shall be used to depict vanished or non-surviving portions of a property when documentary and physical evidence is available to permit accurate reconstruction with minimal conjecture, and such reconstruction is essential to the public understanding of the property.
2. Reconstruction of a landscape, building, structure, or object in its historic location shall be preceded by a thorough archeological investigation to identify and evaluate those features and artifacts that are essential to an accurate reconstruction. If such resources must be disturbed, mitigation measures shall be undertaken.
3. Reconstruction shall include measures to preserve any remaining historic materials, features and spatial relationships.
4. Reconstruction shall not be based on the accurate duplication of historic features and elements substantiated by documentary or physical evidence rather than on conjectural designs or the availability of different features from other historic properties. A reconstructed property shall recreate the appearance of the non-surviving historic property in materials, design, color and texture.
5. A reconstruction shall be clearly identified as a contemporary re-creation.
6. Designs that were never executed historically shall not be constructed.